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Driving globalization: The rise of logistics in Europe 1950 - 2000

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Abstract

The rise of logistics is explained by three factors. The first factor is an economic one: The development of a mass consumption society. In European countries, one can observe mass motorization and a gradual expansion of the motorway networks between 1960 and 1990. These networks facilitated truck transport, leading to the development of cheap transport, warehousing and distribution of consumer goods. This development is part of a mass consumption society, i.e. logistics enable the development of mass consumption societies. Another driver towards transportation and logistics was the European traffic policy. In the 1950s, it enabled trucks to cross borders with full loads and to transit certain countries. Prior to 1980, the quotas for international truck traffic were regulated by bilateral agreements. But these quotas remained small. In the 1980s and 1990s, the European Union pursued a policy toward attaining a uniform market in the European Union. This pertained to the exchange of goods and for truck transportation services. The third factor refers to innovations in the parcel industry. In the 1990s, logistics and transportation changed fundamentally. We can almost speak of a logistics revolution caused by a co-occurrence of various developments, much like the liberalization of the transport and telecommunications industries, the proliferation of internet technologies, the unification of Europe and the dissipation of communism, leading to a new orientation of logistics in the European market.

Keywords: Logistics; Transport; Mass consumption; Traffic policy.

1. Introduction

In the last decades logistics changed fundamentally: from a microeconomic point of view, logistics developed from an auxiliary function in materials management to an independent factor of production that would go onto coordinate world-wide supply chains. From a macroeconomic point of view, the rise of the logistics sector as an important employment sector is fundamental and a force for deepening the division of labor. This paper explores the driving factors of the rise of logistics. It demonstrates how traffic policy of a gradually unified Europe shaped the development of logistics from its basic functions of transport, handling of cargo, and storage to the modern

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concepts of high performance logistics, including concepts of organization of world wide supply chains and dimensions of quality in services, such as promptness and accuracy. Besides the political factor of the unification of Europe, one can identify an economic factor concerning the development of a consumer-oriented economy. The great variety of consumer goods was a challenge for the distribution logistics. As a third factor, the innovations in the parcel industry are considered where for the first time the flow of goods are linked to information technology to ensure speed and quality resulting in the "tracking and tracing technology". The paper is based on the evaluation of research reports, monographs on traffic policy and national and European statistics. The rise of logistics has not drawn much attention of the scholars in the past. So this paper opens a new field of research. First we address to the consumer-oriented economy.

The decades of the economic miracle in Western Europe after 1950, also called "trente glorieuses" or "miracolo economico", mark an evolution of the consumer-oriented economy in Europe, which not only addresses mass consumption but also the mass production and mass distribution of consumer goods (Strasser 1998). Mass production, mass distribution and mass consumption constitute a system. The automobile industry and the automobile trade, which form the basis of mass mobilization, play an important role within the consumer goods industry. The automobile cannot be viewed as only an important consumer good, but also as a product which enabled purchases in distant central markets and the comfortable transport of large amounts of consumer goods. It created the precondition for the focus on large scale entities in the retail trade. Other strong sectors of the consumption-based economic system are banking services, insurance services and services of the tourist industry. However, those sectors are less important for the supply of goods and are therefore neglected in this research.

2. Mass motorization and the motorway network

In the decades following 1950, mass motorization strongly contributed to the economic miracle in Western Europe.[1] Automobile stock rose rapidly. In Western Germany, the growth rates of the 1950s amounted to 20 % per annum. Mass motorization got a fresh impulse from the reasonably priced, iconographic starter models: in Italy the Fiat 500, in France the Citroen 2CV, and in Western Germany the VW Beetle. The existing road system, which in many European countries did not include motorways, was unable to sustain the increasing motorization. There was said to be chaos and accidents on the roads.[2] (Girnth, 1954). In response to the insufficient road network and the increasing influence of the auto lobby on traffic policy, European countries gradually extended the motorway network, which unburdened the roads and cross-town links and promised fast and comparably safe driving (Mom 2005, pp. 745-772. Ross 1998, p. 86). The following table shows extension of the motorway network in the EU15 countries.

[1] For Sweden see Lundin (2004, p. 303-337). For Italy see Paolini (2005). For Germany see Klenke (1993). For France see Loubet (2001). For Great Britain see Thoms et al. (1998).

[2] We define motorways in this paper as junction-free roads with two lanes for each direction.

Table 1: Length of the motorway network in the EU15 in kilometres.

Country/Year	*1960*	*1970*	*1980*	*1990*	*1998*
Belgium	183	488	1.203	1.631	1.682
Denmark	–	84	516	601	861
Germany	2.671	6.061	9.225	10.809	11.427
Spain	–	387	2.008	4.693	8.269
France	174	1.533	5.264	6.824	9.303
Ireland	–	–	–	26	103
Italy	1.065	3.913	5.900	6.193	6.453
Luxemburg	–	7	44	78	115
Netherland	358	1.209	1.780	2.092	2.360
Austria	–	478	938	1.445	1.613
Portugal	–	66	132	316	1.252
Finland	–	108	204	225	473
Sweden	–	403	850	939	1.339
United Kingdom	202	1.183	2.683	3.180	3.421

Source: Eurostat (2002a, p.1). Data for 1960 from World Road Congress (1969, p.51).

The table shows how the pioneers of motorway construction – Italy and Germany – started already after 1950 to extend their motorway network substantially, compared to construction in France and England, where motorway construction was not pushed until the 1960s and 1970s (Moraglio 2007). Already by the 1950s, small countries such as Belgium and the Netherlands had substantially extended their motorway system in relation to their country size. Between 1950 and 1954, Western Germany only built 58 kilometers of motorway and focused more on the repairing war damage. Expansion followed in the following years. Until 1961, 726 kilometers of motorway were built (Bundesminister für Verkehr 1961, p. 241). Despite little financial capital, the Federal Republic of Germany used the shadow budget as a way out in order to booster highway construction in the 1950s, which underscores the high priority of motorway construction (Bundesgesetzblatt I, 1955 pp. 166-179).

3. The logistical function of motorways in the consumer-oriented economy

The extension of the motorway network has not only served the automobile, but also the rapidity and economy of truck traffic. It gave a decisive impulse to the truck-based logistic systems. In the political debate about expansion of the highway system, two aspects - the transportation of people and the traffic of goods on the motorways - were viewed differently within European transport policy. In fact, German politics assigned goods transport to the railroad, and thereby pursued a twofold traffic policy: The motorway was mainly built for the automobile. However, this twofold traffic policy was short-sighted, as it did not address the economic rationalizing effects of truck traffic. Moreover, it impeded the development of logistics as a growing segment in the early phase of a service-oriented society: truck traffic decreased the costs and speeded up the

transport of goods. In Germany, this aspect was not even considered in the research of economic effects of the motorway until 1970.[3]

In contrast to Germany, in Italy the aspect of rationalization of the goods traffic was one reason for the construction of motorways, and was appreciated as transport "modernization" since the railroad showed very poor performance (Bonino and Moraglio 2006). Capital investment in railway modernization focused on the area of passenger transportation, so that rolling material in freight haulage was no longer current. Moreover, the railway could not be integrated into a modern logistical concept of time-based competition, since the freight train did not run on schedule (Kerwer 2001, p. 173-216). In England, the construction of highways began with detour roads around the cities of Preston and Lancashire so that the cross-roads were cleared and goods traffic was accelerated. Charlesworth (1984, p.35) shows the lobby work of the Chamber of Industry and Commerce.

The development of truck traffic along the European motorway network is closely related to the evolution of modern logistical systems. Those evolved in the two main areas of the consumer-oriented economy: in the just-in-time delivery concept for automobile assembly facilities and in the build-up of modern distribution structures in the retail trade for the turn-over of goods in the already developed consumer goods industry.

If one includes the automobile industry into the branch of the consumer goods industry, one can assert the thesis that the consumer-oriented economy is based on modern logistics and vice versa. A consumer-oriented economy is characterized by a differentiated offer of mass customized goods in a consumer market where customers have a large choice of offers. The deliveries of goods are urgent. A rapid change of fashion and models on the consumer goods markets and time-based deliveries to the automobile assembly facilities require transports without delay. In European transport networks, this is only possible via truck, as door-to-door-transports without transfer, while the railway slackens in this system of time and quality competition.

The question concerning the development of distribution systems was put in context with the distribution of consumer goods, and was related to the expansion of department stores and the increasing presence of chain branches within the retail sector. For the first time, scientific marketing methods were implemented systematically in retail. Customer desires were to be scrutinized and, if necessary, sparked. Additionally, agile logistics had to deliver the goods to the store racks in time, in order to avoid empty racks which might cause antagonism and loss of customers, which is very easy on a consumer market that appears to have an almost unlimited offer of goods. This reveals a consumer orientation in modern logistics. In the academic theory of logistics, the location of production plants, as well as central and regional warehouses, was researched in order to minimize storage and transport costs and transport to the stores (ReVelle and Swain 1970).

The collapse of the Eastern bloc in the 1990s highlighted the different logistical structures in the East and West. In the following, the differences in transportation, logistics, and economic systems are to be revealed. The public economy of the Eastern bloc eliminated competition, preferred heavy industry and had the railway carry out transportation. Since its origin 175 years ago, heavy industry and railway have interacted. The railway's transport performance in the Eastern bloc rose from 82 billion

[3] See literature report by Frerich 1974.

tons kilometer in 1950 to 364 billion tons kilometer in 1980 (Dienel 1997, p. 404). The consumer goods industry, including automobile production, showed only weak performance. Poor motorization added no authority to the auto lobby in its effort to promote road construction. The problem of the lack of rural roads had been discussed in Russia since the 1920s, but had yet to be solved. The road network was in bad condition. Motorways existed – if any – only on short segments. The ambitious plans of the 1950s to build a motorway system from Western Russia to Central Europe was never achieved (Krüger 196, p. 157, Siegelbaum 2008, pp. 157-160).[4] Due to the lack of a developed consumer goods industry, including distribution systems supported by trucks, there was no modern logistics in the Eastern bloc that could be characterized by rapidity, precision and a large quantity of goods. There was rather only an intermittent delivery of underserved markets, whereas the quality of the supply was secondary in an economy of scarcity. Nor was the punctuality of the delivery most important, but rather that the delivery arrive at all at some point. The extraordinary delivery deadline of 13 years for a Trabant car in the German Democratic Republic (GDR) proves this aspect. Zatlin (2007) supports the thesis that the poor performance of the automobile industry has contributed decisively to the decline of the GDR.

The Western European development program of the consumer-oriented economic system varied to a large degree from the structures of the Eastern bloc. With the exception of secured public or quasi-public sectors, the market economy regulated competition among service providers. The consumer goods industry and especially the automobile industry were very well-developed. The logistics of the developed consumer goods markets could profit from a close motorway network, to built-up structures of external suppliers in the automobile industry, and productive, truck-based distribution structures for the supply of a large variety of consumer goods.

4. The automotive logistics of the automobile industry

This section deals with the Europeanization of the automobile industry. It focuses on how the "automotive logistics" sector emerged. Growth and high earnings during the years of the economic miracle enabled the well-unionized work force of the automobile industry to implement high company tariffs. Management balanced high costs and affordable end products. The outsourcing of production and logistics I nto sectors and countries with lower wages served as a way out of the cost trap. In 1988, the average hourly wage amounted to 18 euros for industrial workers in Germany, compared to Portugal where the hourly rate amounted to 3 euros (Eurostat 1989, p. 126). The transfer of warehouse operations and production supply processes to low-wage employees of the logistics trade lowered costs. This was the starting point for the development of just-in-time-delivery and the outsourcing of parts production to low-wage countries in the 1980s (Christopher 2005). Both developments gave a strong boost to the logistics industry to create a "modern logistics", which extended the basic functions transport and storage with the aspect of quality: rapidity, punctuality, low error rates and process control with the help of computer networks were in demand. In logistics trade, the separate business segment "automotive logistics" was created, which complemented the

[4] For the Soviet model of economy see Judt 2005, chapter 13.

classical logistic functions with services and production steps, such as inventory management and re-ordering, packaging, pricing and pre-assembly.

5. The railway transport in Europe

Up to the year 2000, European railway societies maintained a cartel of national monopolists. The railways that belonged to the respective countries developed national transport markets for bulk goods within their countries. National orientation created a number of impediments for the establishment of a Europe-wide market for railway transport (European Conference of Ministers of Transport 1985. Stone 2003. Kopper 2007). The market for railway rolling stocks in Europe was very fragmented within the separate countries. Consequently there were small, inefficient batches in orders of new wagons and locomotives. In railway engineering, there were 11 different power systems and 15 different operating systems within Europe. Along with that came national rules and standards for the operation of a particular railway, and the national language for the communication within the railway system – while in air traffic, English was already being used. Furthermore, the authorized axe load differed among the national networks, such that wagons of goods could not be used to full capacity. This fragmentation required a shift of the locomotives and the staff at the respective borders, causing long delays. Each railway made its own pricing system. The additional expenses incurred remained obscure, and there were different opinions on liability, contract duration, and terms of payment.

Using the example of transalpine traffic between Germany, Austria, Switzerland and Italy, the problems of European railway cooperation can be demonstrated. At first, the railway was able to keep substantial market shares in competition with the truck due to the bottleneck at Alpine crossings. For a long time, rail was the most important means of transport for transalpine traffic, since in winter the mountainous crossings were almost insurmountable by truck. Significant use of the roads for goods traffic didn't start until the expansion of motorways across the Alps. In the 1960s, 98 per cent of the transport between Germany and Italy was performed by the railway (Bayliss 1965, p. 129). As a result, goods traffic via rail decreased year by year. In 1983, for the first time, more goods were transported via road than via rail in the Alpine rim.

An important aspect which needs to be considered for the interpretation of competition between road and rail in transalpine traffic is the quality of the transportation. If quality is measured by rapidity and punctuality – an important parameter for just-in-time cooperation – then railway transports show many shortcomings due to locomotive shifts at the borders. According to the logistics-center in Prien at Lake Chiemsee, delays of over half an hour in truck traffic between Munich and Verona affected merely 2% of the trucks. For railway traffic, however, 20% of the freight trains were affected, which can be ascribed to the lack of coordination between the three railway organizations existing in Germany, Austria, and Italy which monitor the transfer of locomotives and staff at the borders.

The motorway between Innsbruck and the Brenner Pass has a long construction history (Brenner-Autobahn AG 1972, pp. 469-482). Already by 1963, the "Bridge of Europe" close to Innsbruck had been completed. With its avant-garde highway chapel, it gave travelers comfort and hope in approaching the dangerous Alpine crossing. The

year 1972 was decisive for truck traffic in that the road between Bolzano and Verona was completed on the Italian side of the Alps. Due to motorway expansion, truck traffic showed explosive growth. In 1994, 132.8 million tons of goods crossed the Alpine rim, of which 50% accounts for transit, 15% for domestic traffic, and 35% for import and export traffic. Sixty-three per cent of the tonnages were transported via road and only 37% via rail. With this, almost ten million trucks crossed the Alps each year. In 1980, Switzerland was still able to report that 93% of its transalpine goods traffic was transported via rail and only 7% via road. With the opening of the Gotthardt Tunnel in 1980, goods traffic was relocated to the motorway A2. In 1994, the Swiss railway's market share was down to 74% (Kracke 1997, p. 23).

In order to limit truck traffic, transalpine goods traffic in Austria and Switzerland was subject to a large number of restrictions based on the respective national and transnational conventions.

6. Common traffic policy in Europe and the liberalization of truck traffic

Border-crossing road freight transport in Europe was only made possible via a number of international institutions and agreements.[5] The Economic Commission Europe (ECE), which organized the commission for domestic traffic, needs to be mentioned. Already prior to 1949, this commission had been enabling truck traffic. This was thanks to its convention on road traffic (also called "Freedom of Road"). Foreign trucks obtained the right to enter a country with their freight, whereas before the convention, the cargo had to be shifted to a domestic truck at the border (Schipper 2007). The commission for domestic traffic coordinated the Marshall Plan's aid supply which started in 1948. It also represented a field of policy for road and truck traffic expansion in order to compensate the railroad capacity constraint which followed the war. On May 19, 1956, the commission established the transport contract within the international road haulage (CMR), and the customs agreement on the international goods transport in sealed trucks with carnets TIR on 15 January, 1959. Therefore, custom checks for border-crossing transit transports became redundant. After all, the European conference of traffic ministers (CEMT), which was founded in Brussels in 1953 by Italy, Belgium, France, Germany, and Switzerland, helped tremendously in coordinating traffic policy in Europe.[6] It had the political goal of facilitating and easing the exchange of goods within Europe, and in 1960 it concluded an agreement at The Haag with respect to maximum size and weight of trucks.

Beside oversight of the European Economic Commission, there were bilateral agreements between two countries regarding the amount of truck allocations. These were determined annually by representatives of the Ministries of Transport. If the contingents were spent, there could be no further truck traffic. This shows how restrictive and inflexible traffic allocation system was, especially with regard to the

[5] Regarding the following see Bundesminister für Verkehr 1961, part VII., Trinkhaus 1998, letter J., Frerich and Müller 2004.

[6] An important step for Western Germany to overcome the foreign-policy isolation. The report of the „European Conference of Traffic Ministers" on 16 October , 1953 is published in the traffic paper 1954, p. 178-180. By now, all European states (except Serbia), including Russia, form part of the CEMT, also Azerbaijan and Turkey.

constantly growing exchange of goods within the European Economic Community EEC.

The agreement for the foundation of the European Economic Community in 1957 aimed at developing a joint traffic policy to ease transnational goods traffic and to abolish barriers confronting the exchange of goods. The EEC agreement, under Title IV ("The traffic"), articles 70 to 84, required the coordination of European traffic policies. Conditions were to be formulated, under which traffic companies throughout the EEC were able to work. In particular, article 79 inhibits the discrimination of transport conditions based solely on the country of origin or country of destination (Trinkaus 1998, letter J211).[7] Article 81 of the EEC agreement provides for a reduction in border taxes and fees. Articles 85 and 90 require free and fair competition in the economy, including the traffic sector. This was specified with the claim for free market access, the restraint of state subsidies, cartel bans, and the prohibition of abuse of power. However, it has been a long and difficult, 34-year way leading to the goal of a European-wide market with free access for transnational truck transport service.

What is most surprising about the EEC agreement is its clear market-based orientation, which differs tremendously from the economic and traffic policies of the individual member countries. At the peak of the Cold War, this orientation was to be understood more as an ideological differentiation to the Eastern bloc than a maxim for domestic policy. Moreover, it needs to be emphasized that the regulations of the EEC and the European Union referred to transnational traffic. Separately, each individual country can regulate its domestic traffic.

Traffic policy can draw on many instruments to regulate truck traffic.[8] There are three categories of instruments: regulation of market access, price regulation and regulation of operation, while taxes for the operation of trucks, security standards for vehicles and drivers' working condition are set. If control of market access is reduced to subjective entrepreneur qualifications and if pricing is not subject to state requirements, this is considered liberalization of truck road haulage. In contrast, the operative regulation of truck road haulage is understood as the legal regulation of truck operation.

The common traffic policy of the EEC focused on truck traffic, which was easier to standardize than the area of railways, since these were state monopolies. In order to implement the requirements of Title IV of the EEC agreement pertaining to truck traffic, the EEC council of ministers had two main fields of policy: the liberalization and the harmonization of the operative truck road haulage regulations. Liberalization guarantees market access for foreign entrepreneurs in the home country, and creates competition in the hitherto isolated national markets. In the 1960s, truck industry regulation in the EEC countries showed varying levels. The countries which used the railway as an instrument for economic and social policy also combined regulation with a protection policy, restrictive licensing and price regulations. These countries include England, France, Belgium, and Germany. The Netherlands considered the transport sector as a regular economic sector without public obligations. Italy limited its railway policy to a deficit settlement (Bayliss 1965, p. 64). Harmonization alludes to the unification of national operative regulations. Differences distort competition and hinder the creation of a

[7] An example fort the discrimination is the transport of 100 tons steel plate. The prices for transportation via railway for a distance of 253 kilometers from Duisburg to Bingen amounted to 610 DM in July 1954. However, the price for a comparably long, but transnational roadway of 252 kilometers from Liege to Duisburg accounted for 378 DM. See Bayliss 1965, p. 11.

[8] The regulation appeared for the first time in the 1930s in all European countries, see Bayliss 1965.

common traffic market. In the field of harmonization, the EEC launched a number of regulations (European Commission 2001, part 3).

For decades, the EEC's council of ministers was unable to put the liberalization requirements of Title IV of the agreement into practice, since some of the member countries initially aimed at harmonizing the terms of competition within the EEC. Among the member countries, Germany and France were interested in railway protection and used the broad harmonization policy to postpone liberalization. As a precondition, they combined liberalization with extensive harmonization. The Netherlands and England had already liberalized truck traffic at the end of the 1960s, and did not support railway-friendly politics. Hence, a conflict between harmonization supporters and liberalization advocates developed[9] (Frerich and Müller 2004, p. 128). According to 1983 estimates of the European commission, high railway deficits influenced opinions on traffic policy in some member states and "initiated them to judge the politics towards other carriers mainly on the basis of their effect on the railway". The commission suggested investigating road haulage for "further possibilities, how the supply could be adjusted to the demand, which made the present system for capacity checks unnecessary at the very end." (Europäische Kommission 1983, p. 6 and 12).

As the conflict between harmonization supporters and liberalization advocates in the Council of Ministers caused a blockade of traffic policy for years, the institutions of the EEC developed an unpredictable dynamic. On January 22, 1983, the European parliament filed suit against the Council of Ministers at the European Court of Justice for failure to act. On May 22, 1985, the European Court of Justice enunciated a judgment against the Council of Ministers for failure to act (Blonk 1985, p. 97). Between 1985 and 1986, the Council of Ministers made decisions for the liberalization of road haulage. The existing discrimination on the side of any third parties due to bilateral quotas of truck rides was abolished in January 1992 with the help of a progressive and noticeable increase in multilateral joint quotas. In 1990, the truck transport tariffs in transnational traffic, which were created to protect the railway, were abolished and free market rates were enacted.

