



## Warehousing in Europe - Northern actor perspective

Olli-Pekka Hilmola <sup>1\*</sup>, Harri Lorentz <sup>2</sup>

<sup>1</sup> Lappeenranta University of Technology, Kouvola Research Unit, Prikaatintie 9, Kouvola, Finland

<sup>2</sup> Turku School of Economics, Rehtorinpellonkatu 3, Turku, Finland

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### Abstract

Importance of warehousing has increased during the recent decade and among cost issues, these outlets have become value adding centers; responding to market changes with maximized corporate profitability. Our research concerns Finnish and Swedish companies, and their warehousing decisions in larger Europe. According to our longitudinal survey results, warehousing location in Finnish companies is more weighted towards East, while Swedish companies focus on West. Warehousing size itself will continue to increase, but smaller units have future too. However, most significant changes appear in the location criteria; most of the new establishments will consider road transportation connection, low distribution costs, infrastructure enabling intermodal transportation and availability of third party solutions. Among these assembly and manufacturing plant location plays important role. Overall from survey results it is seen that emerging economies of Europe are explaining quite many development paths, especially among Finnish respondents.

*Keywords:* Warehousing location; Criteria; Employment; Finland; Sweden.

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### 1. Introduction

Warehousing has become an important enabler of globalized production networks, and quite often short lead times, volume and mix flexibility, postponed customizing in terms of assembly/packaging, as well as corporate profitability, is being achieved through warehousing outlets serving some particular trade area (Christopher et al. 2006; Baker 2007; Koskinen and Hilmola 2008; Hilletoft 2009). Even if warehousing remains as an important enabler of performance among global corporations, it is quite often outsourced (Cap Gemini 2007; Selviaridis and Spring 2007; Marasco 2008), and according to longer-term forecasts the trend will be sustained, even if economic turmoil continues throughout the world in the forthcoming years (UNCTAD 2008: 104-106). However, the employment factor is often forgotten within warehousing – according to Ducruet and Lee (2007) in 27 large European port cities warehouses employed 15.7 % of total transportation logistics employment, similar to the amounts employed by freight

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\* Corresponding authors: O.P. Hilmola (olli-pekka.hilmola@lut.fi), H. Lorentz (harri.lorentz@tse.fi)

transportation (air, rail and road) did. In research works, justification for warehouses and their function in transportation logistics system is well articulated, but only a small amount of research exists on larger European warehousing solutions. As is known, Europe is in cultural and economic terms very diverse, and this of course has implications on readiness of infrastructure and logistics efficiency (Arvis et al. 2007). For example, in Germany, Netherlands, and France, the state of transportation systems is entirely different from former Central and East European countries, not to mention Ukraine and Russia. In West, transportation logistics is mostly implemented using road transports in hinterland connections (Vassallo 2005; European Union 2007), while further towards East railways still hold considerable importance (even if railway volumes collapsed after independence wave and introduction of market economy, e.g. Hilmola 2007, Carbajo and Sakatsume 2004). Although the European Union has enlarged with fast phase during the last two decades, still major emerging economies are outside of this trade area. This increases time consumed in customs procedures, results in higher inventory holdings, higher demand variation, and often in enormous paper work for forwarders (e.g. discussed in Lorentz et al. 2007; Wilson 2007). Also bureaucracy is still problem in former East European countries, even if they are members in EU. So, in logistics and distribution terms, Europe is still lacking as a unified trade area, and among business needs for warehousing, diversity among European countries creates higher demand for warehouses.

In this research work our interest lies on the warehousing decisions of Finnish and Swedish companies in the larger Europe, and for this reason we have gathered empirical data through survey completed during years 2006 and 2009. Altogether the number of responses in our study reaches the level of 100, as we include these two years together. It should be reminded that during year 2006 economic outlook and climate was entirely different from year 2009 – within three years time entire turnaround in terms of decline in industrial business confidence as well as production volumes has occurred. During these years, operating environment in Europe as well as globally has changed to favour emerging markets, such as the rapidly growing Central and Eastern European countries (CEE) and the Commonwealth of Independent States (CIS). This change should also have an effect on warehousing location, warehousing establishment criteria and size of warehouses. These factors altogether are the motivation of this research work, and we are interested in gaining answers to the following research questions: (1) ‘How warehousing location criteria has in overall developed and does there exist any differences between Finland and Sweden?’, (2) ‘How the size of warehouses will develop within medium term?’, and (3) ‘How location criteria evolves in these two countries during the observation years?’.

This manuscripts is structured as follows: In Section 2 we review literature from general point of view concerning locating warehousing facilities, while in Section 3 this review is enlarged into international supply chains and European markets. Thereafter, in Section 4, research methodology is presented, which is followed by data analysis of responses from both of the observations years in Section 5. Research findings are discussed in Section 6 through foreign trade statistics of two examined countries of this study – most of the results could be explained with the development and the magnitude of foreign trade per se. In final Section 7, we conclude our work and propose further avenues for research; especially interesting and important is to follow warehousing decisions within near future due to bottoming of global economic decline and developing operating environments.

## **2. Literature review – Criteria of locating warehousing facilities**

Locating a warehouse or several warehouses is a classic logistics problem, and a sub-problem of production-distribution system design, that has been extensively covered in the logistics and operations research literature (e.g. Baumol and Wolfe 1958; Ballou 1968; Kaufman et al. 1977). The resultant body of literature has been thoroughly reviewed by Owen and Daskin (1998), who point out the long-term and strategic nature of location decisions, as these set the constraints for medium and short term supply chain decisions (Chopra and Meindl 2001), and even the capability of the whole supply network (Srai and Gregory 2008). The following literature review focuses specifically on multicriteria warehouse location researches, for the purpose of revealing quantitative and qualitative criteria for decision making, and setting up a foundation for the subsequent examination of empirical data.

In the literature, multi-criteria decision making approaches have been applied to various supply chain facilities, such as plants (Bowersox 1978; Chu 2002; Lorentz 2008), shipyards (Guner et al. 2009), retail outlets (Kuo et al. 1999), restaurants (Tzeng et al. 2002), and generally, facilities (Yang and Lee 1997). As was stated previously, the interest in this paper is specifically on the warehouse, or in other words, the distribution center, logistics hub, service center, depot etc., the terminology depending on industry and the exact role of the facility. Early multi-criteria warehouse location problem solutions have been discussed in detail already more than two decades ago (Green et al. 1981; Eilon 1982; Lee and Luebbe 1987). Warehouses have a distinct role in the supply chain as enablers of desired level of customer service in global or regional operations. The reviewed literature clarifies this role through the presented location criteria (see Appendix A).