Compared to harmonization, which was subject to veto rule, liberalization was easier to achieve due to majority rule in the Council of Ministers. As a consequence, liberalization was realized without harmonization. For the establishment of equal market conditions, the important adjustment of truck taxes was not achieved until the turn of the millennium. In 1996, the tax burden for trucks in Europe ranged from 414 DM in Finland to 5,286 DM in Austria.[10]

As a result of liberalization, the truck fleet increased sharply to 15.7 million in the years between 1980 and 1990, and in 1998 reached just 20 million, whereas in the decade between 1970 and 1980, the number of trucks rose only by 3 million to 10.6 million. From 1990 to 1999, traffic performance in the EU climbed from 790 to 1,258 billion tons kilometer. This included 76% of traffic within distinct member states (Eurostat 2002a, p. 1 and Tronet 2002). Liberalization lowered transportation costs due to strong competition within individual countries. This enabled commercial freight haulage to secure its market share between 1985 and 1995 against transport on own account ("private carriers"). in all EU countries except Italy and Portugal.

[9] In England the market access and the pricing were liberalized since the 1960s, see Laaser 1991, p. 192).

[10] Data according to the Federation of German Long-Distance Hauliers. One US-Dollar equaled about 2.50 DM in the 1980s.

7. The European Domestic Market as logistics promoter

The establishment of the European Domestic Market on January 1, 1993, and the conversion of the EEC into the European Union (EU) involved the harmonization of fees, taxes, norms and regulations. Furthermore, it was characterized by the omission of border formalities for transnational freight haulage by truck. Until then, long delays at the borders were necessary for the compensation of various strict regulations in the member countries, which lead to long traffic jams for trucks.[11] The detailed investigations of the Cecchini Commission revealed that trucking companies suffered a loss of € 8 billion due to internal administrative costs and delays at the borders. This corresponded to approximately 2% of transnational goods value (Cecchini 1988). The waiting period reflected the processing of required documents at the border. These documents were related to different sales taxes and excise taxes, as well as varied sanitary and veterinary regulations for consumables. Moreover, different technical norms fragmented the market and impeded free goods traffic. Since 1993, those barriers with the exchange of goods and services no longer apply, and trucks can cross the borders without stopping.

The establishment of the European Domestic Market involved the liberalization of truck transport and lent strong support to the restructuring of a Europe-wide logistics and to the intensification of European division of labor. Industry locations and supplier plants could be dislocated because of powerful logistics. While until 1993, distribution systems of producers or trading firms were organized as national entities in Europe, the EU then enabled transition to a transnational form of organization with centers of distribution that were able to supply entire regions internationally. This can be best seen in the metropolitan areas of London, Paris, Brussels and Cologne. There are in total approximately 80 million consumers represented – while the regions around Paris, Brussels, and Cologne is also called "blue banana" in transport geography. A central warehouse in Brussels or Lille can supply consumers in less than 24 hours with a truck-based supply network, making these locations very attractive for logistics in Europe. Since the opening of the Channel Tunnel ("Eurotunnel") in 1994 (Gourvish 2006), the former mining town of Lille, is located in the center of the metropolitan areas. The connection Calais–Folkstone is built up with a commuter rail which transports trucks piggy-back through the tunnel. The train ride from Lille through the Eurotunnel to London takes 90 minutes, to Paris 60 minutes, and to Brussels 30 minutes. The rides via truck are comparable. In 1998, the commuter rail transported 704,000 trucks (Deutsche Verkehrszeitung, 6 February 1999).

The European countries which were cut off from the European Economic Community (EEC) show paradigmatically how integration into the West has stimulated the transportation economy. For this reason, the motorway has been not only a means of transportation but also a political symbol of a new Europe.

First of all, gradual integration into the European Union (EU) and expansion of the motorway network can be exemplified by Czechoslovakia, or the Czech Republic. While already in the 1930s, the Czech military realized the dangerous one-sided dependence of national defense on the railway, and tried to increase flexible transport

[11] In 1986, at the motorway border crossing Kiefersfelden from Germany to Austria, the Federal Government considered a truck's hold of 1,200 meter length as necessary, see Bundestagsdrucksache 10/5908, p. 2.

capacities with the truck, the country was, after 1945, initially subjected to the Soviet economic model (Oliva 2004). After 1980, the 300-kilometer long national motorway connection D1 between Prague – Brno – Bratislava could be put into service[12]. After the collapse of the Eastern bloc and the creation of the independent Czech Republic in 1992, the construction of the motorway D5 Prague – Pilsen – German border started, which was finished in 2006. This motorway was a traffic and logistics connection between the Czech Republic and Germany. When the Czech Republic joined the EU in 2004, the construction of the motorway between Prague and Dresden commenced.

Second, a similar process is to be found in the post-Franco-era in Spain. In 1975, the end of Franco's dictatorship, Spain had only motorways with a length of less than 1,000 kilometers, which consisted of unconnected parts[13]. Most notably, the capital (Madrid) was not connected with any coastal city. In 1980, the highway system reached the length of 2,000 kilometers. After Spain's entry into the EEC in 1986, the network was extended to more than 4,000 kilometers up until 1990 (see table 1). This had a direct impact on the transportation economy: In 1986, the number of trucks reached a value of 1.6 million, and the number of new truck registrations multiplied from 128,000 to almost double the amount, to 215,000 in 1988.[14] At the same time, the number of trucks which crossed the Pyrenees everyday increased from an average of 3,800 in 1986 to 20,000 at the turn of the millennium.[15] The traffic performance of the border-crossing traffic in Spain almost tripled from 12.2 billion tons kilometer in 1990 to 32.8 billion tons kilometer in 1998 (Eurostat 2002a, p.3).

8. Parcel services as pacemaker for the logistics industry

The evolution from the industrial to the consumer-oriented society has increased the importance of valuable manufactured goods compared to bulk goods, and was noticeable in the 1970s due to the increasing volume of sent parcels throughout Europe. During liberalization of transport markets in the US in the 1970s and 1980s, the parcel services UPS and Federal Express were founded, which pretty soon focused on a global operating area. The parcel services have created the package with a limited weight and limited measurements as a special segment of the transportation business. They built a network of cargo airplanes for long-distance transport, which was independent of the freight capacity of passenger airplanes (belly freight) (Campbell 2001).

In the 1970s, parcel services started operating in Europe. In Western Germany, UPS had to make a huge investment for their market entry. This was due to the restrictive regulations within Germany's road haulage law. Only local traffic companies were authorized within a radius of 50 kilometers. UPS had to buy many local traffic licenses to be able to operate in Western Germany.

The parcel services were promoters and pacemakers of the whole logistics industry and, with various innovations, they have paved the way to high performance logistics.

[12] Data according to http://www.dalnice.com/. I thank Mr. Oliva at the University of Bordeaux for this advice.
[13] Data according to ADAC Reisehandbuch 1975.
[14] Data of new registrations in Spain according to the archive DaimlerChrysler, Stuttgart. I thank Mr. Heintzer for his valuable support. Inventory data in: The Europa year-book 1988, p. 2328.
[15] Data according to Transport Consulting Nea, Amsterdam.

They have defined the basic parcel and introduced the objective of standardization to the transport industry. They have tightened transport, achieving domestic delivery within 24 hours, while traditional packaged goods networks show a delivery time of three days. They have implemented measures to guarantee the quality of service. They were one of the first industries to use barcodes, enabling the tracking and documentation of parcels within the system. In marketing, they introduced simple pricing models so that the customer could calculate the transport costs in advance. The complicated pricing models from the era of railway logistics have been overcome.

Up to 2000, parcel services showed high growth rates. They acted as competitors in the packaged goods sector and made much cargo shift to the parcel segment.

9. Conclusion: The Logistic Revolution

In the 1990s, logistics and transportation changed fundamentally: from a microeconomic point of view, logistics and transportation developed from an auxiliary function in materials management to an independent factor of production that would go onto coordinate world-wide supply chains. From a macroeconomic point of view, the rise of the logistics and transportation sector as an important employment sector is fundamental and a force for deepening the division of labor. We can almost speak of a logistics revolution caused by a co-occurrence of various developments:

1. The deregulation of truck haulage markets, air traffic markets, telecommunication markets and mailing markets coincided in the 1990s and strongly affected the private supply of logistics services in the transport industry, parcel services, and telecommunication services, all of which were responsible for the management of logistic networks.
2. The consumer-oriented economy has caused an increased variety of models in materials management, and has heightened the complexity of logistical processes in production and trade. Haulers as logistics service providers have been integrated into production processes.
3. Political developments have lead to a strategic realignment of distribution systems. Both the European domestic market, the collapse of the Eastern bloc, and the establishment of a market-based national economy required a new evaluation of previous logistical concepts in purchasing and sales. In this context, we can also speak of “Euro-Logistics”.
4. The process of globalization has established sites for the production of consumer goods outside of Europe and, at the same time, it has reduced transportation costs to a large extent because of the containerization of the global trade (Levinson 2006). Consumer goods trading took advantage of this new constellation and goods at the new production sites could be bought. This policy required a special import logistics in the harbors and a distribution logistics linked to it.
5. The concentration in food retail has grown considerably within the past years. Retail companies have built up their own specialized logistics systems.
6. Internet-based information systems, created in the 1990s, have drastically simplified and cheapened the exchange of information. They have contributed to the acceleration and precise management of material flows in the logistics supply chain. Internet-based mail order businesses have strengthened parcel services.

7. The reliability and affordability of transport processes, which accompanied the logistics revolution, has increased the division of labor between the various production stages, leading to a displacement of production sites and to their integration into supply chains. This influence of modern logistics concepts on national economies is summarized by the term "logistics effect".

The logistics revolution has been complemented theoretically by the concept of Supply Chain Management created in the 1990s, which takes the entire and probably global supply chain into account instead of optimizing an economic function just locally. With this approach, the logistic revolution has found its theoretical conclusion (Christopher 2005).

The development of logistics was up to the year 2000 a classical success story. There seemed to be no high barriers against expansion. But, many traffic experts saw the rise of truck traffic within Europe critical, taking the environmental costs of truck transport into account. In the European Community a long debate arose, how to identify and to charge these costs as part of the motorway toll. But before the year 2000, in Germany one could drive a truck on a motorway without any toll. Also car drivers and the public regarded trucks as troublemakers and exerted pressure on politics to restrain trucking. The consumers demanded on the one hand a broad selection in the shops, but did not recognize, that this service was almost impossible without truck delivery – at least when the railways did not provide service of high quality. Austria and Switzerland imposed many restrictions on Alps crossing truck traffic. The issue of "green logistics" with a broad bundle of goals entered the scene of traffic policy not until the year 2000.

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Warehousing in Europe - Northern actor perspective

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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.

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; Hilletofth 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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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 throughly 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 (Guneri 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).

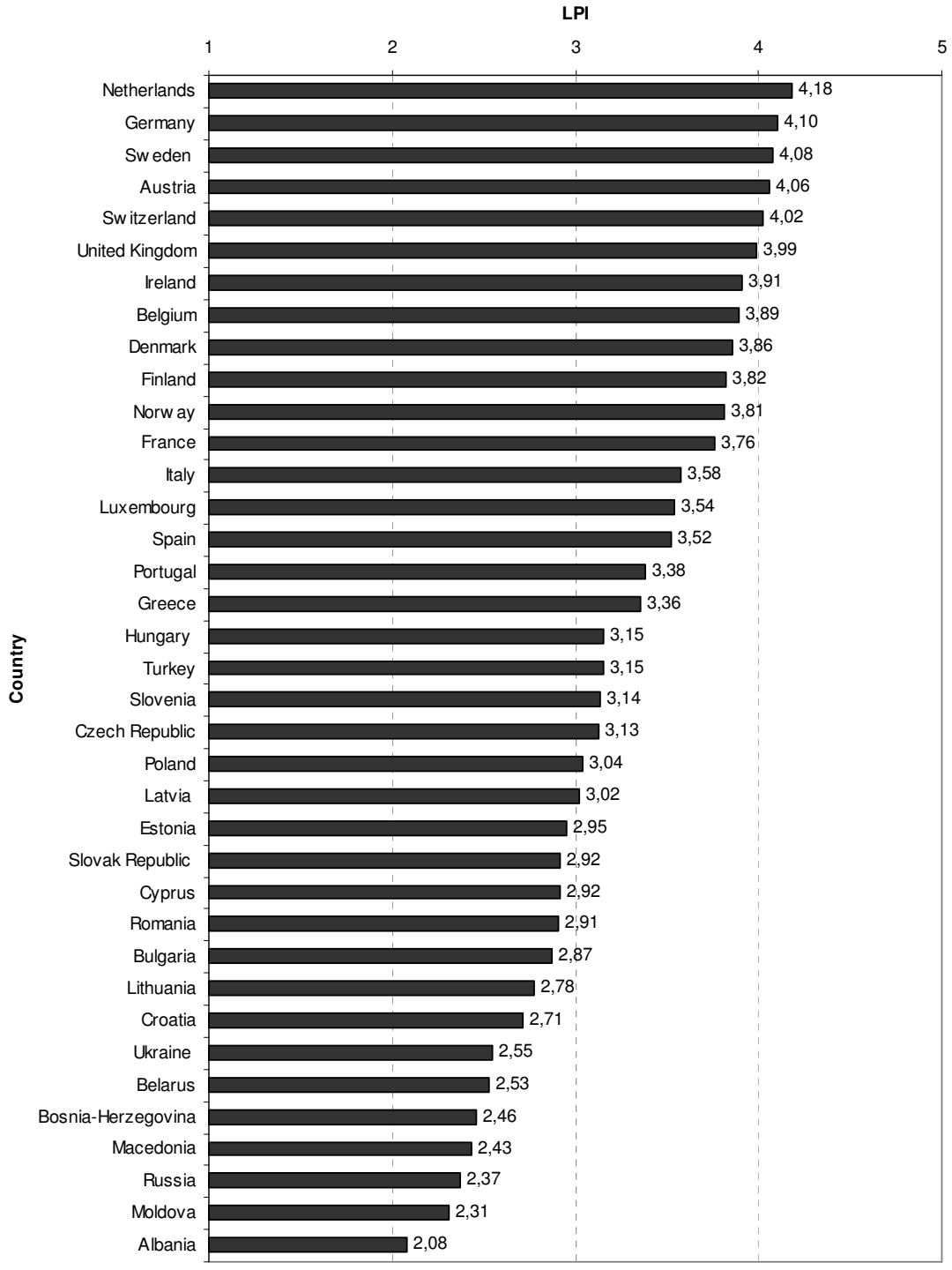

Figure 1: European countries from the perspective of LPI (Arvis et al. 2007).

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.

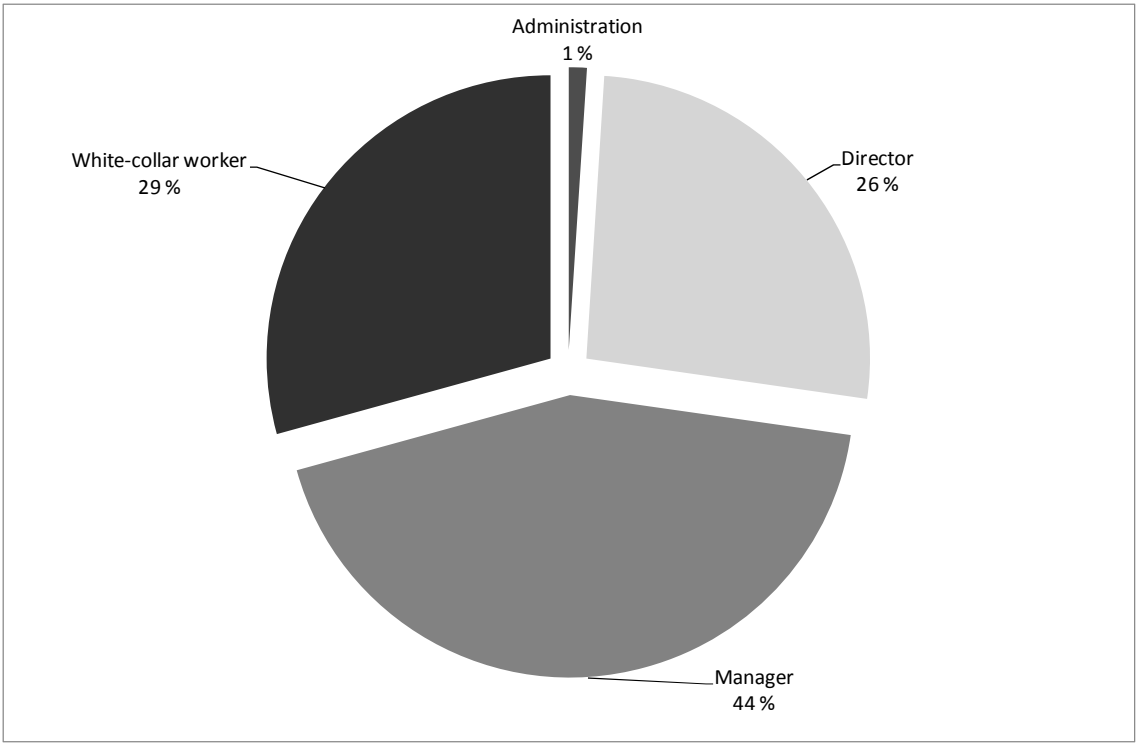

Figure 2: Respondent position in company within both surveys (years 2006 and 2009).

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

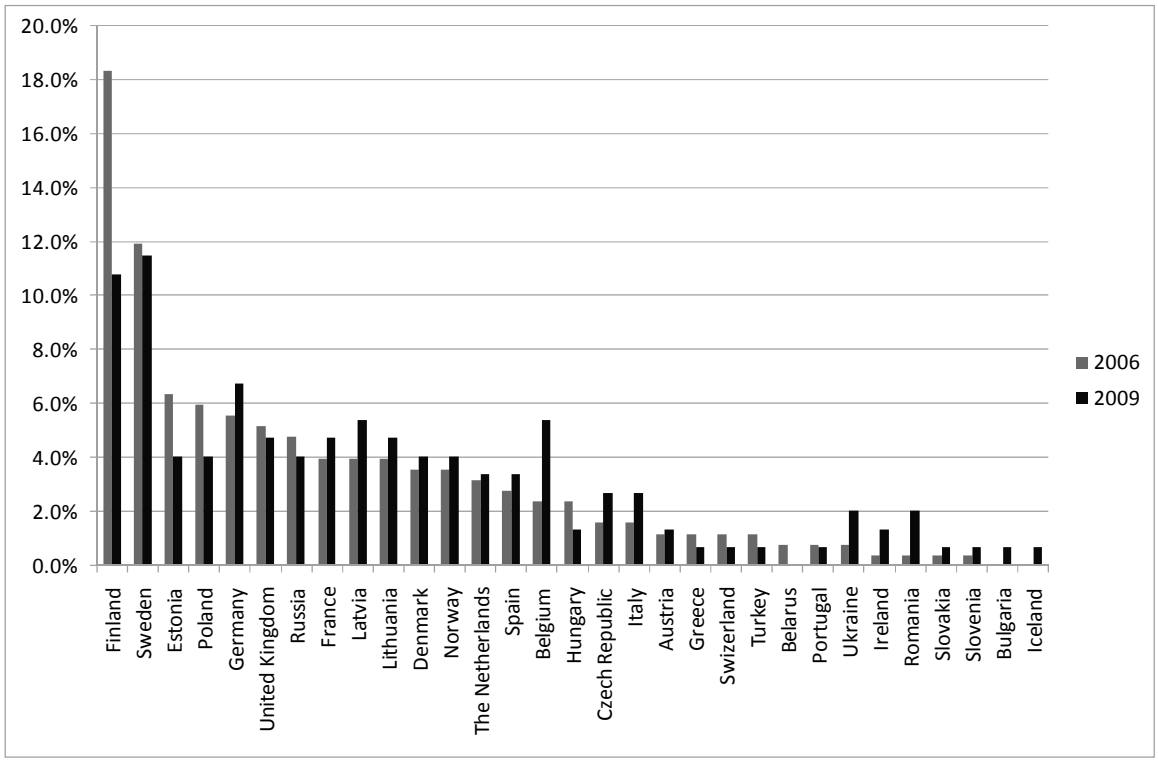

Figure 3: Location of warehouses of all responses during both observation years in Europe in descending order of the initial survey round (year 2006).

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	
2006 (should be)	Yes	No
FIN	49.1	104.9
SWE	30.9	66.1

	CEE/CIS	
2006 (act.)	Yes	No
FIN	64	90
SWE	16	81

Chi Square Test:
0.000

	CEE/CIS	
2009 (should be)	Yes	No
FIN	34.5	72.5
SWE	13.5	28.5

	CEE/CIS	
2009 (act.)	Yes	No
FIN	43	64
SWE	5	37

Chi Square Test:
0.001

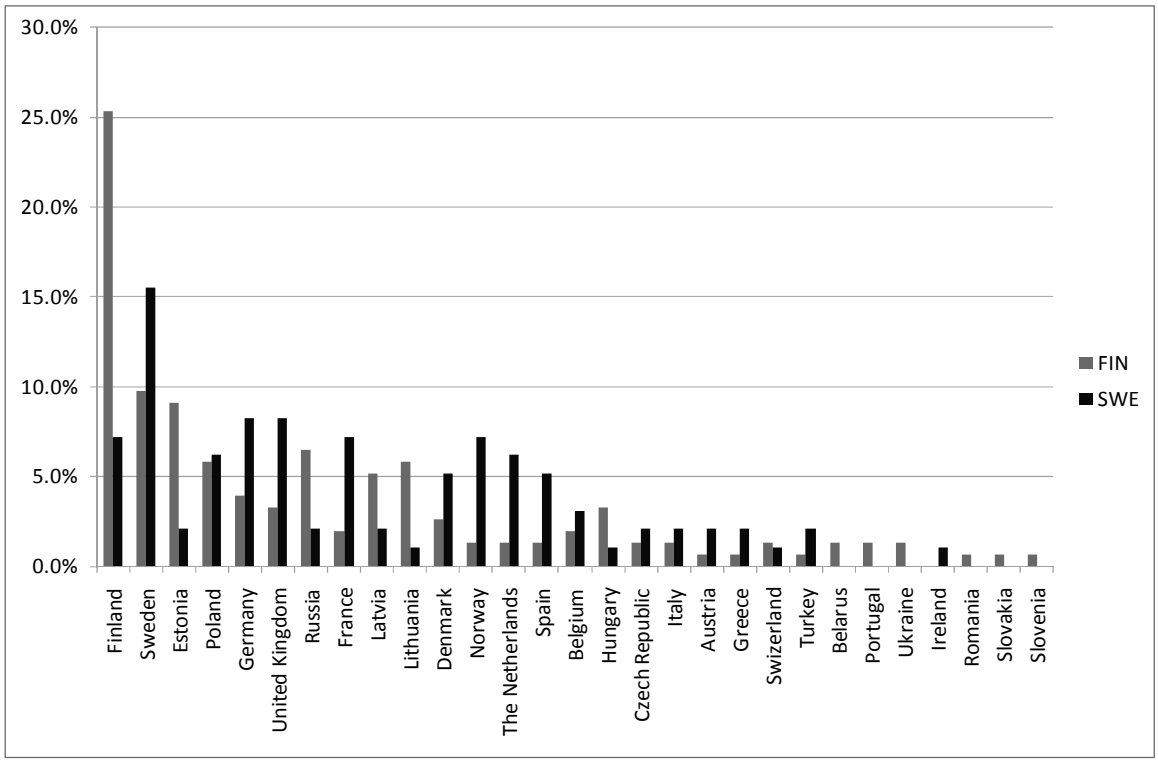

Figure 4: Location of warehouses of Finnish and Swedish companies in Europe in descending order (n = 55), year 2006 responses.