The reviewed articles range from 1997 to 2007, a ten year period. Similarities within these may be found in the used location selection criteria, some which are empirically based, while some are literature based and presented as examples. Cost factors are prevalent in the decision making models, and in some of the multi-phase models, e.g. transportation costs are optimized first or after the consideration of qualitative factors (Ashayeri and Rongen 1997; Sarkis and Sundarraj 2002). Another dominant factor is what might be named as accessibility, meaning connections to various supply chain actors, transportation modes, and importantly, the market (e.g. Melachrinoudis, Min and Messac 2000; Chen 2001), as well as time and reliability related considerations (e.g. Alberto 2000). Political issues, such as incentives, authority relations and attitudes, and foreign trade regulation, seem to play a major role also (e.g. Oum and Park 2004).

## **3. Literature review – Warehousing facilities of international supply chains in Europe**

According to Smykay et al. (1961, 175) a theoretical goal for facility location is as follows: “Every plant should be located at the point of profit maximization.” In current thinking, the focus may have shifted to the role of the facility, such as a warehouse, distribution/logistics centre, in supporting the overall business strategy of a firm (Yang and Lee 1997). This support may come in the form of e.g. holding inventory and

breaking bulk (the traditional approach), or responding rapidly to customer orders, operating a flow-through cross-docking system or adding value to the products as part of a postponement strategy (Baker 2004).

In an international or global setting, warehouses or distribution centers play a key role in supporting supply chain strategies. Relevantly, Christopher et al. (2006) have presented a taxonomy of four global supply chain strategies, distinguishable along two dimensions: Supply characteristics (length of lead time), and demand characteristics (predictability). The strategies vary from lean to agile and leagile (Mason-Jones et al. 2000), and have implications to the nature of warehouses in the international supply chain, i.e. their location, operation and the value-adding activities performed. Baker (2007) underlines the requirement for safety stocks in international supply chains, as supply lead times may be very long, while rapid response is required in the distribution side. Such may be the case e.g. in the fashion industry, where a close-to-market warehouse, that breaks bulk coming from low cost countries, is needed, in order to support a rapid time-to-serve (Christopher and Peck 1997). In the international setting, inventory and warehouse strategies should consider in parallel inventory reduction (e.g. using postponement), and risk management strategies in preparation for possible supply chain disruptions (Baker 2007).

In conclusion, warehouses and distribution centers have an important role in international supply chains. They may simply serve markets or hold inventory, and therefore provide means for appropriate customer service in the international environment prone to long lead times and disruptions. Additionally, postponement strategies may be supported, allowing inventory reduction opportunities in cases where companies face uncertain, diverse and complex international demand.

Europe, with many independent nation states, and varying cultures and languages, presents a challenge for distribution. Many MNCs used to run distribution with national focus, with country-based warehouses and management teams, in order to ensure national market responsiveness. The introduction of the single European market, initiated during the 1990s and continuing until the present time, presents an opportunity to centralize warehousing and distribution operations, effectively meaning regionalization of distribution in Europe (Cooper et al. 1992). For many companies this has meant investments in European service centers or entering into deals with pan-European logistics service providers, with a capability of maintaining high service levels from few hubs to most of Europe. As West European logistics performance is in general on a quite good level (Bookbinder and Tan 2003; Arvis et al. 2007), the efficient and centrally located European distribution centers are used by for example American and Asian companies to supply products across Europe, but even to African and Middle-Eastern customers (Koster and Balk 2008).

The recent World Bank sponsored comparative research on international trade logistics performance (Arvis et al. 2007), offers insight to the management of international shipments in various European countries. The Logistics Performance Index (LPI) incorporates respondent views on several logistics and supply chain dimensions of a country on 1 to 5 scale, namely efficiency of the clearance process by customs and other border agencies, quality of transport and IT infrastructure for logistics, ease and affordability of arranging international shipments, competence of the local logistics industry, ability to track and trace international shipments, domestic logistics costs, and timeliness of shipments in reaching destination. Many of these dimensions relate to the location selection criteria observed previously in the literature,

allowing preliminary evaluation of European countries, from the perspective of locating warehouses in international supply chains (see Figure 1).

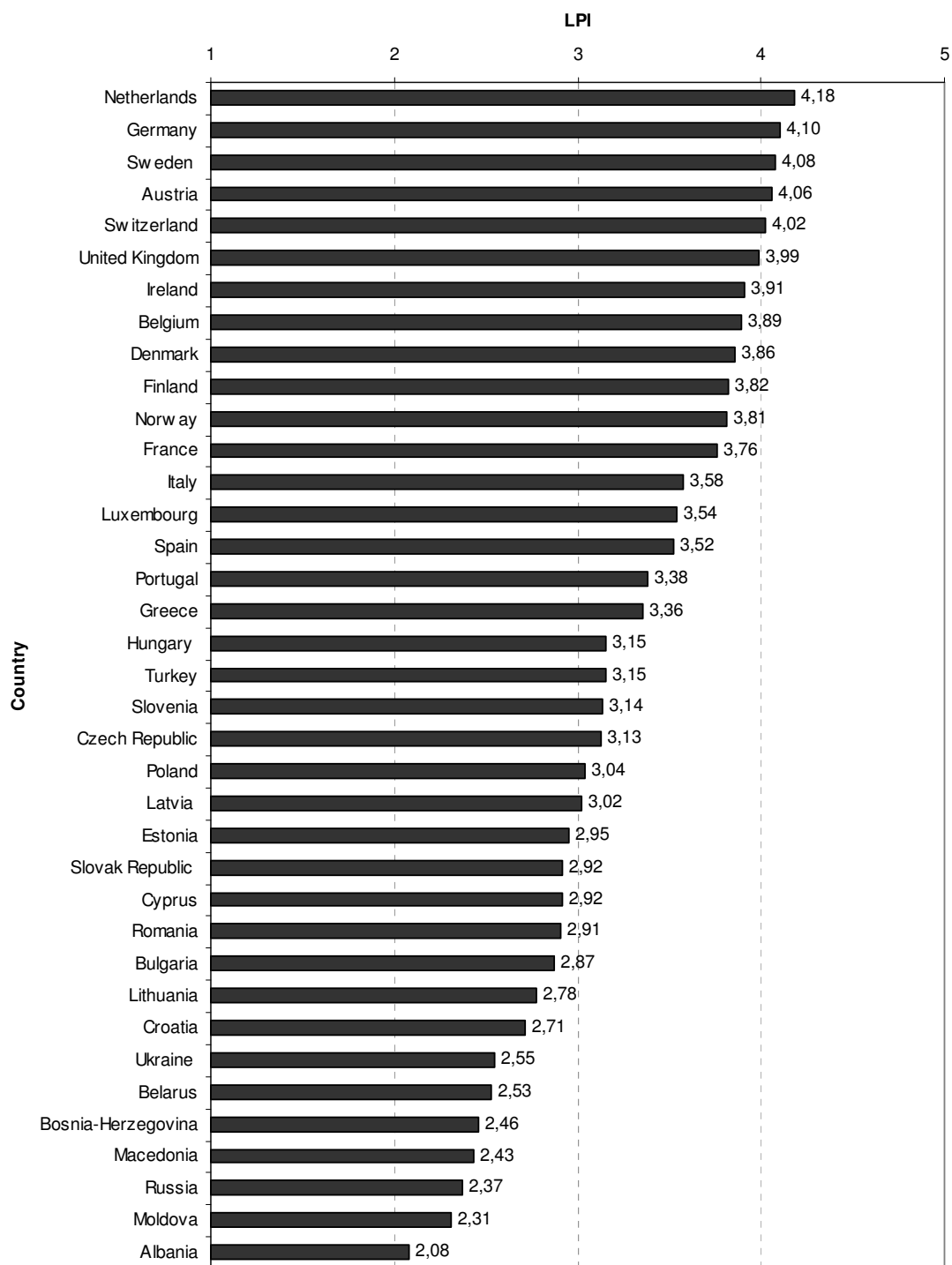


Figure 1: European countries from the perspective of LPI (Arvis et al. 2007).

West European countries perform quite favorably in the comparison (around the LPI value of 4 to 3), with Netherlands as number two in the global ranking. New EU countries and CEE countries in general, achieve low LPI values (from 3 to 2). Notable

is the low performance of Russia, with an LPI score of 2.37 and a rank of 99 among the world's countries.

Key insights from the LPI are as follows. Supply chain predictability and reliability is of primary concern to international traders, even more than direct freight costs. Weak links in the supply chain, induce other costs, such as the costs of hedging against unreliability, higher inventories, and non-delivery in general. These induced costs may be very high, and may effectively eliminate the savings in direct freight costs that are sought after by sourcing from low cost countries. Developing countries and most emerging markets, typically perform poorly in terms of the LPI, and operations in these environments face both high direct freight and induced costs. Already countries achieving LPI values of approximately three, give rise to significant induced costs in the supply chain (Arvis et al. 2007).

#### **4. Research methodology**

For European warehousing of Finnish and Swedish companies we decided to target with a survey the largest companies of these two countries. 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 and Lorentz 2008b. It should be remembered that in web-based surveys the population reached is higher, and even with low response rate, as compared to ordinary postal surveys (Prajogo et al. 2007; Tian et al. 2008), they typically provide statistically sufficient amount of responses. However, all 1000 companies were not targeted with this survey, since financial (funds, investors, and banks), service, insurance, 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 our questionnaire.

After these considerations we were left all in all with around 700 companies (750 during year 2006, 680 during year 2009), to whom we sent the questionnaire through email. Survey response form was available at web-pages in Finnish, Swedish and English. In order to increase reliability of responses, only individual codes of each company (given in the email) were accepted as answers in the form. We contacted companies mostly by email, either directly to the logistics director, to the corporate communications or to the general contact address. This email contact list required relatively large amount of work, since all of the addresses were collected via web search engine. As we launched our questionnaire, and sent first requests for answers, we were amazed that even emails sent to general info addresses reached logistics managers and directors. Also industrial contacts of the authors' institutions aided us to get answers from companies.

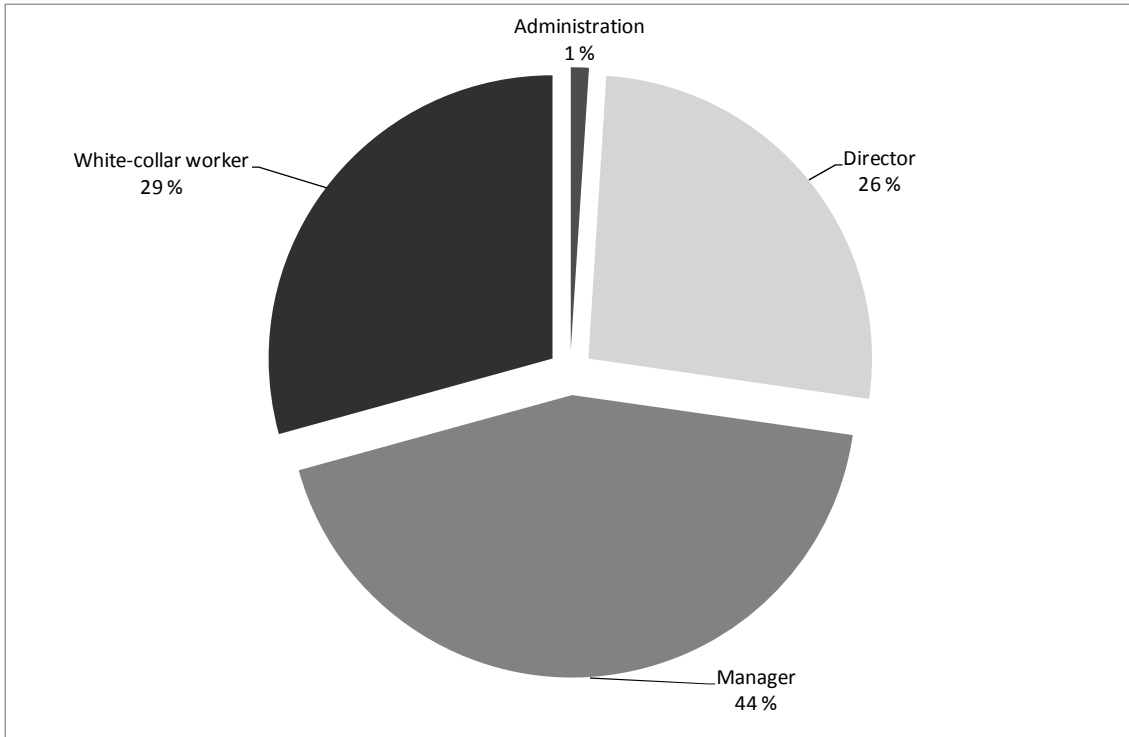


Figure 2: Respondent position in company within both surveys (years 2006 and 2009).

We sent two (year 2006) or three (year 2009) reminders for identified respondent population. During year 2006 we received 72 answers in total, of which five responses were returned as an empty. In reality, the total number of usable responses during year 2006 survey was 67 (8.9 %). It should be reminded that our questionnaire was rather long, and contained numerous detailed question areas. 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 the number of responses received was around 40, and in extreme maximum of 67. During year 2009 we were not able to reach as good response amounts, and 35 answers were usable for our analysis (approx. 5 % response rate). Similar situation holds with earlier survey responses that in some sub-items of the survey we were having approx. 20-30 usable responses. Although, these response rates could show very low proportional performance, they are rather typical for web based surveys. Our sample is a bit biased for Finnish companies, since during year 2006 approximately 70 % of all answers were coming from Finland, and during year 2009 the share of Finnish responses was at the level of 60 %.