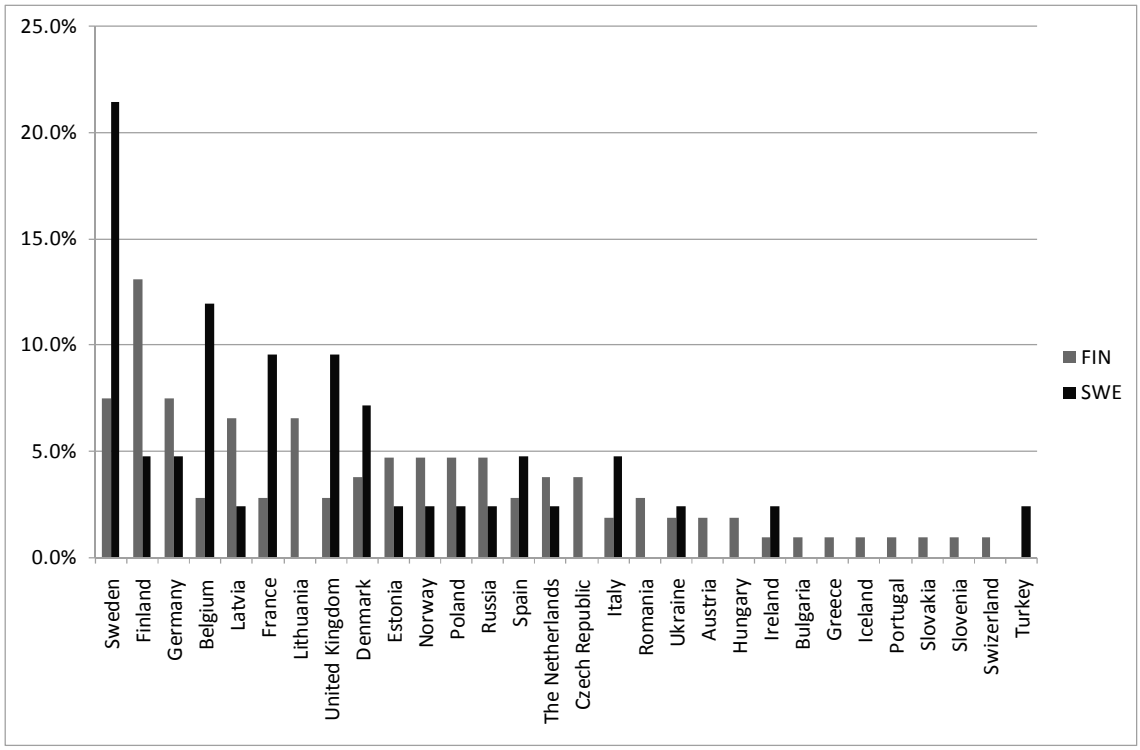

Figure 5: The location of warehouses of Finnish and Swedish companies in Europe in descending order, year 2009 responses (n = 31).

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.

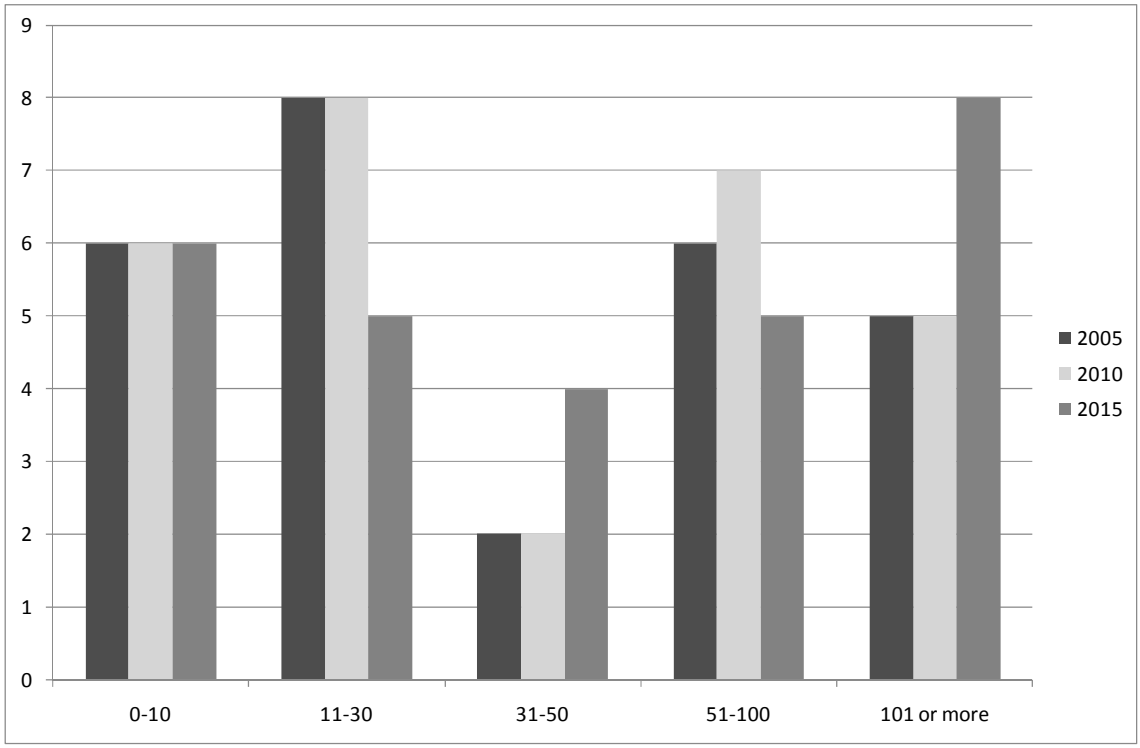

Figure 6: Employment (size) of warehouses concerning both countries using year 2009 responses (n = 28).

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 spesific 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 spesific 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

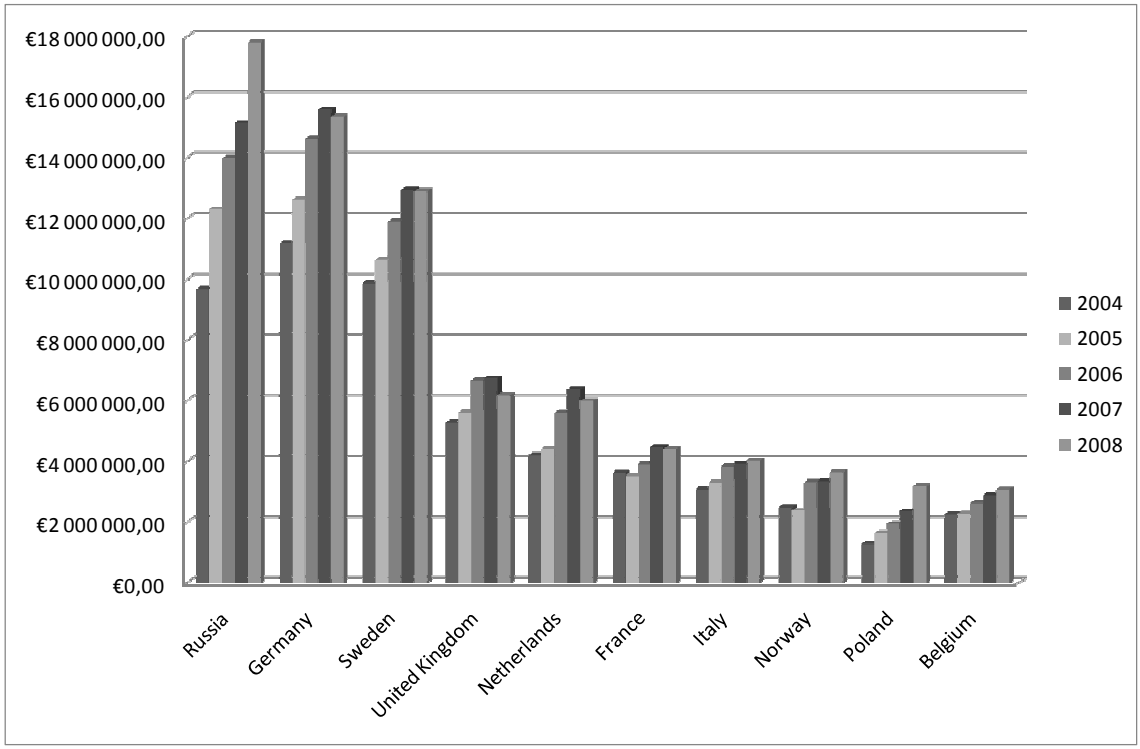

Figure 7: Ten most important foreign trade partners (total import and export) of Finland with larger Europe during years 2004-2008 (thousand euros).
Source: Finnish Customs (2009).

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.

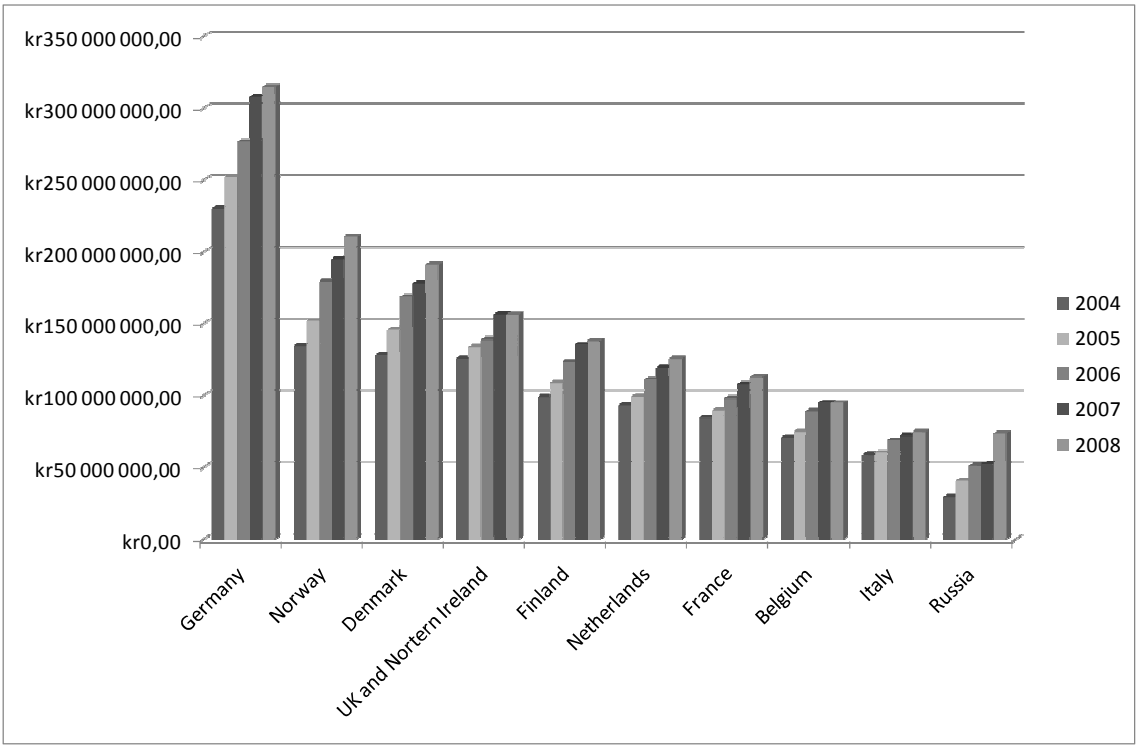

Figure 8: Ten most important foreign trade partners (total import and export) of Sweden with larger Europe during years 2004-2008 (thousand krona).
Source: Statistics Sweden (2009).

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	**Environmental aspects:** environmental regulations, proximity to diposal plant, taxation	**Cost:** operating, start-up	**Quality of living:** climate, crime rate, traffic congestion, living expense	**Local incentives:** tax incentives, union, laws, skilled labour	**Time reliability provided to customers:** proximity to carriers, proximity to suppliers, proximity to customers, waterway, rail, highway	**Response flexibility to customer demand:** proximity to suppliers, proximity to other company's complementary facilities, proximity to customers	**Integration with customers:** facilitation of post-sale service, facilitation of comakership, facilitation of co-design	analytic hierarchy process	Empirical, obtained through group work
Melachri-noudis, 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	Labor quality	Labor-management relations	Linear physical programming	not specified
Chen (2001)	method development for distribution center location selection	Investment cost	Expansion possibility	Availability of acquirement 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	**Environmental aspects:** environmental regulations, proximity to diposal plant, taxation	**Cost:** operating, start-up	**Quality of living:** climate, crime rate, traffic congestion, living expense	**Local incentives:** tax incentives, union, laws, skilled labour	**Time reliability provided to customers:** proximity to carriers, proximity to suppliers, proximity to customers, waterway, rail, highway	**Response flexibility to customer demand:** proximity to suppliers, proximity to other company's complementary facilities, proximity to customers	**Integration with customers:** facilitation of post-sale service, facilitation of comakership, facilitation of co-design	analytic hierarchy process	Empirical, obtained through group work
Melachri-noudis, 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	Labor quality	Labor-management relations	Linear physical programming	not specified
Chen (2001)	method development for distribution center location selection	Investment cost	Expansion possibility	Availability of acquirement material	Human resource	Closeness to demand market			Fuzzy decision making	Non-empirical numerical example

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Review of underground logistic systems in the Netherlands: an ex-post evaluation of barriers, enablers and spin-offs

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Abstract

Now, 10 years after the first plans, we analyse in this paper what has happened with Underground Logistic Systems (ULS). The major question in this paper is: Which barriers and enablers led to the failure of ULS and what ULS spin-offs can be found nowadays? Several factors can be classified as barriers or enablers. The main conclusions that can be drawn are that the opportunities for try-out were too limited; political support could have been gained on higher levels; the costs were too high, the catchment area was too limited; ULS in itself is a very promising system, but there was no one clear goal. In particular, the lack of a thorough and positive business model in combination with a lack of sufficient freight volumes almost immediately guaranteed the failure of the initiative. The spin-offs seem to have taken place in different directions: ranging from rather soft impacts (e.g. scientific knowledge) to more hard developments (adopting and developing transport and tunnelling technologies), and, although difficult to quantify, they are of great value.

Keywords: Innovation management; Underground freight transport.

1. Introduction

In the 1990s, a research project was carried out in the Netherlands that focussed on underground freight transport for Schiphol airport. The title of the project was 'Ondergronds Logistiek Systeem' (Underground Logistic System or ULS). Several aspects of the innovative concept were researched in detail, and it was planned to have a system operational by 2005. Now, approximately 10 years after the first plans, it is

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interesting to see and analyse what has happened with the ULS. At first sight, it can be seen that the initiative is no longer alive. With the help of frameworks used to forecast potential success of innovations, post-innovation failure can also be analysed. Several publications (Wiegmans, 2005; van der Straten et al., 2007; Wiegmans et al., 2007) have dealt with the potential success of innovations in transport. Failure of innovations is not often researched, which is logical as people prefer to focus on success. However, analysing failure might bring insight into future success. And although not successfully implemented, ULS might have had considerable spin-off effects to other projects and/or transport sectors. The focus here is on the success and failure aspects of ULS. The problem analysed in this paper is as follows: *Which barriers and enablers led to the failure of ULS and what ULS spin-offs can be found nowadays?* First, the paper will discuss the characteristics of ULS. Secondly, a theoretical framework will be presented that consists of three elements: product characteristics; user requirements; and the innovation system, which all determine the success potential of transport innovations. Thirdly, ULS will be post-evaluated and reasons for failure will be identified. Furthermore, ULS spin-offs will be identified and analysed. The paper ends with some conclusions.

2. Underground logistic systems in the Netherlands

Underground freight transport deals with automated transport of general cargo by vehicles moving through an underground tunnel network. Because fundamental changes in the organisation of sending and receiving actors are necessary, underground freight transport in the Netherlands is also called underground logistic systems (ULS).

The history of ULS

In the 1970s, ideas were developed in the Netherlands for high-speed transport systems underground. In 1987, the International Systems Development and Support (ISDS) foundation developed the Integral Transport System (ITS) concept, a transport system that consists of a long-distance (more than 200 kilometres) underground high speed network (for passengers and freight), combined with local short-distance collection and distribution networks (only for freight). Between 1987 and 1993, several projects, financed by the national transport department, studied this concept in more detail.

In 1994, the Dutch Governmental Programme for Sustainable Development (DTO) organised several round-table discussions with experts and concerned stakeholders on sustainable technologies for transport in the future (Grontmij, 1994). Within the framework of this research programme, a definition study (Haccoû et al., 1996) was carried out to determine the feasibility and sustainability of underground transport in more detail, and to define the field of application. The study concluded that in the field of urban freight transport, no alternative sustainable transport modes were available except underground freight transport (compared with rail and waterborne alternatives that are available for long-distance transport). This study demonstrated that in urban areas underground freight transport was potentially a sustainable and competitive application. The next step, within the framework of the DTO, was to design a logistic

concept for underground freight transport within urban areas, and to define an implementation strategy. The work was carried out in 1996 and 1997 in the project 'tube transport of freight within urban areas' (Brouwer et al., 1997). The resulting concept was based on small tube-networks as a new, sustainable, logistic concept for commodity transport within urban areas.

Meanwhile, in 1995, private companies started two other underground freight projects. The Unit Transport by Pipe (UTP) project was based on a medium-distance (approximately 100 kilometres) underground connection for mini-containers between the seaports of Rotterdam and Antwerp (Raadgevend Ingenieursbureau Lievense et al., 1995). Another project, the ULS-project, dealt with the feasibility of an underground transport network for air cargo and flowers which would connect Schiphol Airport to the flower auction in Aalsmeer and a new rail-terminal in Hoofddorp. The ULS would make a seamless connection between air, rail and road possible. The feasibility scan, completed in 1996, concluded that the ULS could make an important contribution to the improvement of the accessibility of the Schiphol area, and could reduce the pressure on the environment. A second study, completed in 1997, focussed more on defining the direction of the project. This study produced some further financial and technical transparency and confirmed the findings of the feasibility scan. The (conceptual) design of the system was started in 1997 and continued through 1998 and 1999. A test site was realized in 1999 in Delft (the Netherlands) to test prototypes of the various automated vehicles and handling systems and to develop and test the control system (Pielage, 2005; Pielage and Rijsenbrij, 2005). These studies attracted the attention of a number of Dutch politicians, including members of the Dutch parliament. The Interdepartementale Projectorganisatie Ondergronds Transport (IPOT, Interdepartmental Project-team on Underground Transport), a government task force for the study of underground transport, was formed. In phase 1, the IPOT task force started by making an exploratory study of the feasibility of underground freight transport. Phase 2 concentrated on feasibility studies of local applications of underground freight transport systems, such as for industrial purposes in the area of Schiphol, Geleen and Arnhem/Nijmegen, and for the distribution of consumer goods in the urban areas of Twente, Utrecht, Leiden and Tilburg. Phase 3 concentrated on developing an overall nationwide concept for the Netherlands (IPOT 1998, 1999, 2000). In 2001, the Minister of Transport published a memorandum in which the development of underground freight transport was described as promising and that further development was necessary before it could be implemented as a measure to reduce or avoid congestion on the road infrastructure. The tests and development of the control system needed for ULS were carried out at the Connekt Test Site (formerly known as the ULS Test Site) at the Delft University of Technology. At that time, the ULS Schiphol project and Tilburg were still in progress, although it was considered that parts of these systems would not be built underground but on the surface as an automated system, using dedicated lanes.

ULS applications

Underground freight transport can have an important function as an alternative for road transport, for instance in the combined development of intermodal freight transport by rail or inland navigation and in urban freight transport.