Even if response rate might seem to be low, quality of responses could be considered as high: Most of the respondents were either directors or managers (72.7%; see Figure 2 for details). As we analyzed respondent working experience within the company, we identified that they had “average” or “long working period” in this environment (approx. 80 % of respondents were having working experience within particular company more than four years), and amount of years worked within logistics indicated similar substantial level of experience.

### 5. Empirical data analysis of two warehousing surveys

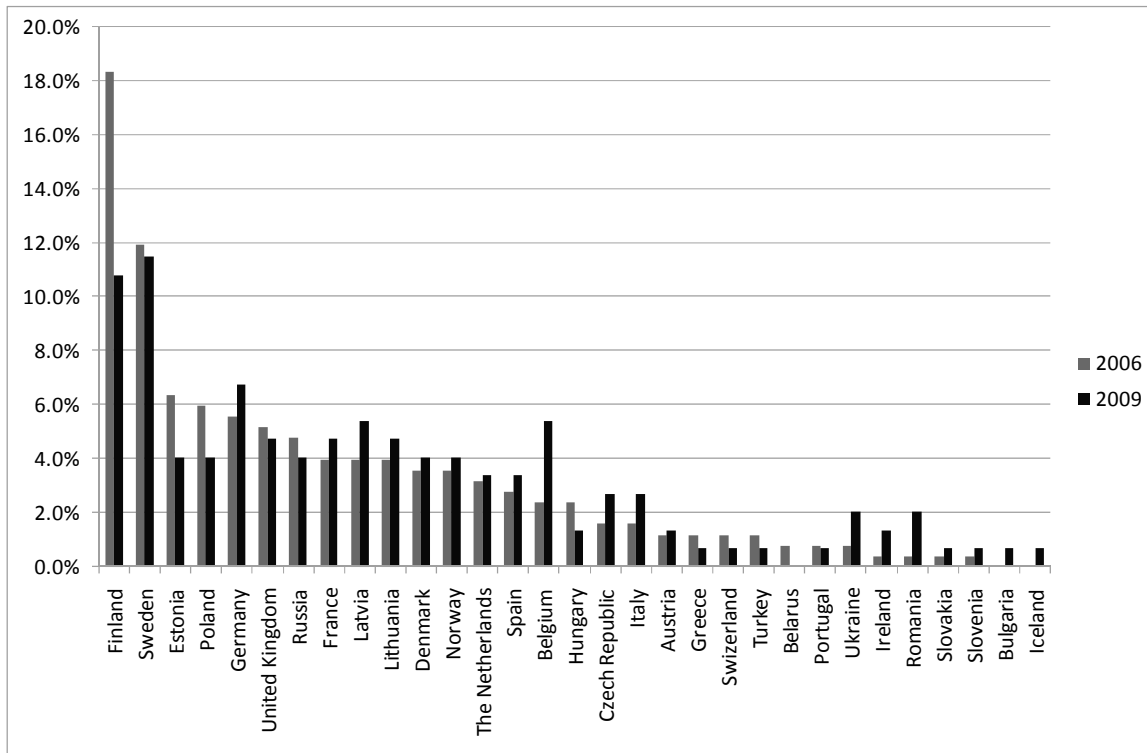


Figure 3: Location of warehouses of all responses during both observation years in Europe in descending order of the initial survey round (year 2006).

Location of Finnish and Swedish warehouses is shown in Figure 3, including both years 2006 and 2009. As is being illustrated, home countries still dominate warehousing location, but in a case of Finland “home” popularity has decreased to the level of Sweden. Thereafter, locations are interesting mixture of East and West, while the popularity dynamics of foreign destinations does not show that great variance. Only identifiable larger-scale change, with the decrease of of Finland, is the increase of Belgium. However, it should be noted that this latter country has considerably improved its importance as warehousing location. Countries of not showing any great frequencies in warehouses in Europe are those economies, which are smaller and/or are emerging. So, it could be argued that companies still to some extent consider that demand in these could be fulfilled through other countries (with larger absolute product volumes).

Table 1: Warehouse location in CEE/CIS region or not (Chi Square tests; note that multiple countries could be indicated to be used in respondent company in these two main groups).

CEE/CIS			CEE/CIS			Chi Square Test:
2006 (should be)	Yes	No	2006 (act.)	Yes	No	
FIN	49.1	104.9	FIN	64	90	0.000
SWE	30.9	66.1	SWE	16	81	

CEE/CIS			CEE/CIS			Chi Square Test:
2009 (should be)	Yes	No	2009 (act.)	Yes	No	
FIN	34.5	72.5	FIN	43	64	0.001
SWE	13.5	28.5	SWE	5	37	



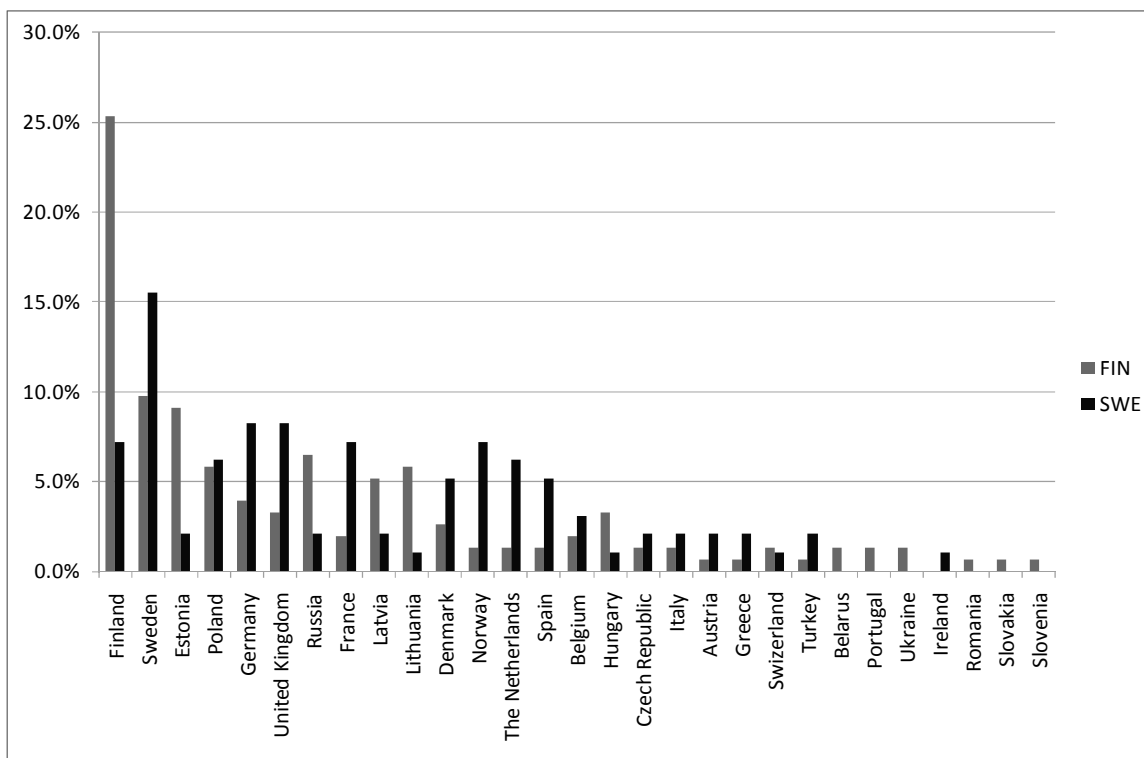


Figure 4: Location of warehouses of Finnish and Swedish companies in Europe in descending order (n = 55), year 2006 responses.

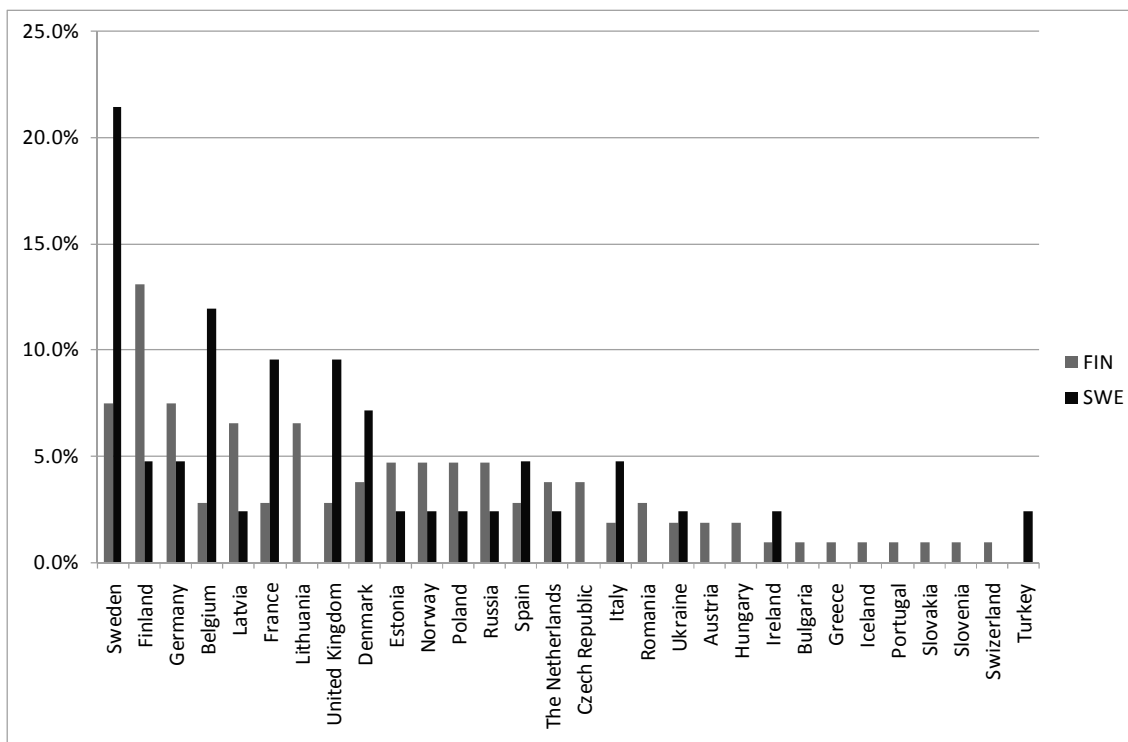


Figure 5: The location of warehouses of Finnish and Swedish companies in Europe in descending order, year 2009 responses (n = 31).

Even if overall sample does not show that great changes, country-wise responses do have significant differences. As is shown in Figures 4 and 5, Finnish companies have

warehousing more in Central and Eastern Europe / Commonwealth of Independent States (CEE/CIS), while Swedish companies have built their distribution through West European countries (such as Belgium, France and United Kingdom). As further analyzed in Table 1, this clearly identifiable situation is also statistically significant as tested with Chi-Square test (probability for otherwise  $< 0.001$ , and it concerns both of the survey years). Test assumes (in left-hand side) that Finnish and Swedish answers are equally distributed in these two regions, but as could be noted that Swedish companies very rarely have their distribution centers in CEE/CIS region, while in the case of Finnish companies this frequency is much higher than expected.

There does not exist that large differences within the size of warehouses between Finnish and Swedish responses – both show similar trend, which is identifiable in Figure 6. So, some shift towards larger warehouses is well apparent, however, in the future there exists even the smallest kind of units, employing 0-10 people. Situation was rather similar in year 2006 survey, as respondents evaluated warehousing size for years 2001, 2005 and 2010. Results showed that either small or very large warehouses existed among respondents (actually lowest frequency was the same as in Figure 6, warehouse employing 31-50 employees). However, emphasis was at that time clearly in smaller warehouses more (0-10 or 11-30 people employed). Development at the time was also showing moderate shift towards larger outlets, but even based on this earlier study, smaller units had their place in operations during year 2010. So, year 2009 survey confirms that the size of warehouses will continue to slowly increase, but it is two-fold.