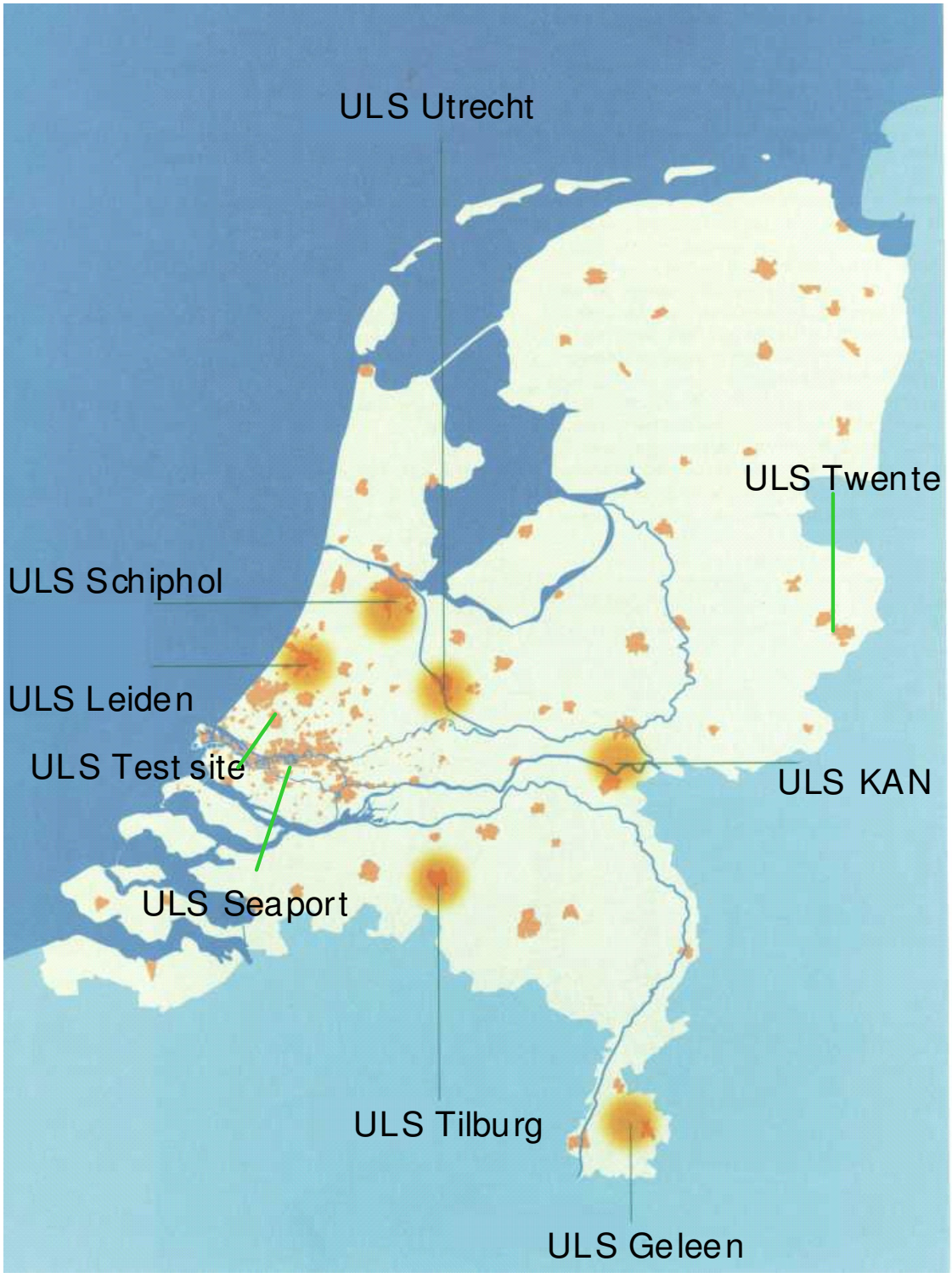

Figure 1: ULS projects in the Netherlands.
Source: Visser (1999).

The following applications can be mentioned (Visser and van Binsbergen, 2000):

1. In urban areas, for provisioning post offices, retail trade, catering establishments, office, and consumers. This application concerns the transport of load-units of pallet size. The feasibility of this application was researched in Dutch cities, (Utrecht, Leiden and Tilburg), in Japan (Tokyo), and in the UK (London).

2. Inside or between industrial complexes, logistical centres, and multimodal terminals, such as airport and harbour complexes. This application concerns the transport of load-units such as pallets, maritime containers and aircraft pallets. ULS Schiphol in the Netherlands is one example of this application.
3. Collection or long-distance transport of agricultural products, ore and solid waste. For this purpose, capsule pipelines have been developed and applied in Japan, the USA, and Russia.
4. Hinterland or cross-country transportation of maritime containers. Studies have been done in the USA but nothing has been put into practice.

ULS – as developed in the Netherlands – were in fact developed for the first two basic applications, but mixed applications are possible. The second application, the connection of industrial and logistical complexes to multimodal terminals, is intended to improve long-distance transport by rail or by inland navigation. Many of these complexes have no direct rail or inland navigation connection. A direct connection is often not possible. By establishing a ULS between these complexes and a rail or inland navigation terminal, an efficient, fast and relatively cheap connection can be provided, so that transport by rail or inland navigation becomes a realistic option.

(Dis)advantages

The concept combines the advantages of taking the traffic movements underground and applying electrical propulsion, with the economic advantages of unimpeded automated transport over a dedicated infrastructure that is separated from passenger traffic. The economic advantages are to be found in an almost direct delivery in the Schiphol area (no more need for round trips with mixed cargo), 24 hour service, relatively low variable and exploitation cost, and short turnaround times. Other advantages concern the lower (local) environmental burden, resulting in reduction of noise, visual pollution, and emissions, reduction of congestion problems, reduction of energy use, and a related reduction in CO_2 emissions, more intense use of available space, and an increase in traffic safety. On the other hand, a completely new underground infrastructure must be provided. This requires high investments, a long realisation time, and much fine-tuning with (local) stakeholders. However, the balance of the advantages and disadvantages was not decisive enough, and the ULS project was finally put on hold in 2002 (Pielage, 2005). The question therefore arises: Which barriers and enablers have influenced this decision?

3. The theory on the adoption of innovations

An ULS can be seen as an innovation, because an innovation is defined as an idea, practice, or object that is perceived as new by a unit of adoption (Freeman, 1989). Every innovation goes through an innovation development process (Rogers, 2003). Also in the case of ULS this process can be described in several phases: An ULS evolves (phase 1) from the recognition of the increasing level of congestion and air pollution caused by freight and passenger transport. This increase has led to a need for an alternative and more reliable (underground) transport system. Through applied research (phase 2) a new alternative (ULS) has been developed that under ideal conditions, contributes to reduced

congestion and emissions of hazardous pollutants. This ULS is first introduced in a so-called niche market such as the Schiphol area (phase 3) to demonstrate the concept. As a result of this niche market demonstration the technology can be diffused and adopted (phase 4) by other units of adoption. So far, no introduction has taken place and it is not to be expected that this will happen in the near future. In order to analyse this lack of adoption, ULS will be analysed with respect to three elements (based on Wiegmans et al, 2007 and Van der Straten et al, 2007): product characteristics; user requirements; and innovation system (the framework within which innovations are created). Adoption is the outcome of an innovation decision process to completely use the innovation as the most suitable option. This process is a mental one through which the unit of adoption passes from first knowledge of an innovation to a decision to adopt or reject that innovation (Rogers, 2003). This innovation-decision process, or process of adoption, has 5 different stages briefly discussed below. The knowledge stage occurs when the unit of adoption, in this case actors in and around Schiphol, are exposed to the ULS and gain understanding of how the ULS functions. If this knowledge is considered relevant to the unit of adoption than the persuasion stage can begin. At this stage, the units of adoption form a favourable or unfavourable attitude towards the ULS. Characteristics of the innovation are especially important at this stage. The next stage is the decision making phase. When the decision is made to adopt the ULS, the implementation stage follows directly. In the final stage, the confirmation stage, the adopter evaluates the decision taken to adopt the innovation.

On the basis of ten interviews with experts who were involved in ULS, we aim to reconstruct the recent history of ULS, in order to analyse enablers and barriers to adoption. An enabler for adoption can be seen as any aspect that stimulates the adoption of ULS by an adopting unit where ULS is not in operation (adapted from van der Straten et al., 2007). Clearly, a barrier towards adoption could represent any aspect that inhibits the successful implementation or realisation of ULS in a certain area. Most of the variance of adoption of innovations is explained by the five attributes of innovations (product characteristics): relative advantage, compatibility, simplicity, try-out (or trial ability) and opportunities to observe. Rogers (2003) deservedly defines the attributes of an innovation as 'perceived' because he thinks it is the receiver's perception of attributes of innovation and not the actual attributes as classified by experts that affect the ease of transferring. Innovation studies, literature and research widely support the influence and validity of these perceived attributes of innovation (Holloway; 1977; Moore and Benbasat, 1990; Kearns and Huo, 1992; Goldman, 1992). In this research, the perceived product characteristics (attributes of innovation): compatibility, simplicity, try-out, context consistency, and relative advantage are used in the theoretical model. In addition to the product characteristics, two other characteristics categories that partly explain the adoption of an innovation are added: 1) user requirements (the relative advantage) and 2) the innovation system. For transport research, the relative advantage is often 'translated' into quality aspects of transport (Wiegmans et al, 2007). Quality aspects that we consider for the ULS are (based on Wiegmans et al, 2007): reliability, costs, efficiency, flexibility, safety/security, speed, and catchment area. The innovation system that focuses on the support of different actors in the innovation system could have three different aspects that apply to the ULS (adapted from Brouwer et al, 1997): 1) project complexity; 2) project management, and; 3) clear goals. Together, these three areas lead to our research model that structured the interviews with the experts (see Figure 2).

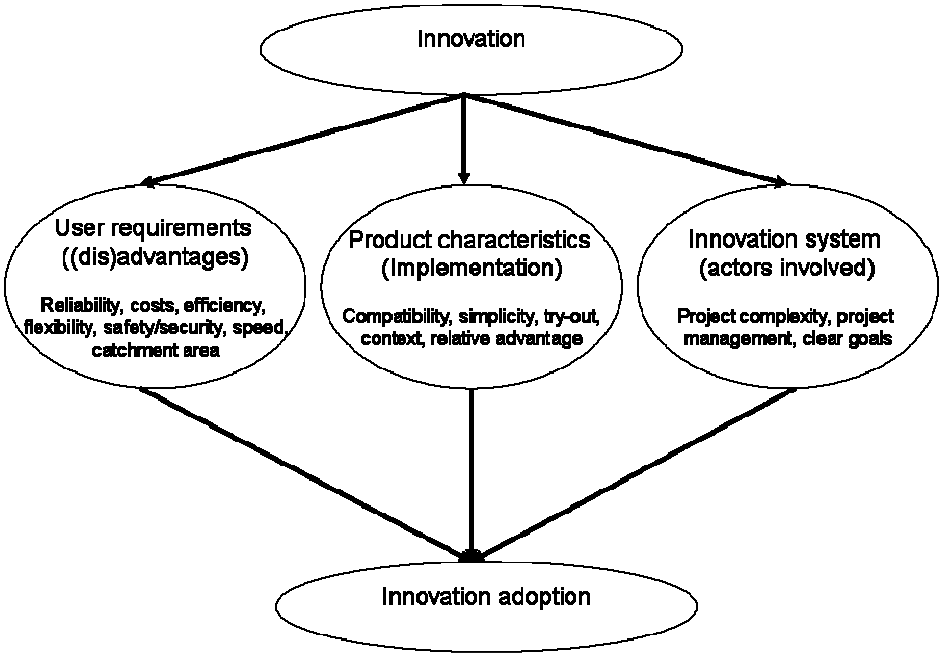

Figure 2. Research model
Sources: Based on Rogers (2003); Cardebring et al. (1999); IQ (1997); Konings and Ludema (2000); Wiegmans (2003).

3.1. Adoption of ULS: product characteristics

In this research study, the perceived attributes of innovation (product characteristics) – compatibility, simplicity, try-out, context consistency, and relative advantage – are used as the basis for the interviews and the ex-post evaluation. *Compatibility* refers to the degree to which an innovation fits into existing infrastructure (technological). The degree of compatibility of an innovation, as observed by the actors involved, correlates positively with the degree of adoption of this innovation. An idea that is more compatible is less uncertain to the potential adopter and fits more closely with the situation of the individual. Diffusion research suggests that compatibility may be a little less important in predicting the outcome of the decision to adopt than the relative advantage (Rogers, 2003). The ULS is technologically different from the transport modes already in operation. To determine whether or not the compatibility with the infrastructure is an enabler or barrier one has to look if changes have to be made to the existing infrastructure, and thus if supporting infrastructure has to be built. *Simplicity* is the degree to which an innovation is perceived as relatively easy to understand and use (Tidd et al., 2001). The simplicity of an innovation, as perceived by members of the system, is positively related to adoption. In general, simplicity is less important than relative advantage or compatibility (Rogers, 2003). ULS might be based on a different kind of technology, which is new to the freight transport sector. When ULS is easily understandable and no new knowledge is needed, then this can be seen as an enabler for adoption. *Try-out* refers to the degree to which an innovation can be experienced and tested (Rogers, 2003). Try-out is the degree in which an innovation can be experimented with on a limited, free of charge or no cost basis (Tidd et al., 2001). The try-out opportunity, as perceived by members of the system, is positively related to adoption.

The possibilities to 'try out' an innovation, as perceived by members of the system, is positively related to adoption. The variable *context consistency* is defined as: 'the degree to which ULS is perceived to be consistent with the existing values, experiences from the past, the needs of potential users and beliefs in the context of freight transport' (Rogers, 2003). The *relative advantage* can be seen as the degree to which an innovation is perceived as better than the product it replaces, or competing products (Tidd et al., 2001). Relative advantage has been found to be one of the strongest predictors of the outcome of the decision on whether or not to adopt. The relative advantage of an innovation, as perceived by members of the system, is therefore positively related to adoption. The nature of the innovation determines what specific type of relative advantage is important to adopters. In this study, we do not take the relative advantage as a separate attribute, but we operationalise it through the user-requirements.

3.2. Adoption of ULS: user requirements

The success potential of innovations must be determined in order to select the most promising innovations. A second category of characteristics that determine the success potential are user requirements. The user requirements for ULS will have to do with changes that lead to a better transport quality. The main drivers of transport operations are costs, reliability, and speed (Wiegmans, 2003). The implementation of ULS probably also strongly depends on improving these drivers. Several other criteria can be found in transport research (Cardebring et al., 1999; IQ, 1997; Konings and Ludema, 2000; and Wiegmans, 2003): reliability, costs, efficiency, flexibility, safety, speed, space saving, and automation. Worrell et al. (1997) mentioned fuel efficiency and costs as general success criteria. Hekkert and Harmsen (2001) used system dependability as a criterion to compare innovations. Tsamboulas and Dimitropoulos (1999) identified the nodal centre's size, catchment area, and the level of political support for the investment as the main decisive factors for choosing the appraisal method and decision criteria for investments in container terminals. The following criteria have been selected to analyse the user-requirements: reliability, costs, efficiency, flexibility, security/safety, speed, and catchment area. Reliability is the degree to which ULS meets the agreed service time. Innovation costs are the investment costs involved in purchasing ULS and the exploitation costs incurred after purchase. Efficiency refers to the degree to which ULS is able to perform the operations efficiently (as compared with truck transport). Flexibility is the degree to which ULS is capable of solving problems for customers when they arise. Safety/security refers to the safety and security of ULS. Speed refers to the number of load units per time unit that ULS is capable of handling. The catchment area of ULS refers to the average distance of the shipments that ULS might be able to attract.

3.3. Adoption of ULS: the innovation system; actors and project management

In the beginning of the Governmental task force IPOT, meetings were held with national and international experts, and the literature was reviewed to define the critical enablers of and barriers to the innovation system of ULS. From experiences in Japan it was learned that it is important to involve the right stakeholders in the process and, in particular, an influential private stakeholder as a driving force. Innovations, from Sony's

Walkman to Toyota's Prius show the importance of a stakeholder, who believes in the innovation and acts as the driving force. The other critical factor was learned from earlier innovation projects in the field of transportation, such as combi-road (an automated transport system for moving containers on road and rail over longer distances), and can be described as 'support from society'. Social and political support is greater when people and politicians actually know and are able to see that the innovation works and performs as promised. The third critical success factor requires that the right conditions are created for successful implementation (van Binsbergen and Visser, 2001). Society is built on the basis of current transport systems and is seldom ready for new revolutionary innovations. In order to fulfil these success factors Brouwer et al. (1997) described the implementation strategy for ULS in urban areas. Derived from this framework, innovation management system characteristics that have been selected for the analysis are: project complexity, project management, and clear goals. Project complexity: The complexity of a project depends on different factors, such as the required functionality of the design, the conditions in which the product has to perform, the number and type of actors and the required technologies. In order to show the difference, a total redesign of a transport system is a much more complex and ambitious project to manage than, for example, a new design for an existing car type. Project management includes complementarity, multidisciplinarity and competence. A critical success factor for an innovation trajectory is project management and the available skills in the project team. Complementarity and multidisciplinarity within and between project teams are key words. The competence of the team members or the members of an industrial consortium are a key factor. Clear goals: Innovation projects often fail because of vague or unclear project objectives, too many objectives, or objectives that change during the course of the project. Setting objectives is important. It focuses the project on specific aims over a period of time and can motivate staff to achieve the objectives set.

4. Ex-post evaluation of barriers and enablers

The ULS-project (Schiphol) is well documented in terms of feasibility studies, design studies and project reports. No ex-post evaluation has taken place since the project was halted. As a first effort, this evaluation is based on ten interviews with employees from firms of consultants, engineering companies, industries, universities, and responsible authorities at the national Department of Transportation who were involved in the project.

4.1. Analysis of the product characteristics

From the theoretical framework, the characteristics compatibility, simplicity, try-out, and context consistency will be evaluated. ULS Schiphol was largely based on proven-technology to make it compatible and was designed as a dedicated, solitary system for freight. This means the semi-continuous transport of smaller amounts of standardised load units 24 hours a day in an enclosed environment. Much attention has been given to make the system compatible with load units that are traditionally used by the shippers (AC pallets, roll cages). Less attention was given, however, to the connecting

infrastructure and to the availability of sufficient freight volumes. Particularly in the beginning, the system must operate as link in an intermodal system. Only in a limited number of situations, referred to as the 'niche-markets', is it possible to build a door-to-door ULS. Transhipment is needed which reduces the overall performance of the ULS and is an important cost factor. Therefore, it also became quite a design challenge to create the right transhipment facilities for ULS. The solution was found in automating the transhipment process. However, it has never been tested in pilot projects to see if it actually worked. Overall, the respondents perceive compatibility neither as a barrier nor as an enabler to successful adoption.

Although the overall concept of ULS was complicated, it was reasonably easy to understand (simplicity), despite the fact that part of the design was based on quite innovative technologies. Existing technologies combined with new technologies provided the basis for a totally new system. The new technologies were partly based on upscaling existing automated transport systems, such as the AGV-technology used at ECT seaport terminals in Rotterdam and the smaller AGVs in automated distribution centres. Much energy has been put into visualising the concept (3-D graphics and simulation, etc). Overall, the respondents perceive simplicity in a mixed way. The perception 'neither as a barrier nor as an enabler to successful adoption' has the most support from the respondents, followed by 'barrier'.

Try out possibilities for the ULS-system were considerable, although the complete system has never been built. The opening of the ULS test site where trucks were tested was a good start but it never came to a complete real-life pilot. The test site was very helpful in testing parts of the system but a pilot should be more than testing the technology: the system should have to prove itself in a real life situation with real users. The costs acted as the main barrier to set up a real and fully operational pilot of a complete ULS system. According to the respondents, try-out possibilities acted as a barrier for the successful adoption of ULS.

The context consistency acted as a barrier. The freight transport and logistics industry is a relatively conservative and very competitive industry with many small and some large companies with rather low margins. The freight transport industry showed a limited interest in the ULS-projects. There was a lot of public attention and interest from national, regional and local public authorities. According to the respondents, more could have been done with respect to the political aspects; one of the main problems indicated is that the political decision makers should have been involved at much higher levels than was the case at that time. From a technological point of view, ULS was the next phase in automation within the logistics supply chain. However, for the period concerned, ULS was maybe a little too 'modern'.

From the interviews, it can be concluded that compatibility and simplicity neither acted as a barrier nor as an enabler (see Table 1). In order to increase the chances for the successful adoption of ULS, the compatibility and/or simplicity should be improved. Try-out possibilities clearly acted as a barrier for ULS Schiphol. Several separate parts of ULS Schiphol have been developed and tested. However, a complete real-life system has never been built and tested. The context consistency also acted as a barrier. The ULS system was maybe rather too sophisticated in the time period concerned. Furthermore, the political support should have been gathered on a higher level.

Table 1: Interview results of the product characteristics.

	1	2	3	4	5	6	7	8	9	10
compatibility	E	B	0	0	0	0	0	0	0	B
simplicity	B	E	B	0	0	0	0	B	E	B
try-out	E	0	B	B	B	0	B	B	B	E
context	B	B	0	B	0	0	B	B	B	B

Notes: E = enabler; B = barrier; 0 = neither barrier nor enabler (neutral).
Source: 10 interviews were held with Ondergrondse Logistieke Systemen experts.

4.2. Analysis of the user-requirements

In theory, ULS performed rather well compared with existing freight transport modes. An important issue was (and still is) that it was unclear how these advantages would be valued by the proposed future customers. ULS Schiphol performed well in terms of reliability. This was clearly an enabler for the system. The main points of concern were occasional disruptions and maintenance. Calculations showed that the high number of vehicle kilometres driven every day would cause a disruption once every week. Given the high capacity of the system, this was acceptable. However, for the customers it would be a problem to have a disruption once a week.

The investment costs in tunnels were too high, in particular because these costs could not be shared with other users, as is the case with other transport modes. It was expected that the government would finance the investment costs, but that did not materialise. This led to an overall cost picture that was unacceptable to both political and private actors. ULS performed quite well in terms of operational costs. On average, calculations showed that the costs were 25 percent below those of a road transport service (with a depreciation period of 50 years). A main problem in the cost area was that the project was perceived by many involved actors as a technological project and the economics were not perceived as an equally important issue.

Improving the overall efficiency of freight transportation was an important objective. The tests showed that the system performed well. Even the loading and unloading, one of the major concerns, performed well. The actual loading and unloading had to be measured in seconds rather than minutes as was first expected. Overall, the respondents perceive this neither as a barrier nor as an enabler.

In itself, the system was quite flexible. It was an open standard and many different loads could be transported. However, the construction time and the long-term investment in the infrastructure made it quite inflexible compared with road transport. Overall, the respondents perceive this neither as a barrier nor as an enabler.

Much attention was paid to safety and security issues. Protocols were designed. Because of the enclosed environment, the system performs better than existing transport modes. Overall, the respondents perceive this neither as a barrier nor as an enabler.

The maximum speed of 30 km/h was no limiting factor to compete with single/mode road freight transport over relatively small distances. At these distances, speed is not an issue. The respondents perceive speed either as an enabler or as neutral. At longer distances, longer travel times will be compensated by higher reliability and demand availability.

The catchment area of the ULS Schiphol was limited. According to the respondents, the catchment area acted neither as a barrier nor as an enabler. The project area has been

redefined many times: about 40 different versions of ULS have been developed. It proved that the 'total open airport' was the best solution. Ultimately, the freight volume was too limited and the connections with rail (and barge) were not sufficient. Therefore, in the end, we perceive that the geographical coverage acted as a barrier for ULS.

To summarise the user requirements, the barrier to ULS Schiphol was costs (see Table 2). This shows that one main important criterion for freight transport solutions (costs) did not favour the successful implementation of ULS Schiphol. Enablers for ULS Schiphol were: reliability and speed.