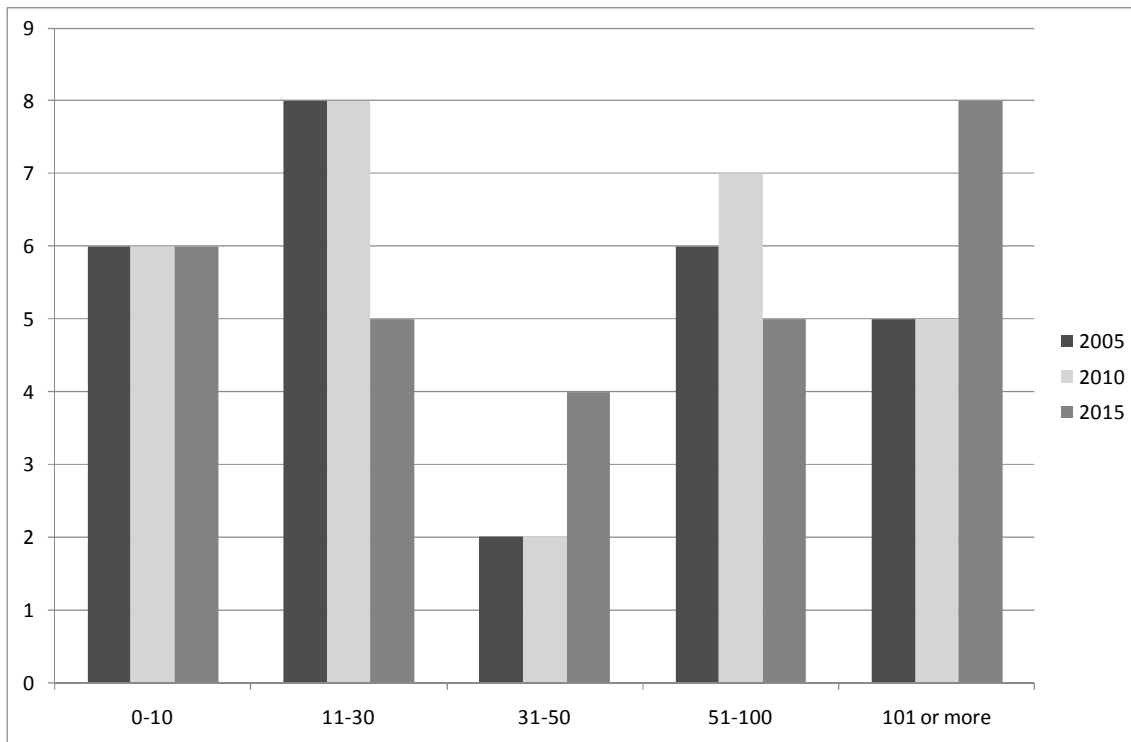


Figure 6: Employment (size) of warehouses concerning both countries using year 2009 responses (n = 28).

Table 2: Warehouse location criteria concerning both countries using year 2006 responses (n = 43); #1 denotes as the most important criterion, while #2-5 the second to the fifth important.

Warehouse Location Criteria	# 1	# 2-5
Low distribution costs	41.9 %	11.0 %
Assembly/manufacturing plants near-by	16.3 %	4.1 %
Inbound logistics were easy to connect	14.0 %	8.7 %
Third party logistics solutions are widely available	9.3 %	7.0 %
Road transportation connection	4.7 %	17.4 %
Sea transportation connection	4.7 %	4.7 %
Selected place appears to hinder future potential	4.7 %	6.4 %
Company specific warehouses available for lease/rental	2.3 %	5.2 %
Enlargement space in the future	2.3 %	9.3 %
Air transportation connection	0.0 %	1.7 %
Availability of labour	0.0 %	4.7 %
Infrastructure support for intermodal transportation	0.0 %	8.1 %
Low cost of labour	0.0 %	6.4 %
Railroad connection	0.0 %	5.2 %

Table 3: Warehouse location criteria concerning both countries using year 2009 responses (n = 23); #1 denotes as the most important criterion, while #2-5 the second to the fifth important.

Warehouse Location Criteria	# 1	# 2-5
Road transportation connection	26.1%	8.7%
Low distribution costs	21.7%	12.0%
Assembly/manufacturing plants near-by	13.0%	3.3%
Infrastructure support for intermodal transportation	13.0%	8.7%
Third party logistics solutions are widely available	8.7%	12.0%
Inbound logistics were easy to connect	4.3%	7.6%
Low cost of labour	4.3%	8.7%
Railroad connection	4.3%	1.1%
Selected place appears to hinder future potential	4.3%	8.7%
Company specific warehouses available for lease/rental	0.0%	6.5%
Availability of labour	0.0%	2.2%
Enlargement space in the future	0.0%	7.6%
Air transportation connection	0.0%	5.4%
Sea transportation connection	0.0%	7.6%

Most dramatic changes in our survey between two observation points were present in location criteria as Tables 2 and 3 demonstrate. During year 2006 the most important criteria for selecting warehousing location was low distribution costs – this factor dominated all the others items, ranked as first in priority (Table 2). However, for year

2009 quite many things have changed regarding the most important criteria – road transportation is nowadays the most important factor in decision making, followed closely by low distribution costs (Table 3). Among these, rather interestingly, intermodal transportation support has considerably increased its importance; companies occasionally give it the status of the most important factor. Near proximity of assembly and manufacturing operations have remained as the same during the both observation points. Also availability of third party logistics solutions has held its importance during both years.

As a very weak future signal, it is notable that the availability of labour has not been and will not most probably be among key criteria as warehousing establishment is considered. However, low cost of labour has increased its importance, and some companies consider it even as the key criterion in decision making. Further, some companies consider railroad connection as the most important criterion in decision making, although railway's position as the "second to the fifth most important factor" has decreased considerably. Thus, it should be emphasized that during both years 2006 and 2009, most important factors for warehousing establishment are clearly distinctive, but lower importance factors are scattered around more equally among different alternatives.

## 6. Discussion – Explaining warehousing survey results through foreign trade activity

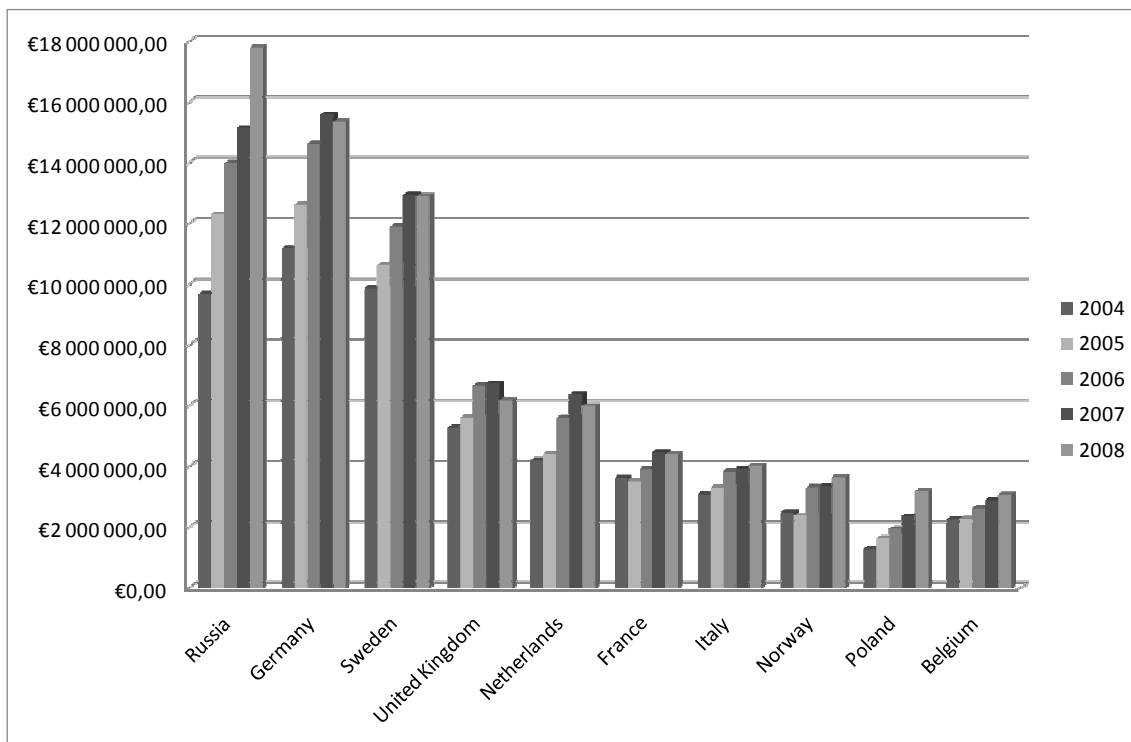


Figure 7: Ten most important foreign trade partners (total import and export) of Finland with larger Europe during years 2004-2008 (thousand euros).

Source: Finnish Customs (2009).

Major finding of this research work is the difference in location of warehouses between Finnish and Swedish respondents, which has persisted in both of the survey rounds. This difference could of course be explained with geographical factors (e.g. Finland is sharing the longest border in Europe with Russia, and Sweden is having nowadays land connection to Denmark, and eventually to the whole Central Europe), but in the end these two analyzed countries are located close to each other, and could be assumed to have similar opportunities to utilize the larger European markets. It could also be assumed that companies in integrated Europe do not necessarily design their operations for single countries, but e.g. for the entire Baltic Sea Region.

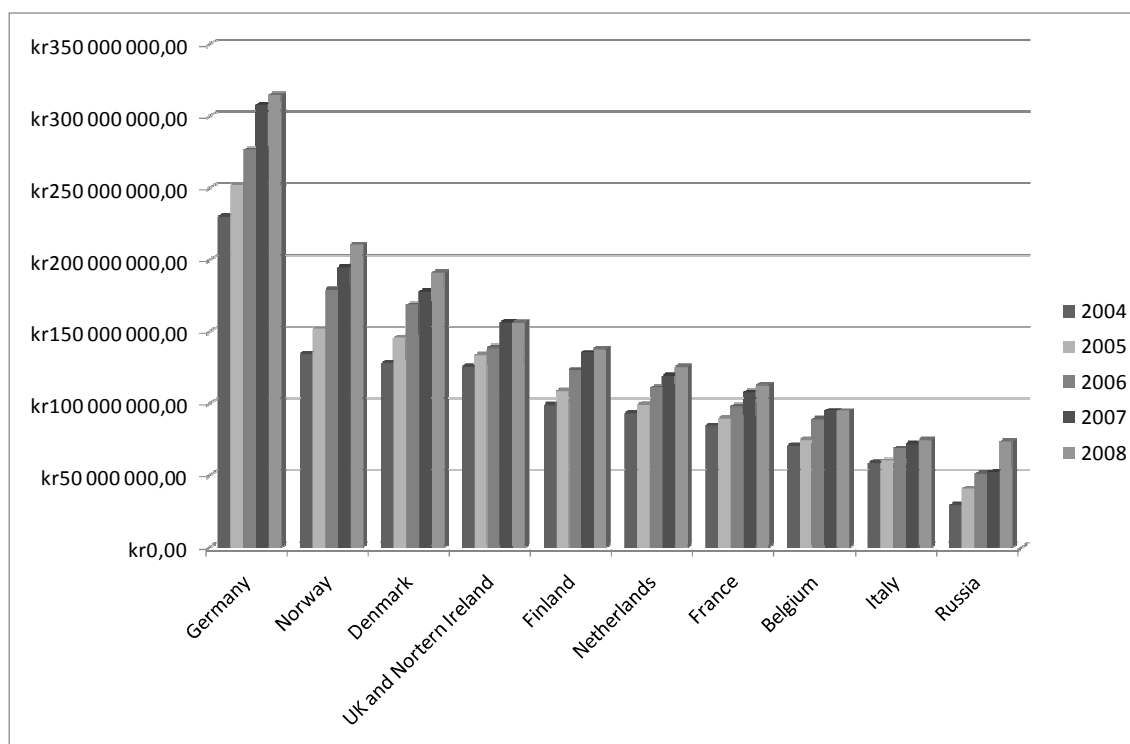


Figure 8: Ten most important foreign trade partners (total import and export) of Sweden with larger Europe during years 2004-2008 (thousand krona).  
Source: Statistics Sweden (2009).

One quite good argumentation base for the location of Finnish warehouses in East, and in case of Sweden, in West could be gained from foreign trade statistics. We gathered from these two countries five year data concerning the ten most important European trade partners (total import and export). As Figure 7 shows, Russia is currently most important trade partner with Finland, and has nearly doubled its importance during the observation period up to 17.8 billion €. Similar magnitude change has occurred also with Polish trade. Remaining countries in Figure 7 are located in West, but show more conservative development during the observation period, and actually are levelling off during the year 2008. This of course due to the reason that economic crisis reached firstly West, and thereafter continued to affect East. Russia was able to avoid economic downturn for several quarters longer, since raw material prices experienced their severe decline after summer 2008. Swedish warehousing emphasis on Westerly direction is also understandable by analyzing trade statistics – trade relations have been established mostly with neighbouring countries, Central Europe as well as the UK and Northern Ireland (Figure 8). Even if Finland is also having significant amount

of trade with UK, Sweden is on entirely different level in this respect, 150 billion kronas is roughly 14 billion Euros, which is 8 billion € more than Finland. Similar difference between these two countries is present in trade activity with Germany, Netherlands, France, and Belgium. However, notable is the growing importance of Russian trade for Sweden as well: Approximately 150 % increase during observation period. It remains as an issue of further research, whether this trend will continue, and will it lead into more warehousing in Russia for Swedish companies.

Another finding in our study was the growing diversity in warehousing location criteria, which could be explained with difficult operating environment of year 2009. As low distribution costs were clearly the most important criteria during the year 2006, in the latter observation year this was accompanied with road transportation connection, as well as third party logistics solutions availability (, which sustained its importance from year 2006, but proportional importance has increased, since the decrease of low distribution costs). These three factors emphasise efficient and declining distribution costs in fluctuating demand environment. Road transportation companies are typically small actors, which are in need of elasticity in prices as economic downturn occurs. Also by using third party logistics solutions, freight prices (e.g. sea and air) may be reduced (due to negotiation power), and operations in warehouses may be enhanced by using outsourced services, instead of own employees.

However, in terms of warehousing criteria, in addition to the low-cost factor, notable is the increasing popularity of intermodal transportation. Reasoning for the use of different transportation modes in distribution process could be found from increased importance of the Easterly direction, simply due to reason that CEE/CIS economies still today have high freight market for rails. For example, in Russia rails have market share of 85-90 % (from freight tonne-kms), if pipeline transportation is not included in the calculations, similarly e.g. in Poland there exist still the second largest railway freight market of the European Union. As we further analyzed responses of the 2009 survey, we found out that infrastructure support for intermodal transportation was having highest priority among Finnish companies (all three responses from Finland in this regard), country which was having more foreign trade with East and also warehousing locations. For this reason we argue that railways have increased their importance for Finnish companies. Reaching e.g. other than capital city destinations in Russia and Ukraine, is most conveniently completed with rails rather than by road. This is also often the most cost efficient solution. We expect similar shift to also reach Swedish companies, if CEE/CIS countries become more important for them. Also increasing pressure to lower environmental emissions will create demand for railway transportation.