Table 2: Interview results of the user-requirements.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
reliability	E	E	E	E	E	0	E	E	E	B
costs	B	B	B	B	B	0	B	B	B	B
efficiency	E	0	E	0	0	0	0	0	0	0
flexibiity	E	0	0	0	B	0	0	0	0	B
safety/security	0	0	E	0	0	0	0	0	B	B
speed	E	0	E	0	E	0	E	0	0	E
catchment area	0	B	0	0	B	0	0	0	0	0

Notes: E = enabler; B = barrier; 0 = neither barrier nor enabler (neutral).
Source: 10 interviews were held with Ondergrondse Logistieke Systemen experts.

4.3. Analysis of actors and project management

The project was financed by the Ministry of Transport and Waterworks and supervised by other Ministries participating in the interdepartmental project team (IPOT). The airport authorities, the VBA (flower auction Aalsmeer) and the rail operators also participated. However the main 'working' actors were researchers from firms of consultants and universities. The government turned out to be the only real driving force behind ULS. The Ministry of Transport set the condition that the private sector should participate and take the lead in the project as financer. During the project, it became clear that the private sector had only shown interest but had no intention to really participate financially in the project. Other actors, such as the transport industry were also not involved and neither were the high level decision makers. Probably the lack of a real sense of urgency among the high level decision makers played a role in the lack of success of ULS.

Many actors participated in the project making it a complicated project. But, according to the respondents, the project complexity was neither a barrier nor an enabler for the success of the ULS system. There were too many institutions involved with too many interests, different goals and different ideas about ULS. Also the dynamic surroundings at Schiphol, with a new runway (Kaagbaan) made it complex.

The mix of different institutions (private organisations, universities and consultants) in the ULS project all with different interests made it complex but at the same time guaranteed a multidisciplinary group of team members with complementary competences. Several respondents indicated that the team was too large and also that team changes influenced the progress and stability. The project was managed well with milestones and strict deadlines. The other ULS-projects were smaller and only one or

two consultants were involved. According to the respondents, this was either a barrier to the successful adoption or a neutral factor.

The main objectives (clear goals) of the project were basically two: the first was to develop a knowledge (R&D) on automated (and underground) freight transport. The second one was to implement ULS. But also policy objectives, economic as well as environmental played a role. According to the respondents, there were clear barriers for the successful adoption of ULS. There was a lack of one central goal shared by all actors. First the idea was to build an underground system, but later on this changed to ground level. Furthermore, there was no owner of the problem and an insufficient sense of the urgency.

Table 3: Interview results of the project management.

	1	2	3	4	5	6	7	8	9	10
project complexity	0	B	0	0	0	0	B	B	B	B
project management	0	B	0	B	0	0	B	B	B	B
clear goals	E	B	B	0	B	B	B	B	B	E

Notes: E = enabler; B = barrier; 0 = neither barrier nor enabler (neutral).
Source: 10 interviews were held with Ondergrondse Logistieke Systemen experts.

To summarise the project management, barriers to ULS were: clear goals and project management (see Table 3). The other factor (complexity) seems to be neutral for successful ULS adoption.

4.4. ULS Spin-off

Until now, ULS has not been implemented in the Netherlands. This means that there are no direct spin-offs of the ULS project. However, the project stimulated considerable academic and private research, received support from different local and regional governments and gained public attention. Therefore, the research and attention will have generated some spin-offs. Possible knowledge spin-offs are: i) automated transport technology; ii) terminal technology; iii) logistic concepts; and, iv) tunnelling technology. One spin-off mentioned is the implementation of knowledge about AGV-technology in the people-mover project at the Rivium (Rotterdam, the Netherlands). The experience with the test site has been used by TNO for their new test site. The ULS studies stimulated the thinking about unmanned transport and innovative transport systems (for example the cargotram). Much has been learned about prototyping, modelling, simulation, and testing of automated freight transport. The ULS project initiated the thinking about new logistic systems in the Netherlands, such as agrologistics. Knowledge on underground construction is being applied at the Euromax terminal in Rotterdam. It has also drawn attention to traditional pipeline transport and to new initiatives (the multicore pipeline at seaport Rotterdam, and the ethylene ring pipeline in Northwest Europe). The project has been important for the personal knowledge development of many students (Masters, PhD), researchers and consultants. The knowledge is further used in other areas (national and international). A considerable number of articles have been published and papers presented at international conferences. The project has been important in promoting Dutch research internationally.

5. Conclusions

The research question in this article was: Which barriers and enablers have led to the failure of ULS and what ULS spin-offs can be found nowadays? The research question has been answered using the theoretical model that served as the basis for the interviews with the experts. If we consider compatibility, simplicity, try-out, context consistency and the relative advantages of ULS as possible success or failure factors, then some conclusions can be drawn. On the basis of the interviews, it can be concluded that compatibility and simplicity acted as neither a barrier nor an enabler. Try-out opportunities and context consistency acted as a barrier. ULS was largely based on proven-technology to make it compatible and was designed as a dedicated, solitary system for freight. However, ULS was less compatible with the outside (Schiphol airport) infrastructure. Therefore, only in a limited number of niche-markets is it possible to build an ULS-system. The overall concept of ULS was complicated but also quite easy to understand. Existing technologies were combined with new technologies and provided the basis for a totally new system. Try-out possibilities for the ULS system were too limited. The opening of the ULS test site where trucks were tested was a good start but it never came to a complete real-life pilot. The context consistency acted as a barrier. The political support of the important political decision makers was lacking and so was support from the private sector in the field of logistics (transport companies and the large shippers). The lack of support from the private sector was the main reason why political decision makers discontinued the projects.

The main conclusions from the user requirements are that the main barriers to ULS Schiphol are costs. An important enabler for ULS Schiphol was reliability and speed. Although the variable costs were considered relatively low compared to existing modes the investment costs were high. The total costs immediately put ULS at a disadvantage as compared to the truck. The catchment area was neutral in its impact on successful adoption. The area was too limited, and the connections with rail and inland waterways were limited, which meant a reduction in potential freight volumes. The reliability of ULS was a clear enabler. The system was very reliable, although, given customer requirements, a projected failure of every once per week can be perceived as considerable.

The main conclusions for project management are that barriers to ULS were clear goals and project management and the other factor was neutral for successful ULS adoption. In the ULS-project, many actors were involved having many different interests, goals and ideas. Although this made the project more complex, these factors were not critical for it. However, the lack of a real owner of the problem, a ‘Mrs ULS’ who should have been the driving force in the project, was a serious issue. The lack of a clear goal and changes in the other goals also acted as a barrier.

Although the ULS-project has not been implemented, the investments have resulted in spin-offs. The beneficial effects seem to be taking take place in different directions: ranging from rather soft impacts (scientific knowledge elaboration and dissemination, mapping the innovative image of the Netherlands, encouraging thinking on innovative transport and logistic solutions, increased attention for conventional pipeline transport policy) to more hard developments (adopting and developing transport and tunnelling technologies) and, although difficult to quantify, they are of great value. In the final analysis, perhaps the most valuable spin off remains the ‘learning experience’: the knowledge about which barriers to overcome and to make the most of the enablers of

the ULS-innovation process as they have been experienced. This should be a major asset if the development and implementation of ULS is to be successful in the future.

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Cellular automata cell structure for modeling heterogeneous traffic

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Abstract

Gap maintaining behavior significantly affects the traffic flow modeling under heterogeneous traffic conditions. The clearance between two adjacent moving vehicles varies depending on several traffic conditions. From the data collected on the gap maintaining behavior it has been observed that vehicles maintain different gaps when travelling under different traffic conditions and this is also influenced by lateral position of the vehicle. Mallikarjuna (2007) has found that this variable gap maintaining behavior can be explained using a macroscopic traffic characteristic called area occupancy. In this study, these relationships would be used in deciding the cell width which is the basic input for cellular automata (CA) based heterogeneous traffic flow models. It is proposed that the dominant vehicle in the traffic stream, its lateral position, and lateral gaps on either side are the governing factors in deciding the cell width. Cell width has been finalized based on this input and it is found to be varying when area occupancy is varying from 3 to 15%.

Keywords: Heterogeneous Traffic; Cellular Automata; Varying cell width; Area occupancy.

1. Introduction

Traffic flow models are crucial in implementing transportation planning and traffic management measures. Several types of traffic models such as models based on kinematic wave theory, Gas kinetic theory, and car following theory are available for this purpose. Wide ranging physical dimensions, weight, dynamic characteristics of vehicles makes it difficult to apply these models for heterogeneous traffic. A driver, traveling under these conditions, can utilize any space available on the road without any lane discipline. Many researchers have worked on it and developed some suitable solutions to model the heterogeneous traffic but their applicability is limited due to difficulties in data collection. When different types of vehicles share the same road space without any physical segregation, the extent of vehicular interactions varies

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widely with variation in traffic mix and traffic conditions. It also generates significant level of friction to the movement of vehicles in the traffic stream. Solutions to these kinds of traffic problems can be found through systematic study of all the relevant characteristics of traffic, with enough data support. Limited data has been collected to study the inter-vehicular friction (lateral gap) between different types of vehicles moving under various traffic conditions. With this limited data it is really not possible to come to any conclusions. There should be some minimum data available for understanding the gap maintaining behavior. From limited observations, Mallikarjuna (2007) has shown the variation of average gap maintained by vehicles with respect to area occupancy. In this study some more data has been collected and the gap-area occupancy relationships proposed by Mallikarjuna (2007) have been extended. These extended relationships have been utilized in arriving at the cell structure of the Cellular Automata (CA) model for heterogeneous traffic.

In most of the existing CA based models that are dealing with the heterogeneous traffic, certain cell sizes are used to incorporate the behavior of various vehicle types. This cell size is a function of physical dimensions and the lateral gaps maintained by the vehicles. Lateral gaps maintained by vehicles vary depending on the traffic conditions and this variability is not incorporated in any of the CA based models. In heterogeneous traffic conditions, where the lane discipline is absent, the variability in the vehicle and road size, in terms of cells, has significant impact on the model outcome. One example is, under jamming conditions, gaps maintained by vehicles are low and a two-lane road is utilized by vehicles as if the road is 3-lane one. When the vehicles and road geometry are represented using a constant cell size, the model can not represent the above said behavior. This paper explains the influence of the variability in the gap maintaining behavior on the vehicle size and the road geometry expressed in terms of cells.

2. Literature Review

Many models have been developed to model the vehicular behavior on the mid-block sections of urban roads. The review of such research work carried out especially on heterogeneous traffic flow models is presented below. This review is more about the microscopic data used in different traffic flow models. Some of the works done using cellular automata concept are also reviewed.

Nagaraj et al. (1990) investigated the linear and lateral placement of the vehicles in mixed traffic environment to develop a simulation model. They have done extensive data collection studies on gap maintaining behavior of vehicles. Data was collected on a two lane undivided road catering to the bidirectional traffic. Data on lateral and longitudinal gap maintaining behavior was collected in this study. Transverse clearance thresholds for different categories of vehicles from their study are shown in Table 1.

Singh (1999) based on the data collected on gap maintaining behavior, developed a relation between the lateral gap and speed of the interacting vehicles. The minimum and maximum lateral spacing has been estimated for two lane road for different combinations of vehicles. He has also measured the data on lateral gaps from the physical barriers like kerb, median etc. Gundaliya (2005) has developed three CA based models for heterogeneous traffic flow simulation. In case of single lane and two lane heterogeneous traffic flow models, a constant cell width of 5.0 meter was used

irrespective of traffic conditions. In this grid based heterogeneous traffic flow model, the cell size has been optimized as 0.9 m X 1.9 m using genetic algorithm. Constant cell width was considered irrespective of traffic conditions. Mallikarjuna (2009) has developed a CA based heterogeneous traffic flow model to study the traffic on midblock road sections. Several microscopic data such as lateral and longitudinal gaps are extracted using a image processing based software called TRAZER. Gap maintaining behavior was explained using area occupancy and it was found that with increasing area occupancy lateral gaps maintained by vehicles are reducing. But this variability in the gap maintaining behavior was not incorporated in the proposed traffic flow model. The cell width was constant irrespective of occupancy, which is a limitation of this model.

Table 1: Transverse clearance thresholds for different categories of vehicles.

Type of Vehicle	*Minimum clearance at zero speed (m)*	*Maximum clearance at 60 kmph speed (m)*
Bus	0.4	1.0
Truck	0.4	1.0
Light commercial vehicle	0.3	0.7
Car	0.3	0.7
Auto-rickshaw	0.2	0.7
Motorized two-wheelers	0.1	0.7
Bicycle	0.1	0.5[a]

Note: [a]Maximum clearance at 20kph.

Gunay (2007) found that more frictional clearances are required with the increasing speed of passing vehicles. Again it was also found that increase in the centre line separation reduces the time headway between the leader and the follower. It was assumed that the speed of a vehicle is affected by the effective route width (ERW). Dey et al. (2008) developed a simulation model for modelling mixed traffic flow on two-lane roads. They found that any vehicle was able to pass the lead vehicle when the lateral clearance was 1.5 times the width of the passing vehicle. But nothing was mentioned about the variation in the lateral clearance requirement with respect to road and traffic conditions.

Lan and Hsu (2006) has introduced the concept of "Common Units" (CUs), in which vehicles and road are represented by cells. They proposed the CU size to be 1.25x1.25 meters. This cell size has been arrived at based on the field data collected on the safe gap requirements for the movement of motor cycles. But there is no clear description of the procedure adopted in arriving at this cell size. Hsu et al. (2007) in another study proposed the CU size to be 1.25x1.0 meters, which is corresponding to a maximum speed equals to 31sites/sec (111.6 kph). They used this grid size for standard freeway lane (3 CUs in lateral direction) and as well as for narrow urban street (2 CUs in lateral direction). The size of the vehicles in terms of cells was decided based on their physical dimensions and the required safe gaps. They used compact cars and a twin-truck for this study but they have not considered motorcycle, bus, and single-unit truck, which are very important to represent the heterogeneous traffic scenario. Lan et al. (2009) proposed a new revised CA model with piecewise-linear speed variation as well as limited deceleration capability using the similar cell sizes proposed in Hsu et al. (2007).

From the literature review it can be observed that a comprehensive approach is lacking when modeling the heterogeneous traffic. Complexity in microscopic data collection, specifically when collecting gap related data, has been one of the major problems faced by the researchers working in this area. Microscopic data on gap maintaining behavior is crucial in developing the microscopic traffic flow models. The objective of this study is to analyze the variable gap maintaining behavior under heterogeneous traffic conditions and to incorporate this behavior in traffic flow models. The influence of the variable gap maintaining behavior on the cell structure of the CA based models is analyzed. Cell width is found to be varying with the traffic conditions which are characterized by area occupancy.

3. Cellular Automata Model

In the CA models of traffic, the position, speed, acceleration as well as time are treated as discrete variables. In CA approach, a lane is represented by one-dimensional lattice and each unit of the lattice represents a cell, which can be either empty or occupied by at least one vehicle or part of the vehicle at a given instant of time. The state of a cell at time t is a function of the states of a finite number of cells (called its neighborhood) at time $t - 1$. These neighbors are a selection of cells relative to the specified cell, and do not change (though the cell itself may be in its neighborhood, it is not usually considered a neighbor). Every cell has the same rule for updating, based on the values in this neighborhood. Each time the rules are applied to the whole grid a new generation is created. Mallikarjuna (2009) has described the details of cell state updating procedure used in the CA model for heterogeneous traffic conditions. Applicability aspects of CA model for heterogeneous traffic is discussed below.

3.1. Applicability of the CA Model for Heterogeneous Traffic

CA model used for homogeneous traffic required modifications in cell structure as well as in updating procedures in both lateral and longitudinal directions. To model no lane-discipline which can be attributed to driver discomfort as well as due to the presence of small sized vehicles, the present concept of lanes may not be useful. It is also planned to include lateral gaps at different traffic conditions in addition to actual vehicle width while deciding the CA structure. The factors mentioned in the remainder of this paragraph differentiate the CA structure for homogeneous and heterogeneous traffic. The cell width must be decided in such a way that the small vehicles such as motorized two wheelers and three wheelers are represented properly. The cell must incorporate the gap maintaining behaviour of different vehicles under different traffic conditions. Gap maintaining behaviour varies depending on flow, occupancy, neighboring vehicle type, and the cell widths are to be changed accordingly. Heterogeneous traffic consists of several types of vehicles, differing in both physical and mechanical characteristics. Hence it is required to group the vehicles either based on physical characteristics or mechanical characteristics. Updating procedure in both lateral and longitudinal directions must be changed in accordance with the cell structure. From this discussion it can be said that the cell structure is crucial in developing the CA based heterogeneous traffic flow model.

4. Data Collection

Data used in this study was collected from two urban mid-block sections of Delhi metro region. First data set was collected on a mid-block section of the Dabri road near Delhi-Noida-Delhi (DND) flyway, connecting Delhi and Noida. This section is a three lane road, with a lane width of 3.4 meters. But the lane markings were not followed by vehicles and effective road width used by vehicles was limited to 8 meters. This road was considered for data collection mainly because of the availability of vantage point to collect the video film. The second data set has been collected on inner ring road, which is one of the major arterials in Delhi near Maharanibag. This road is having a shoulder of 2 meter width and the road width is 10.5 meter. The essential microscopic data related to gap maintaining behavior has been extracted from the trajectory data extracted from the TRAZER. Various data related to microscopic characteristics such as lateral gaps, difference in lateral positions of various groups of vehicles were derived using the trajectory data. Data on microscopic characteristics specifically that are used in finding the cell width are presented here.

4.1. Microscopic Data

Lateral gaps and lateral distribution of vehicles are the important microscopic characteristics about which the data is presented here. When road width is more, there will be more number of vehicles travelling side by side. In this situation finding the cell width is complex and it may take several values. To avoid this scenario major vehicle type in the traffic stream and the lateral distribution of such vehicles under varying traffic conditions are taken as the governing criteria. When more subject vehicles are travelling near median, the effective width of the vehicle is considered as the summation of vehicle width, gap maintained with median and half of the gap maintained with the adjacent vehicle. Lateral distribution of vehicles observed under different traffic conditions is presented in Figures 2 to 6. Detailed procedure used in finding the effective vehicle width is shown in Figure 1. Once the gap data is obtained, relationship between lateral gaps and area occupancy is established. These relationships would be used in varying the cell width, depending on the traffic conditions.

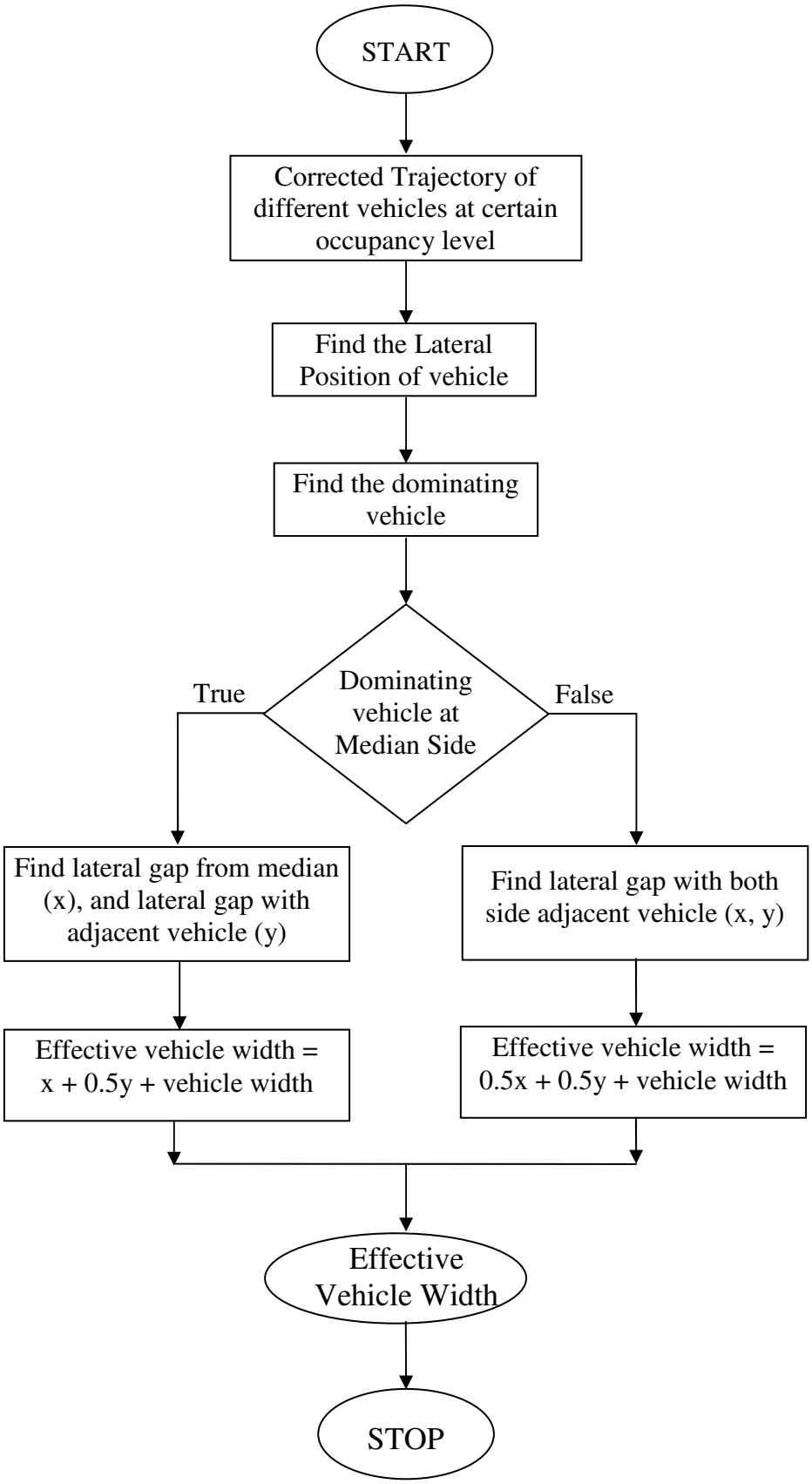

Figure 1: Flow chart showing the procedure about finding the effective vehicle width.