Our survey indicated also some minor change in the growth of the size of warehouses; however, there is future for smaller warehouses too. One explanation for this sort of two-fold development could be explained with well developed and efficient logistics solutions in Western European countries, and on the other hand developing practices of emerging economies of Europe. So, it will take quite many years for warehousing centralization to work around in larger Europe, and only major scale political and trade agreements between European Union and other European countries will offer such an opportunity for logistics. If this will not materialize, we will have smaller warehouses scattered around in East for years to come.

## **7. Conclusions**

Importance of warehousing has significantly increased during the most recent decade, mostly due to globalization and continued further manufacturing centralization. Therefore, warehouses have become more like value adding and high response centers, which enable corporations to achieve operational performance and high profitability. As was illustrated in the literature review, not only cost issues and other operational factors (e.g. transportation distance, transportation modes, factory locations etc.) account in warehousing success, but also political, legislation, geopolitical and trade regulation issues do have significance for building superior performance. Our research concerned larger Europe, continent which has been going through peaceful economic area enlargement and trade liberalization in recent two decades time (this should minimize the effect of other than operational factors). Our research concerned two northern economies of Europe, namely Finland and Sweden, and their respective company warehousing decisions. Interestingly, overall warehousing location during observation period has not experienced that great change (only the popularity of Finland has decreased, while Belgium has experienced contrary development). However, during both of the years, Finnish companies seem to be concentrating more on East as Swedish companies do operate in West. This difference was even considered as significant in statistical terms. Warehousing unit size will somewhat increase, but various sized warehouses will exist in the future too. Also location criteria of warehouse have changed during the years: Currently companies consider simultaneously road transportation issues, low distribution costs, proximity of assembly and manufacturing plants as well as infrastructure support for intermodal transportation. Also the availability of third party logistics services was felt as important. In the 2006 survey, it was found that low distribution cost was the single most dominating factor. In some respect location criteria have become more “down-to-earth”, i.e. concerning transportation modes and logistics outsourcing.

For further research, it would be important to conduct warehousing survey once again during year 2010 in these examined countries. This is important mainly due to the global economic turmoil, and mostly due to large-scale change of business environment. Survey of 2009 was conducted during the sudden downfall phase, but for year 2010 bottoming process is expected to happen. For Swedish companies year 2010 could be different, due to the reason that Swedish economy is not connected into common European currency (Euro), and they still have own krona in use, which has provided needed flexibility (devaluation) during the crisis time for manufacturing companies to sustain their international competitiveness. This similar flexibility is not available in Finland, where profitability in declined markets could only be achieved with massive productivity improvements. It is also currently known, that Swedish companies are exporting more goods to near-by countries due to weakened currency, while in Finland industrial production is still in decline. So, we could expect that Swedish companies are more interested in establishing warehouses in the Easterly direction due to increased competitiveness, markets which have been typically served by Finnish companies. Crisis has hit hard also the Russian economy, but not in the worst possible manner, and therefore it could be assumed that companies in Sweden do hold interest in enlarging their presence particularly over there too. In addition to crisis issues, we would be interested in continuing the analysis of current survey responses, and instead of country level comparison, it may be fruitful to examine the effect of respondent size factors on

warehousing decisions. This research set-up could reveal rigid centralization of warehouses in larger companies, while smaller ones may be assumed to follow most important markets and customers.

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## Appendix

## Summarized literature review of multicriteria warehouse / distribution center location selection

Reference	Aim	Decision criteria	Method(s)	Source of criteria
Ashayeri & Rongen (1997)	modelling of distribution center location with an application in European telecom industry	Transport + location costs Throughput time Location factor index, with quantitative and qualitative criteria	Kuehn-Hamburger model, Grid-model, Electre method	na
Alberto (2000)	location of a combined manufacturing-distribution facility	<b>Environmental aspects:</b> environmental regulations, proximity to disposal plant, taxation <b>Cost:</b> operating, start-up <b>Quality of living:</b> climate, crime rate, traffic congestion, living expense <b>Local incentives:</b> tax incentives, union, laws, skilled labour <b>Time reliability provided to customers:</b> carriers, proximity to suppliers, other customers, railway, highway <b>Response flexibility to customer demand:</b> proximity to suppliers, proximity to other company's complementary facilities, proximity to customers <b>Integration with customers:</b> facilitation of post-sale service, facilitation of comakership, facilitation of co-design	analytic hierarchy process	Empirical, obtained through group work
Melachrinoudis, Min & Messac (2000)	model for optimal relocation site and schedule for a combined manufacturing-warehousing facility in the US	Cost (set-up and operation) Access to customers Access to suppliers Access to transportation infrastructure Tax incentives	Linear programming	not specified
Chen (2001)	method development for distribution center location selection	Investment cost Expansion possibility Availability of material Human resource Closeness to demand market	Fuzzy decision making	Non-empirical numerical example

Reference	Aim	Decision criteria	Method(s)	Source of criteria
Ashayeri & Rongen (1997)	modelling of distribution center location with an application in European telecom industry	Transport + location costs Throughput time Location factor index, with quantitative and qualitative criteria	Kuehn-Hamburger - model, Grid-model, Electre method	na
Alberto (2000)	location of a combined manufacturing-distribution facility	<b>Environmental aspects:</b> environmental regulations, proximity to disposal plant, taxation <b>Cost:</b> operating, start-up <b>Quality of living:</b> climate, crime rate, traffic congestion, living expense <b>Local incentives:</b> tax incentives, union, laws, skilled labour <b>Time reliability provided to customers:</b> proximity to carriers, suppliers, other proximity to company's customers, waterway, rail, highway <b>Response flexibility to customer demand:</b> proximity to suppliers, proximity to other complementary facilities, proximity to customers <b>Integration with customers:</b> facilitation of post sale service, facilitation of comakership, facilitation of design	analytic hierarchy process	Empirical, obtained through group work
Melachrinoudis, Min & Messac (2000)	model for optimal relocation site and schedule for a combined manufacturing-warehousing facility in the US	Cost (set-up and operation) Access to customers Access to suppliers Access to transportation infrastructure	Linear physical programming	not specified
Chen (2001)	method development for distribution center location selection	Investment cost Expansion possibility Availability of material Human resource Closeness to demand market	Fuzzy decision making	Non-empirical numerical example