4.1.1. Lateral Distribution of the Vehicles

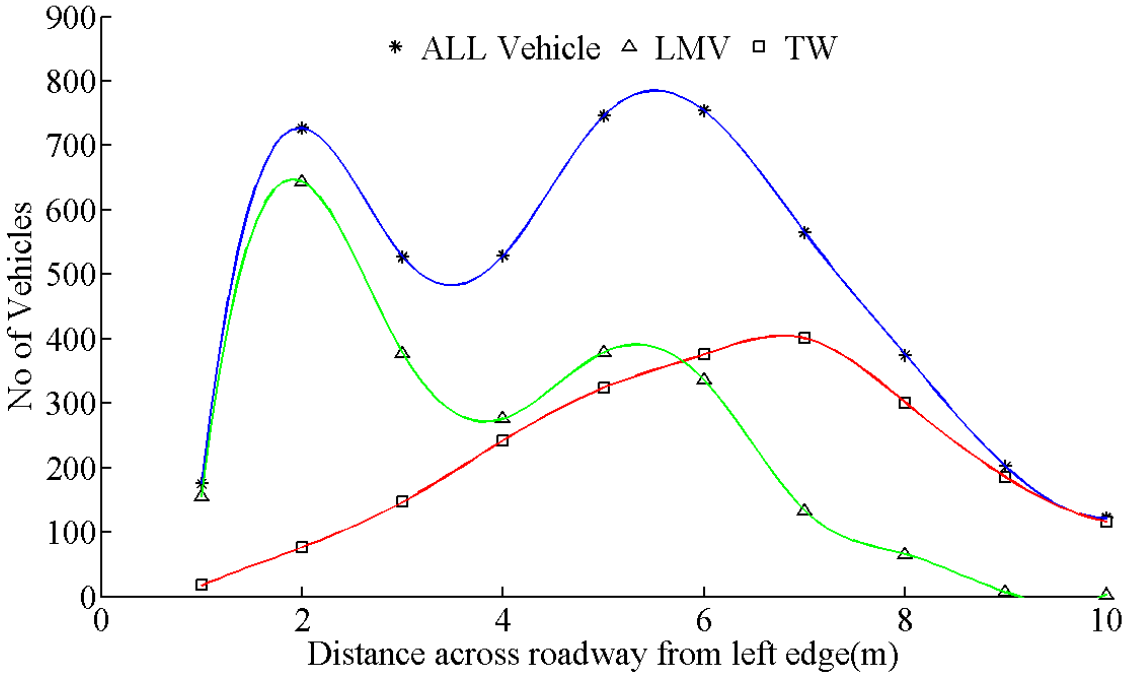

Figure 2: Lateral distribution of Vehicles observed between 8-45 and 9-45 hrs.

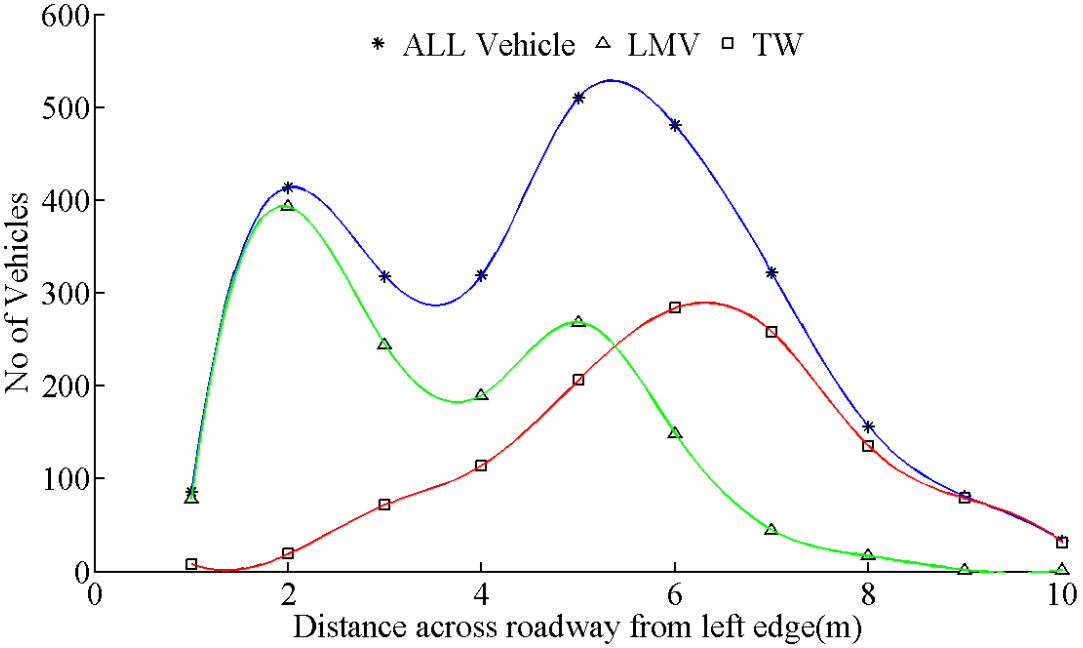

Figure 3: Lateral distribution of vehicles observed between 10-15 and 11-15 hrs.

Under heterogeneous traffic conditions, vehicles can have any lateral position irrespective of their physical and mechanical characteristics. A two lane road can have three vehicles side by side under certain traffic and road conditions. Lateral distribution of vehicles and their lateral gap maintaining behavior governs the number of sub-lanes or effective road width to be used in a CA model. When lane discipline is not strictly followed, to avoid discomfort of traveling on shoulder lanes, vehicles tend to travel

away from the shoulder lane. When traffic volumes are high there is a tendency of segregation, where two wheelers tend to travel on the left side of the road. Three hours data set collected on the Dabri road and 30 min data of ring road has been analyzed. In first one hour, from 8-45 AM to 9-45 AM around 4000 vehicles have passed through this road section, and 2700, and 2000 in the other two hours, 10-15 to 11-15 AM and 12-15 to 13-15 PM, respectively. Lateral distribution of vehicles is shown in Figures 2 to 6. From these figures, it is clearly observed that, most of the vehicles are utilizing the available road space as if it is a two lane road.

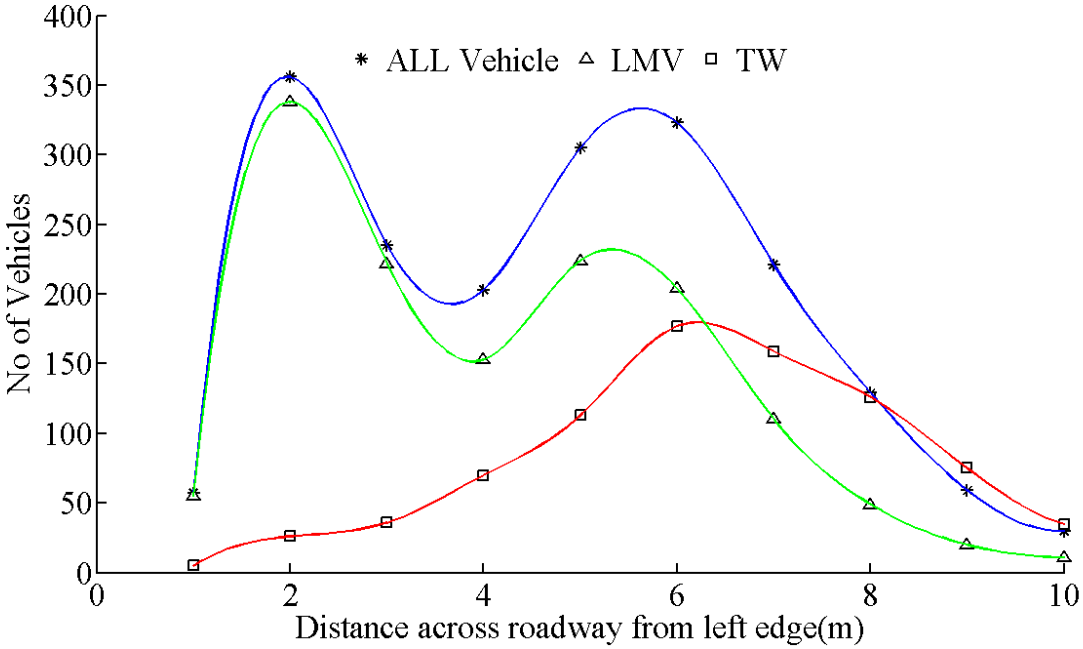

Figure 4: Lateral distribution of vehicles observed between 12-15 and 13-15 hrs.

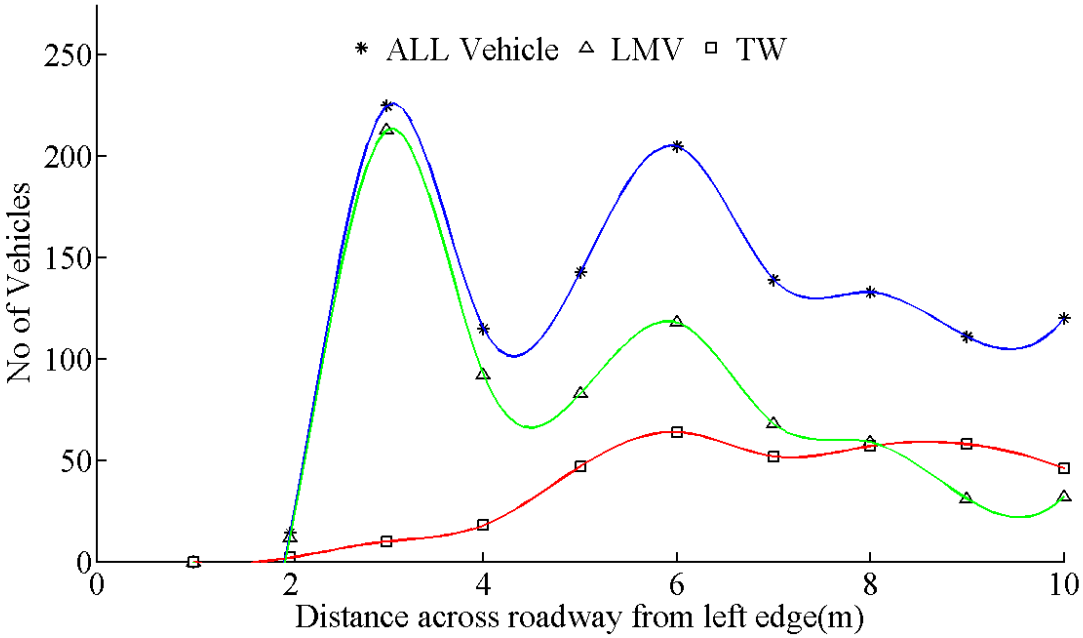

Figure 5: Lateral distribution of vehicles observed in ring road between 15.30 and 15.45 hrs.

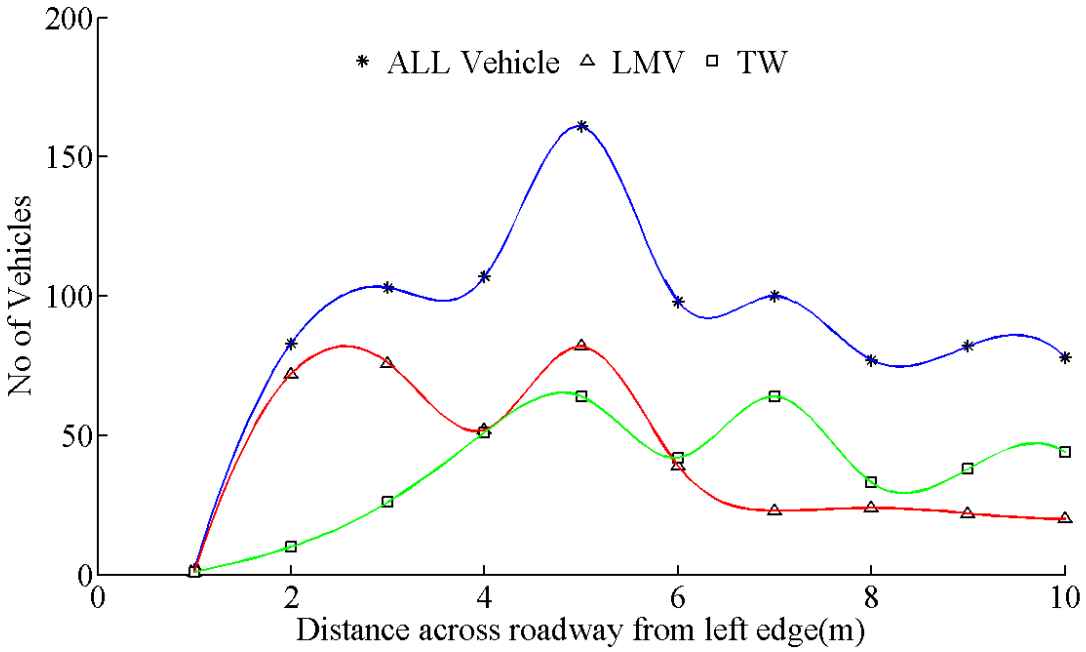

Figure 6: Lateral distribution of vehicles observed in ring road between 15.45 and 16.00 hrs.

Two distinct peaks can be observed, at around 2 m and 6 m. It is observed that most of the LMVs are travelling on the right side (near median) of the road. From the other two hours data also, it has been found that all the vehicles were utilizing the available road space like previous one hour period. From Figures 2 to 6, it is clearly observed that the lateral distribution of vehicles is varying depending on the traffic volume and composition of the traffic. At higher traffic volumes, segregation of two wheelers and LMVs are observed. From the above analysis it can be said that LMVs are dominant mode in the traffic and the position of its movement is varying with respect to the traffic conditions. For all the three hours of Dabri road LMVs are travelling close to median and on the Ring road LMVs are more or less utilizing all the three lanes evenly.

4.1.2 Lateral Gaps

Lateral gaps maintained by different types of vehicles are important in deciding the cell width. In the CA model for heterogeneous traffic, lateral gap is included in vehicle widths i.e., vehicle width in this model comprises of actual vehicle width and gaps maintained on both the sides. To utilize this characteristic in CA model, it is essential to know the variation of the lateral gaps maintained by different vehicles. It is difficult to study the lateral gap maintaining behavior of each and every vehicle under several observed traffic conditions. Hence, average lateral gap maintaining behavior of different vehicle groups is studied and presented in Figures 7 and 8. In these figures the variability is explained using a characteristic called area occupancy which was found to be better in representing the heterogeneous traffic conditions compared to density or occupancy (Mallikarjuna 2007). Due to the numerous complex interactions associated with the heterogeneous traffic, it is not easy to describe the gap maintaining behavior with varying traffic conditions.

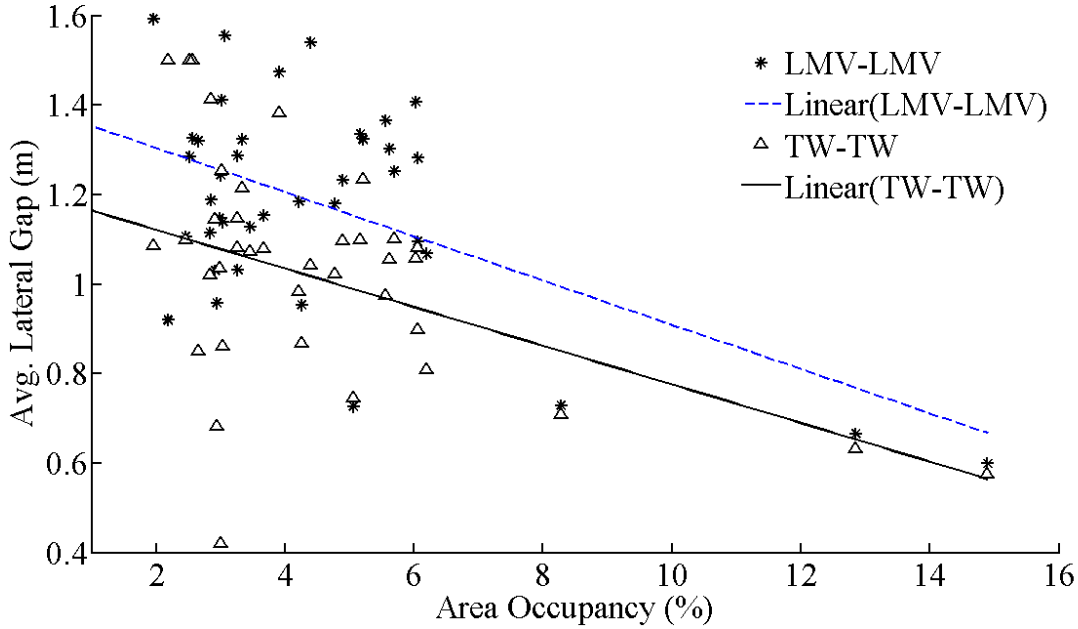

Figure 7: Influence of area occupancy on average lateral gap (m) between LMVs and TWs.

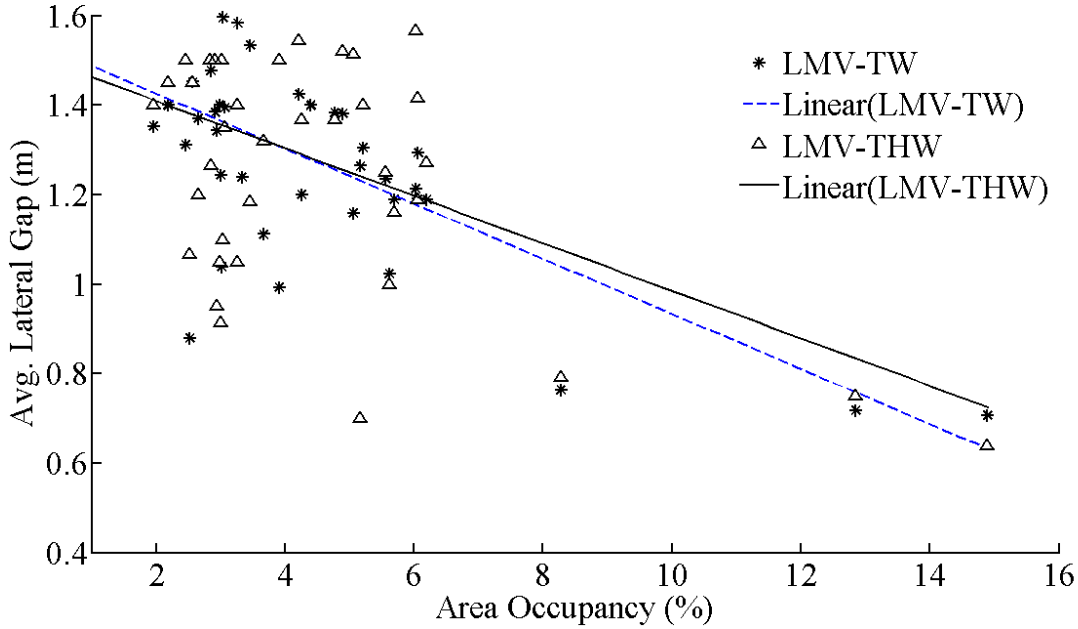

Figure 8: Influence of area occupancy on average lateral gap (m) between LMV-TW and LMV-THW.

The influence of an important traffic characteristic known as area occupancy on lateral gap maintaining behavior of vehicle combinations LMV-LMV, TW-TW, LMV-THW and LMV-TW are tested. In Figures 7 and 8, influence of area occupancy on lateral gap maintaining behavior of 4 types of vehicle combinations is presented. It is found that the average lateral gap is decreasing with the increasing area occupancy.

5. Cell width

The procedure used in finding the cell width is shown in Figure 1. As shown in this figure, clearances maintained with the median and with the other vehicles is the key input in finding the cell width. Figure 9 shows the influence of area occupancy on mean clearance from median for different vehicle types. It can be seen that, in case of TW and HMV, mean clearance from median is decreasing as area occupancy is increasing.

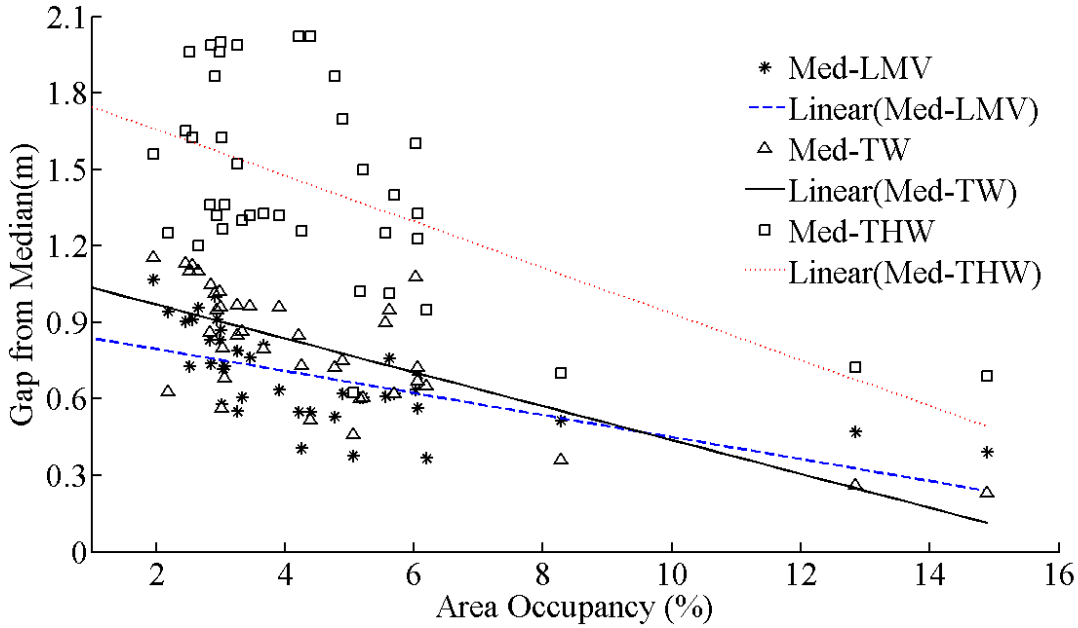

Figure 9: Influence of area occupancy on mean clearance from median for different vehicle types.

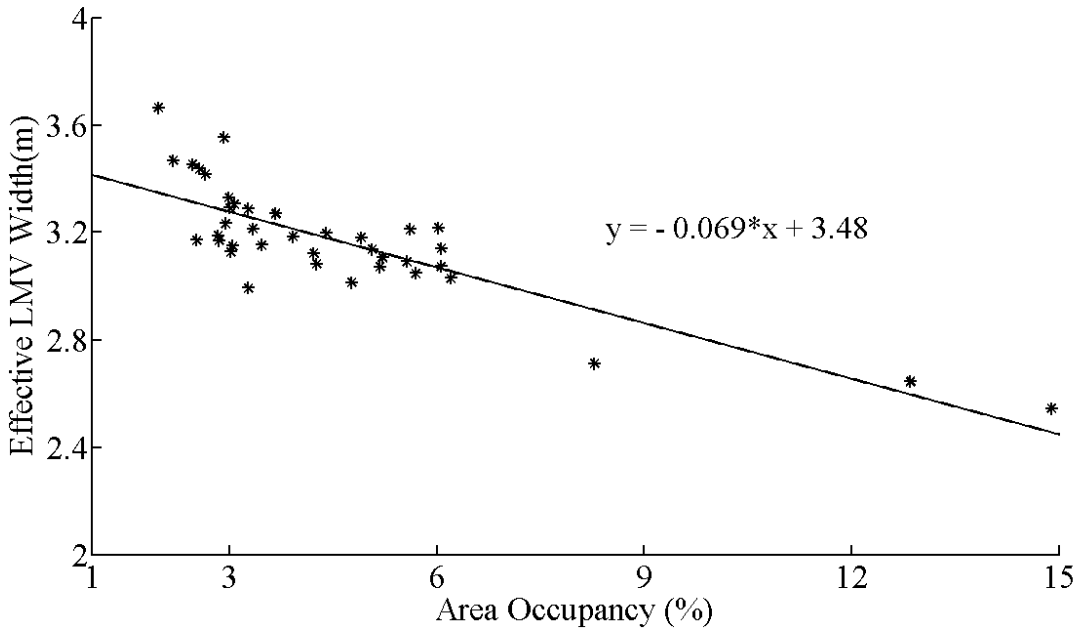

Figure 10: Variation of effective LMV width at different area occupancy levels.

Data on lateral gap maintained by different types of vehicles that has been considered in this study is the average value collected over five minute intervals. It has been found that effective LMV width decreases when average area occupancy increases (Figure 10). It is already mentioned that LMV is the dominant vehicle and its effective width is varying depending on its lateral position on the road, area occupancy, and the side vehicle. Hence, the larger value among different vehicle combinations at different area occupancy levels is taken into consideration while deciding the cell width.

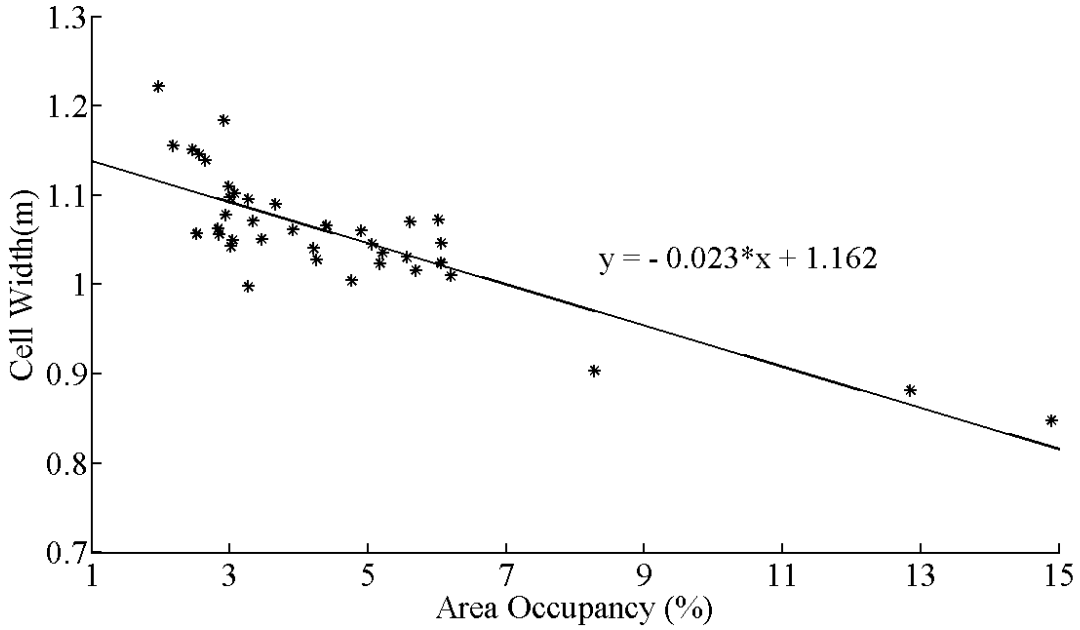

Figure 11: Cell Width (m) vs. Area Occupancy (%).

To represent all the vehicle combinations, LMV's effective width is divided by 3 and is plotted against area occupancy and is shown in Figure 11. This acceptable cell width is plotted against area occupancy to get the cell width at different area occupancy levels. Figure 11 shows the variation in cell width at different area occupancy levels. A linear regression line obtained from the cell width and area occupancy relationship is shown below.

$$\text{Cell Width (in m)} = -0.0234 \times \text{Area Occupancy} + 1.1652 \quad (1)$$

Using the above relation, cell width (m) for different area occupancy levels is found out and shown in Table 2. This cell width has been used to find the vehicle width as well as road width in terms of cell at different area occupancy levels and shown in Table 3.

Table 2: Variation of cell width (in meter) with area occupancy.

Area Occupancy	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
Cell width (m)	1.10	1.07	1.05	1.02	1.00	0.98	0.95	0.93	0.91	0.88	0.86	0.83	0.80

Table 3: Cell width and road width in terms of cells.

Area Occupancy	TW	LMV	THW	HMV	Road Width
3	2	3	3	3	9
4	2	3	3	3	9
5	2	3	3	3	10
6	2	3	3	3	10
7	2	3	3	3	10
8	2	3	3	3	11
9	2	3	3	3	11
10	2	3	3	3	11
11	2	3	3	3	12
12	2	3	3	3	12
13	2	3	3	3	12
14	2	3	3	3	13
15	2	3	3	3	13

6. Conclusions

In this study, microscopic data such as lateral gaps between adjacent vehicles, median, and lateral distribution of vehicles have been analyzed. It has been found that volume of LMVs is higher in all the three cases, and hence, LMV is the dominating vehicle. Data of three hrs of Dabri road shows that most of the LMVs are passing nearby median and the 15 minutes of ring road data shows that most of the LMVs are passing through the middle of the road. This information is used in deciding the effective vehicle width. Finally, the cell width has been decided on the basis of the effective width of the dominating vehicle at different area occupancy levels. This cell width is used in finding the vehicle width in terms of cells. It is observed that the vehicle width as well as the road width in terms of cells is varying when area occupancy is increasing from 3 to 15%. This information indicates that lateral gap maintaining behavior of vehicles is important in deciding the structure of the cellular automata based traffic flow model and this is more significant when developing the heterogeneous traffic flow models covering various traffic conditions.

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Public transport and its privatization in East Europe: the case of Tirana, Albania

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Abstract

The purpose of the article is to discuss the operations of the public bus sector and the impacts of its privatization in Tirana, the capital of Albania. In addition to a synopsis of public transport operations in post-communist East Europe, the first part of this article presents an overview of public transport operations in Tirana from 1990 to the present day. The second part of the article discusses the findings of three sets of transportation surveys.

Keywords: Tirana; Albania; East Europe; Public transport; Bus transport; Public service privatization.

1. Introduction

The purpose of the article is to discuss the operation of the public bus sector and the impacts of its privatization in Tirana, the capital of Albania. The first part of this article presents an overview of public transport operations in Tirana from 1990 to the present day. The second part discusses the findings of three sets of transportation surveys.

Due to the absence of academic literature on transportation issues in Albania, much of the information in this article was obtained from transport-related studies conducted by various consultants for Tirana in the course of the last twenty years and press reports on urban transport. Other information was obtained through interviews with representatives of formal public transport companies and informal public transport operators.

From 1944 until 1990, an exceptionally repressive communist dictatorship governed Albania. During communism, private car ownership was forbidden. As most destinations within the capital were easily reachable on foot due to its relatively small size (300,000 people on 12 km^2), walking was a chief form of travel throughout that era. In addition, a substandard public bus system, bicycles, a few motorcycles, and a few taxies for special occasions provided passenger transport. A small fleet of horse-drawn carriages was in use for goods transport. The poor quality of public transport in Tirana

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during communism stood in sharp contrast with other communist capitals, which often had very good bus and rail systems.

Since the fall of communism, Tirana has experienced a population explosion from 300,000 to well over 800,000, owing to rural-urban migration (see Fig 1). In this process, a dual city has formed. In the inner city, new high-rise apartment buildings (typically 10-12 stories) were built at high densities squeezed in the space among the existing buildings. On the city fringes, new migrants, who were unable to afford regular housing, occupied public or private agricultural land and built substantial houses without permits. (Squatter settlements generally fall outside the City's administrative borders). The occupied land was often devoid of infrastructure, including roads, and had poor access to formal public transportation lines. This process was followed by big box retail and light industrial sprawl along the main intercity roads (Pojani 2010).

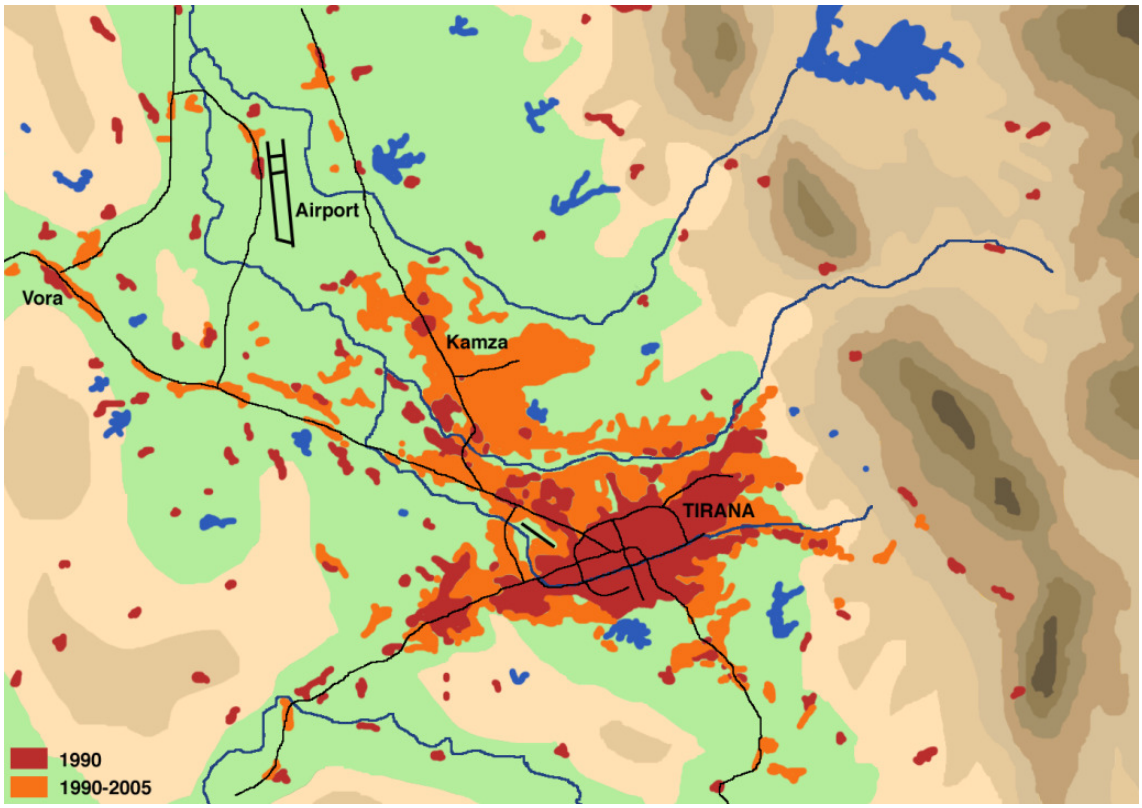

Figure 1: Urban expansion in the post-1990 period. (Most squatter settlements are around Kamza). Courtesy of CoPlan.

Meanwhile, as in other Eastern European countries (see Pucher and Buehler 2005; Komornicki 2003; European Commission 2009) car ownership skyrocketed. Now approximately two thirds of the households in the inner city own a car. Cars were purchased to fulfill mobility needs but were also seen as symbols of freedom and social status. However, public transport use has remained high. Squatter residents, in particular, are dependent on the inner city for work, and rely almost entirely on public transport to reach jobs. Nonetheless, this modal shift to auto use led to major environmental problems: pollution, noise, serious traffic congestion, shortage of parking, accidents, and mobility problems for the poor.

2. Public Transport in Post-Communist Eastern Europe

In communist countries, central governments provided massive subsidies for the operation and maintenance of publicly-owned public transport systems. The ridership was almost entirely captive since most households did not own cars. Transport enterprises were heavily overstaffed leading to low labor productivity, high per-unit costs, and chronic financial difficulties. In the last decade of communism, the quality of service and vehicle and infrastructure maintenance was declining throughout East Europe (Burnewicz and Bak 2000; Suchorzewski 1994; Suchorzewski 1995).

When communism ended in 1990, the subsidies to public transport were drastically reduced. Moreover, international lending agencies focused on roadway improvements. Under these pressures, municipalities were forced to substantially cut back service and increase fares, especially in smaller cities (Pucher and Lefevre 1996).

As a result, in the beginning of the 1990s, public transport's cost recovery rates improved (Suchorzewski 1995) but fare increases accelerated the shift to private automobiles causing a further deterioration of public transport. In the first years of the transition the public transport trip share fell by 10 to 20% in Poland, Hungary, Czechoslovakia, and East Germany (Pucher and Lefevre 1996).

With escalating costs and declining quality, the privatization of public transport services was seen as a necessity. Privatization of public transport was also part of a larger trend in the late 1980s and 1990s, both in the East and West, toward the incorporation of cost concepts and competitive market principles into the provision of public services. On a pragmatic level, the lures of contracting out public services included reduced public expenses, increased efficiency, and private sector development (Leland and Smirnova 2009). This was particularly true in East Europe where, during the decentralization reform, national governments were imposing extensive responsibilities on local governments without providing or enabling revenue sources adequate to meet those tasks. However, in some countries such as Great Britain during the Thatcher administration, privatization of transportation was also meant as part of a grand political project, the fundamental idea of which was to create a society unified by the market (Feigenbaum and Henig 1997).

Some authors sustain that, despite stated intentions to improve economic efficiency, privatization in East Europe, seen as a stepping stone for capitalism, was indeed primarily motivated by ideology: a wish for the long-term transformation of society (Feigebaum and Henig 1997). Eastern European governments generally had a libertarian political orientation in the decade following the fall of communism and were not interested in preserving the old, publicly-oriented regulatory instruments (Burnewicz and Bak 2000).

Other authors maintain that a major reason for privatization in East Europe was that international financial institutions, including the World Bank and the European Union actively promoted it, despite some local resistance (or indifference):

> *"The attitude of many [public transport] managers encountered in Warsaw, Gdynia, Budapest, and Bucharest showed little enthusiasm toward either the institutional or the societal consequences of [privatization]… Managers in Budapest, for example, publicly accepted the EU's mandates, yet privately expressed the hope that internal dissent from these strong EU states would spare them the need to continue down an unpopular path"* (TCRP 2003, pp. 19-20).

Although privatization did take place in other sectors, bold deregulation policies in the transport sector were deferred by the legacy of communism (Sturm et al. 2000), as a result of resistance by employees of large transport enterprises, who feared redundancy (Burnewicz and Bak 2000; Mayer 2009), and/or due to public fears about the consequences of privatizing a critical function. In other cases, the employees were interested in purchasing their transport companies, but lacked the necessary financial means for modernization of the rolling stock (Burnewicz and Bak 2000).

The form and speed of public transport de-monopolization, restructuring, and privatization has varied substantially among East European countries, depending on national traditions, employees' opinions, the role of trade unions and private capital resources. Wealthier countries such as Poland, the Czech Republic and Hungary introduced enabling legislation as early as 1988-1990. Some countries gave priority to "mass privatization" (the Czech Republic, Poland, Romania, Bulgaria, Latvia, Estonia), others to selling shares to the workers (Slovenia and, to some extent, Poland) or to direct sell-offs (Hungary and as well as Poland, Romania, and Bulgaria). By 2000, in most Eastern European countries the majority of public bus transport companies were private. The scale of diffusion of small transport enterprises was different for individual countries, with the largest diffusion in Poland and the smallest in Romania (Burnewicz and Bak 2000; AVV 2000; Suchorzewski 1995; Taylor 2004).

In regards to urban public transport in particular, a large comparative review (TCRP 2003) found that capital cities in East Europe presented a continuum with respect to degrees of privatization policies. Commonly, public and private transit lines coexist within the same city. Typically, a large municipal company provides the long-established services with the privatization of some of its functions, and/or with private companies operating newly instituted lines, or "feeder" services such as minibuses and taxis. TCRP's review (2003) concluded that:

> *"Privatization has been positive for many of the systems visited in that it has required these systems to focus on both improving efficiencies in the delivery of service and enhancing customer service… [A] reason for restructuring was to make public transport more attractive to private-sector capital investors, particularly from the West. To date, little of the anticipated investment by the private sector has been realized."*

Other scholars have reached mixed conclusions on the merits of privatization of transport in post-communist countries (Adam and Schwartz 1992; Cohen and Schwartz 1992; Lipton et al. 1990; Major 1991; Pejovich 2005; Gómez-Ibáñez and Meyer 1993).

The regulatory regime differs among countries, ranging from strong regulations in Poland, to a mixed environment in Slovakia, to a more liberal attitude in Hungary and the Czech Republic, although not in regards to fares (Sturm et al. 2000). Sturm et al. (2000) say that:

> *"Whereas in the West the regulatory state developed as the least intrusive, and therefore most stable, option for the relationship between the state and society, our research shows that regulatory reform in the East is not only less important, but different. The underdevelopment of civil society there, as well as the slow generational change of administrators, have given regulatory reform the character of permanent compromise. What governments defend is certainly not socialism, but a high degree of control (centralized or decentralized) of the state."*

It must be noted that public transport remains a vital service in Eastern European cities. While in the 1990s there were many studies on its privatization and general performance in the region, funded by international organizations, systematic studies on the current state of public transit services are virtually non-existent.

3. Public Transport in Tirana: 1990-present

3.1. Moribund Public Transport in the 1990s

Unlike other East European communist capitals, the quality of public transportation in Tirana, which consisted of buses only, was deplorable during communism (Fig. 2). Once communism was over in 1990, Albania started a painful journey toward a market economy, which was marked by poverty and political chaos. Public transport problems assumed crisis dimensions, marked by a huge drop in ridership. See Table 1.

Figure 2. Public bus in the 1980s.

Tirana inherited a small bus fleet (114 buses) from the communist era, which covered 12 routes, with an average distance of 12 km per route. The bus stock was dilapidated. The average age was 20 years. On any given day, only about half the buses were in service. The buses were usually overcrowded, and did not follow a schedule. Waiting times at stops often exceeded 30 minutes. The ticketing system was manual: a conductor collected fares on board and issued tickets (monthly passes were also used). After changes in the city's land uses and density structure that followed the fall of communism, many routes and stops became inconvenient (Transurb Consult 1994).

Table 1. Decline of public bus system ridership in the 1990s.

Year	*1981*	*1986*	*1991*	*1993*	*1996*	*1997*	*1998*	*1999*
Passengers carried (million/year)	53.6	59	26.7	19	25	23.6	23.7	26.8
Bus km run (million km/year)	6.54	7.77	5.86	5.6	3.44	2.77	2.77	3.08
Income from ticket sales (million Lek/year)	-	-	7.26	48.8	129	149	200	247
Total bus fleet	144	161	189	114	120	104	95	116
Average number of buses in service	117	109	76		66	73	60	70
Total passenger capacity, seated and standing (thousands)	10.2	13	15.5		9.39	8.27	7.92	10.8
Bus potential km used (%)	81%	68%	40%		55%	70%	63%	60%
Passengers/day/bus in service	1,256	1,487	960		1,036	889	1,087	1,060

Source: T.E.C.N.I.C and Transurb Consult 2000, Transurb Consult 1994.
Note: No available data after 2000, due to privatization.

Buses had low standards of hygiene, maintenance, and service (Fig. 3). During Tirana's hot summer months the air within the buses was unbreathable. During the commute peaks and in rainy days overcrowding became extreme. Furthermore, buses were extremely slow. Often, rather than leave and depart according to a schedule, buses waited in the stations until they had sufficient passengers on board. Bus stops provided no shelters.

As far as management was concerned, the public transport sector remained strongly centralized throughout the 1990s. Although there was no statutory monopoly on public transport, a single public enterprise provided public transport services (both urban and suburban) in the city. This enterprise was part of the Ministry of Transport and had no working capital (and no outstanding debt) of its own. In 1994, during the decentralization reform, this enterprise passed under the jurisdiction of the City of Tirana, which had no capacity to manage the system. Despite the provisions of the decentralization legislation, the Ministry of Finance kept providing the funds for capital improvements directly to the operating company, bypassing the City, in order for the system not to disintegrate entirely. Operational losses were paid for in block grants from the state treasury (Transurb 1994; ITS 2006; T.E.C.N.I.C. and Transurb 2000).

Under this administrative mish-mash, the transport enterprise stopped existing as an organized transport company and became a quasi-informal operation run by the bus drivers, who even bought or appropriated some of the buses. Its future was uncertain. Thus, there was little incentive and motivation for the bus operators to take steps to improve service or reduce costs: the system was overstaffed and there were no controls over the fuel supply. Non-productive routes represented one fifth of the distances covered (Transurb Consult 1994; ITS 2006; T.E.C.N.I.C. and Transurb 2000).

The fare was cheap, costing only 5 Lek per trip (about $0.05) in the mid-1990s and 15 Lek per trip (about $0.15) in 2000, regardless of the distance travelled; children traveled free of charge. However, more than 30 percent of the passengers transported evaded the

fare. Bus revenues covered only 35 percent of operating expenses.[1] The central government subsidized the rest (Transurb 1994; ITS 2006; T.E.C.N.I.C. and Transurb 2000).

Figure 3. Public bus in the 1990s.

By the mid 1990s, bus ridership had dropped by 50 percent from communist-era levels. By the late 1990s, the modal share of public transport had dropped to 16 percent of trips, about half of which were to and from work. The poor quality of bus services

[1] It must be noted that public transport is unprofitable throughout Europe, and commonly requires massive operational subsidies. The degree of unprofitability varies greatly among countries and even among cities in the same country. In 1995, the average cost recovery ratio for urban bus services was 51% in West European countries. UK Commission for Integrated Transport (http://www.cfit.gov.uk/pubs/2002/psbi/lek/a3/08.htm).

helped accelerate the users' flight to the automobile. In a vicious circle, reduced revenue led to further deterioration (Transurb 1994; ITS 2006; T.E.C.N.I.C. and Transurb 2000).

With the arrival of foreign aid, by the mid to late 1990s, a colorful mismatched fleet of used vehicles, which had been previously used in other European cities, replaced the decrepit bus fleet that was in service during communism. Little effort was made to adapt their appearance for use in Tirana. Often buses carried the logos of the foreign companies that had donated or sold them at low prices, and even displayed "out of service" signs in foreign languages. Any instructions were in foreign languages as well. While these buses were in much better condition than the fleet they replaced, they did not contribute much to the improvement of the image of public transport.

3.2. The Emergence of Informal Public Transport

Due to the crisis of the formal public transport system, around 1999, a large number of informal minivans (or "furgons") stepped into the market. Informal vans, with all their shortcomings, provided a valuable service, filling the void left by formal operators (Pojani 2004). This form of informal transport sector is indeed standard in developing countries across the continents. (See Cervero and Golub 2007).

Inner-city furgons (10-seat minivans) ran on all the public bus routes competing with the public enterprise, but also served destinations that were entirely un-served by buses. The fare was a little more than the public bus: 20 Lek ($0.20), versus 15 Lek on buses, regardless of the distance travelled. Children were charged only if they took a seat; otherwise they could sit on a parent's lap. Furgons' numbers much surpassed the number of formal buses, especially on the two main lines in the inner city. The frequency of furgons in all lines was 960 per hour while the frequency of buses was 86 per hour. However, as a result of their smaller size, furgons served the same number of passengers per day as formal buses (about 70,000, according to the City of Tirana). Half of the minibus trips served the morning and afternoon commute. (T.E.C.N.I.C. and Transurb 2000).

Many urban residents, including wealthy ones, were furgon users (regular or occasional). Furgons were considered the fastest transportation mode in the city (Pojani 2004). In fact, it was easier for furgons to maneuver in the traffic because of their smaller size. Also, furgons performed "elastic" trips picking up and dropping off people on request along the route; if police were in sight at intersections, furgons adjusted their stopping point to avoid police controls.

However, both users and non users considered furgons as a "cross to bear" rather than a solution to the urban transport problem. The main complaints regarded their quality. Furgons were intercity vehicles adapted to urban travel. As such, getting on and off the vehicles was difficult, there was only one entry, and there was little ventilation. As a result of their frequency, there was usually room for passengers to be seated; otherwise, a trip standing in a furgon was very uncomfortable. Furthermore, frequent stops along the way posed problems for traffic management. Finally, people felt that the poor image of the furgons damaged the general image of the capital city (Pojani 2004).

Initially, the furgons were unlicensed. The authorities tolerated them since it relieved them of the need to invest in public transport. Also, no rules on private transport licensing were in place because urban transport had been a public monopoly for years. In 2002-2003, the City made some attempts to regulate the private informal operators. First, it required furgons to be licensed; as a result, only a few hundred vehicles

obtained licenses (T.E.C.N.I.C. and Transurb 2000). Second, the City required furgons to stop at bus stops only; however, bus stops were by then inconvenient due to changes in the city's population distribution. Third, the City required owners to paint furgons in order to distinguish them from other vehicles; this intervention improved their exterior only (Fig. 4). Finally, furgons were banned from the inner city in 2004 (see below).

Figure 4. Informal transport vehicles in the city center in 2003. (Photo courtesy of Kenneth Baar)

3.3. Privatization of Bus Services and Current Trends in Urban Travel

In 2001, in line with trends in other East European cities, the City of Tirana decided to privatize the public transport sector. Terminating the competition from furgons was a necessary step in order to find buyers for the formal lines. Unlike other countries, Tirana's bus sector privatization was more pragmatic: its prime drive was not ideology but by lack of financing and management capacity. Also, privatization had been recommended as early as 1993 by foreign consultants funded by the European Commission (Transurb Consult 1994; CGEA 1999).

The privatization did not take place immediately. In the early 2000s, only the suburban public transport lines were privatized; the private companies did not own the vehicles but were licensed by the city to operate the lines. Private operators charged a fare 5 Lek ($0.05) higher than the public company and did not offer discounts for low-income groups or bus passes. In 2004, the Council of Ministers announced that the fares charged by the public company were to match those charged by private operators and private operators were to offer monthly passes and lower fares for students (CoPlan 2007).

By 2006, nine out of the ten urban lines were effectively privatized; four private companies operated them (Table 2). As a result of privatization, subsidies have dropped considerably: from 150 million Lek ($1.5 million) in 1999 to 20 million Lek ($200,000) in 2005 (ITS 2006; Demiraj 2007). However, as far as vehicle quality is concerned, the public enterprise vehicles are considered the worst in the city by users (CoPlan 2007).

Now the City of Tirana, rather than being a transport provider, plays mostly the role of monitor of private companies. The central government still retains powers over urban transport. The central government institutions, including the Ministry of Public Works, Transport, and Telecommunications, the Ministry of Finances, and the Ministry of Internal Affairs, determine bus fares, prepare the legal framework for urban transport, recommend the quality parameters for buses, and lay out long-term strategies for urban transport, with consideration of environmental impact and European Union directives (CoPlan 2007). In 2008 fares were increased from 20 Lek to 30 Lek in response to bus companies' complaints about raising fuel costs and threats to suspend the sales of monthly passes, which caused agitation among the population.

Table 2. Bus operators in Tirana.

Operator	*Route*	*Length (km)*	*No. of Bus Stops*	*Hours per Day*	*Freq. (mins)*	*No. of Buses on Route*	*Bus Fleet*	*Passengers (million/ year)*
PTUU Tirana (Public)	Kinostudio-Kombinat	8.7	13	18	3	24	66	8.3
Alba Trans	Tirane e Re	5.8	13	16	3	16	38	4.4
(Private)	Tufine	6	9	16		9		
Tirana Lines	Kamez	7	13	17	3	16	60	6.3
(Private)	Laprake	3.2	5	17	2	6		
Ferlud (Private)	Unaze	7.4	19	18	2	44	55	8.3
Tirana Urban Trans	Porcelan	3.2	6	18	5	10		
(Private)	Sauk	8	13	18	3	13	42	6.4
	Uzina Traktori	8	14	16	5	10		
Otto-Al (Private)	Uzina Dinamo	8.9				15	15	
Total		**66.2**				**163**	**276**	

Source: City of Tirana, Department of Transport.

The City decides on the distribution of public transport in the city, the expansion of public transport lines, the location of bus stops and terminals, the amount of subsidy for the enterprise that is still public, and the terms of contracts with private companies. It also proposes changes in bus fares to the central government. By law, urban bus companies have to allow handicapped people, war veterans, children under 14, and orphaned minors to travel for free; suburban bus companies are required to offer these groups a 50 percent discount. Bus companies are not reimbursed for these free or discounted tickets that they issue. Only a small percentage of the public transport users have veteran, orphan, or handicapped status but there is some evidence that a number of people falsely claim one of these statuses (ECAT 2008).

The contracts between the City and private companies have a number of flaws. For example, the contracts do not specify the penalties to be paid by private operators if they do not comply with the contracted schedule or size of fleet. Also, the contracts do not specify the number of passengers that a bus can carry at one time to prevent overcrowding (CoPlan 2007).

Despite these issues, as a result of privatization, the bus service has improved considerably while fares have stayed affordable. Buses charge only 30 Lek ($0.30) per ride regardless of the distance travelled. Monthly passes are also available (900 Lek per line; 1,200 Lek for all lines; and 600 Lek for students). Urban bus lines are legally bound to offer monthly passes; 41 percent of urban bus users buy them. The urban lines' revenue from monthly passes is between 18 percent and 46 percent of all revenues depending on the line served and the selling efforts of different operators (ECAT 2008). The demand for monthly passes is so high in Tirana that, during a shortage in 2008 caused by bureaucratic delays, a black market emerged, in which they were sold at a more than double the price (*Koha Jone*, 5 March 2008; *Koha Jone*, 28 March 2008).

Suburban lines charge higher fares depending on the distance and do not offer monthly passes. The round trip fare required to reach the largest informal settlement west of the city is 100 Lek ($1), which represents a considerable expense for low-income commuters. Typically, bus companies perform controls on buses or establish fixed revenue amounts that the conductors have to turn in at the end of their shift (CoPlan 2007).

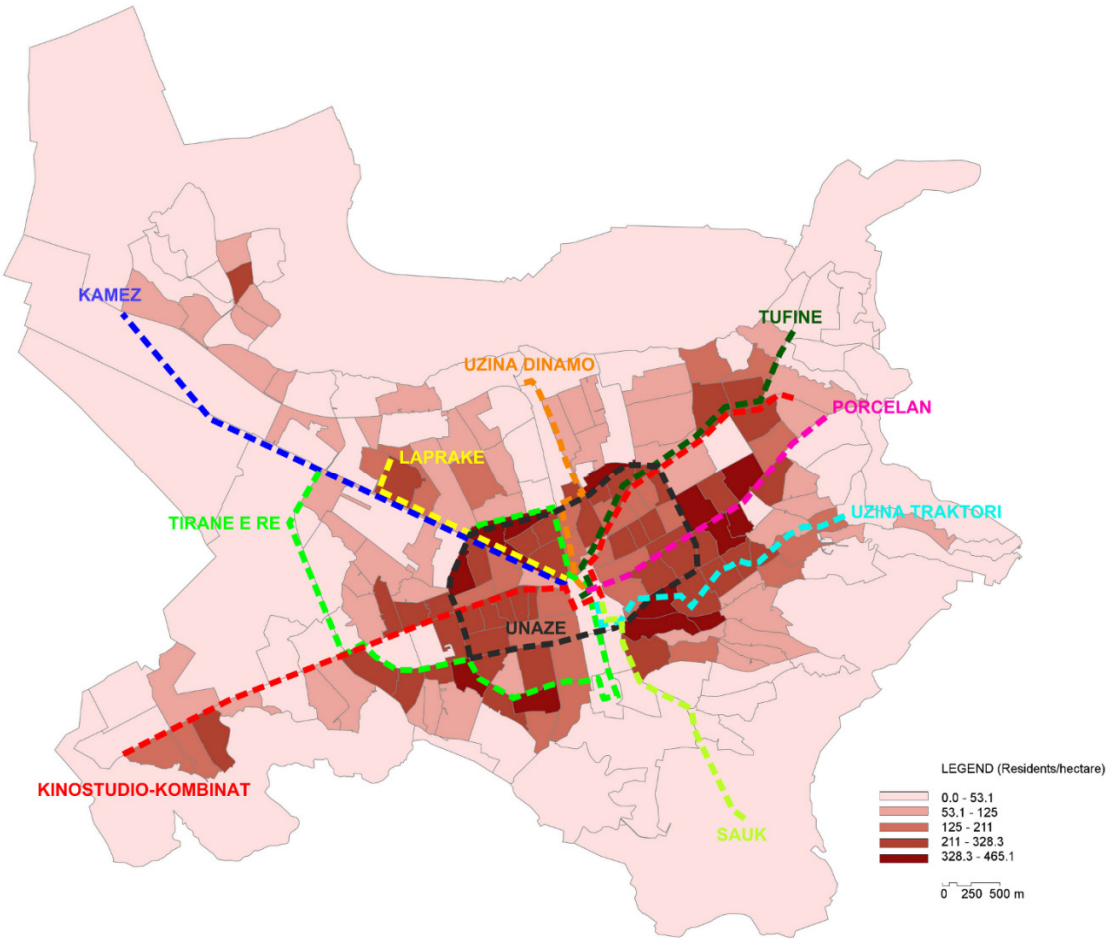

Figure 5. Bus routes in Tirana

Unfortunately, the bus network is still not very extensive (Fig. 5). The system also suffers from a number of other failings. All bus lines operate on fixed routes but bus stops and schedules are not coordinated among bus lines nor posted in public places. Information about the system layout and service frequency is not readily available at bus stops or on the vehicles. However, urban buses run very frequently, every few minutes; therefore, there is no need for a schedule for these buses. Buses serving suburban destinations, on the other hand, run every half hour or every hour and they often change schedules. In addition, if the line "intrudes" into another jurisdiction, such as the case of the Kamez line that connects Tirana and Kamez, conflicts over service coverage have arisen between the two municipalities, which further undercut service quality (CoPlan 2007).

Often there are comments in the press that buses intentionally prolong waiting times at stops and run at lower speeds compared to contract specifications, in order to collect more passengers. In addition, the press has criticized the City of Tirana for not enforcing contractual requirements, such as the provision of air conditioning inside buses, claiming that at least 5 percent of the elderly citizens who visit emergency rooms in the summer become sick while riding buses (*Gazeta Shqip*, 28 August 2009). In addition, criticism is directed to the fact that some buses are covered in advertisements (Fig. 6), which makes it difficult for passengers to distinguish among the lines (*Gazeta Sot*, 20 January 2009). In mid-2010, the busiest line, Unaza, added ten new air-conditioned buses to its fleet.

Figure 6. Bus in the center covered in advertisements.

The public company, which still operates one line, is on the verge of bankruptcy. As a result, service improvements are impossible. Its revenue/expense ratio was about 65 percent from 2001 to 2005. The operational losses for every bus exceed three million Lek per year ($30,000). Less than half of its vehicles on average are in operation daily. The company is still overstaffed: the average staff per bus of 10.2 people is 4-5 times higher than private companies (ITS 2006; Demiraj 2007).

Interviews with representatives of the private bus companies suggested that they are struggling as well and catalogued a host of problems. The increases in fuel costs through the end of 2008 placed a large burden on them because fuel purchases constitute more than half of their total expenses. In addition, the time wasted while buses are stuck in traffic with the rest of the vehicles brings about substantial losses. Bus delays drive away customers. In many cases, bus stops are obstructed by illegally parked cars, frustrating drivers and passengers; bus companies felt that this happens because the road police are not adequately watchful. The revenues of suburban companies are substantially undercut by competition from illegal furgons. The two-year contracts with the City of Tirana (for both urban and suburban companies) are too short for them to make many investments. Meanwhile, Tirana's residents pay no specific urban transport taxes. All bus company representatives requested the creation of dedicated bus lanes by the City (Bushati 2007; Demiraj 2007; Bardhi 2007; Ismaili 2007; Riveni 2007).

On the other hand, the Consumer Protection Office issued a study in 2008, which estimated that the revenues of bus companies are at least $21 million per year while their costs are $14 million per year at the most, leaving profits ($7 million) sufficient to improve the service without any subsidy from the City (*Gazeta Panorama*, 25 November 2008; *Gazeta Shqip*, 28 August 2009).

In an effort to survive (or maximize profits), bus companies employ financially unsustainable strategies, such as using capital improvements funds for daily operations, or socially detrimental strategies, not paying any benefits (such as social security) to their employees. Some suburban operators that partially cover the inner city as well, try to "trick" their passengers in order to increase revenues: they allow them on board with urban monthly passes, and once out of Tirana, require them to pay extra (CoPlan 2007). At the same time, private operators are under pressure to invest in capital improvements in order not to lose their market share and meet pollution standards (ITS 2006).

Although banned from the inner city, informal transport has continued to play a major role in the metropolitan region. It serves commuters from the suburban and rural areas, who travel into the inner city and between satellite towns. Furgons serve 14 percent of the overall travel in Tirana's district (compared to 57 percent served by buses), 33 percent of the travel between satellite towns, and 27.5 percent of the travel from the suburbs to Tirana. The largest informal squatter zones west of Tirana are among the most heavily dependent on informal transportation due to a shortage of formal service in their area (CoPlan 2007). Bus companies, suburban ones in particular, complain that the competition from furgons is unfair (Bushati 2007; Demiraj 2007; Bardhi 2007; Ismaili 2007; Riveni 2007).

Forty-two percent of the city residents and 37 percent of suburban and rural residents in Tirana's district favor travel with licensed vehicles, because this makes them feel safer during trips while a high percentage of users (30 percent) are indifferent to whether the vehicle is licensed or not; they say that the most important factor to them is to reach their destinations on time (CoPlan 2007).

In 2007, this author conducted surveys of 33 furgon drivers. Some findings from these surveys were: (1) drivers typically worked for themselves, owned their vehicle, and had no outstanding debt to banks or informal lenders (2) drivers worked long hours including weekends but their efforts were rewarded as their typical earning varied from 25,000 to 40,000 Lek per month ($250-400), which is comparable to white collar public administration wages (3) the vehicles used were old and polluting (4) drivers requests to

the local government included a terminal station, financial help in the form of tax relief, fuel price controls, long-term licenses, controls against corruption while securing licenses, less harassment from the police, and more traffic controls, road signals, and road maintenance.

3.4. Residents' Views of Public Transport Services

In 2003, right before privatization, this author directed a random door-to-door transportation survey of 201 adults, mostly living in a central, particularly desirable neighborhood. This author followed up in 2007 with a citywide random telephone survey, which included 384 adults.[2] The 2007 survey responses were well distributed in the inner city but did not reach suburban residents.

The 2003 surveys indicated that 58 percent of women and 43 percent of men commuted to work by public transportation (formal and informal). The 2007 surveys indicated that 38 percent of women and 23 percent of men rode buses to work. The percentage of households with cars jumped from 44 percent in 2003 (in a wealthy central area) to 64 percent in 2007 (citywide). But still only a little over half of the population (54 percent) could drive and possessed a driver's license in 2007. In the 2007 surveys, about half of the surveyed population considered the quality of bus services very poor or poor.

Other recent information on public transport in the Tirana metropolitan area, including informal settlements, comes from a 2007 survey of more than 2000 residents conducted by an urban planning NGO, CoPlan. Seventy-six percent of the survey respondents were public transport users. More than half of the surveyed population used public transport every day. Another 14 percent used it every weekday. Buses were the main transport mode for two thirds of the surveyed population, while cars were the main mode for less than one fifth. The use of taxis was negligible. The main public transport users were the residents who lived at the end of the lines. Car access is much lower in the metropolitan region compared to the inner city, though the study did not report specific data. Car users typically spent over 10 times more per week for transport compared to public transport users (350 Lek/week vs. 3800 Lek/week).

Less than 10 percent of respondents were "very satisfied" with the bus service, while 30 percent were "very dissatisfied". Among suburban and rural residents, in particular, one third were "very dissatisfied". City residents tended to be more neutral towards the public bus service. The main complaints about buses from dissatisfied customers included (1) sexual harassment by other passengers (2) poor hygiene (3) risk of theft, and (4) people pushing each other. The surveys revealed that Tirana's residents were strongly in favor of the creation of bus lanes. By 2007, just a handful of people considered the introduction of rail-based transport in Tirana as a possibility.

While urban bus users complained more about bus overcrowding, slow speed, and low frequency, suburban bus users complained more about high fares, frequent stops, frequent changes of bus stop locations, the fact that passengers are allowed to transport trading goods on buses, and the suburban lines' lack of access to the city center. The last item is particularly important because suburban and rural users often carry luggage during trips. 88 percent of suburban lines users and 35 percent of the urban lines users indicated that public transport vehicles make extra stops, in addition to the formal bus

[2] This sample size allows for a survey of the official population in the City of Tirana (650,000 inhabitants) with a confidence level of 95% and a confidence interval of 5.

stops, on passengers' requests. Overall, the least satisfied users were the commuting employees and students, who comprise a majority of passengers. Respondents cited the carelessness of the public transport staff, the heavy traffic load, the low number of buses, and the lack of controls by authorities as the main reasons undermining bus service quality (Fig. 7).

Figure 7. Bus picking up passengers while in traffic. Bus stop obstructed by parked cars.

A great majority of respondents (83 percent) said that they would use public transport even more if the service was improved. Moreover, 67 percent of car users said that they would use public transportation more if the service was improved. Only 15 percent of car users said that they would not switch to public transport under any circumstances. The most desired improvements were an increase in service frequency and an improvement of vehicle quality. About 60 percent of respondents wanted longer service hours. Other, less pressing, requests were the extension of service in peripheral areas, increases in and improvements of bus stops, and reductions in the fare. However, 57 percent of people said that they would be happy to pay a higher fare if the public transport service was improved. Interviewees who did not support fare increases commonly indicated that it was pointless to pay more because rampant corruption would prevent any improvements.

The abovementioned findings are consistent with the findings of opinion surveys carried out by the City of Tirana (2007, 2008), which include questions on public transport. In brief, the City's surveys suggest that (1) almost half of the surveyed population uses primarily buses for urban transport while a little over one third uses primarily cars (2) in some peripheral neighborhoods, public transport is the main transport mode for more 60-70 percent of the surveyed population, and (3) the improvement of public transport and road infrastructure ranks high in citizens' priorities, especially of those who live farther from the core.

4. Conclusions

Tirana's transport problems and adverse transport externalities may be substantially alleviated without exceptional public investments due to the high density, moderate size, and flat terrain of the city. As a result, much urban travel can be conducted on foot, by bicycle, or with short bus rides. Bus services play a central role in the life of the city and its citizens and are paramount in improving the accessibility of substantial portions of the population, particularly for residents in peripheries, who are spatially isolated but depend on the capital for jobs and other services. The quality of public transport services is a major preoccupation of the residents.

It must be noted that while comparisons may be drawn between Tirana and other East European capitals, which are primate cities in their nations, Tirana's size is smaller than its counterparts, and its public transport system is entirely road-based. The operation of a bus system presents a different, and arguably simpler, set of problems than the operation of the multi-modal systems (road and rail) of other East European capitals.

Although both critics and advocates of public transport privatization believe that it results in increased fares and reduced services for the user (TCRP 2003), in Tirana the privatization of bus services, which has advanced even faster than in other Eastern European capitals, has considerably improved the service while fares have stayed affordable. Although the public sector has generally assumed a laissez faire attitude after privatization, which contrasts with some East European cities but parallels others, fares have remained regulated by the central government.

Both users and the public sector have benefitted from privatization, the former through improved services at low cost, and the latter though drastically reduced disbursements to the bus transport sector. However, user surveys reveal large dissatisfaction with the current service, partly due to higher expectations in the post-communist period now that the population has more exposure to the better quality systems of neighboring countries, and access to private cars. Also, bus companies in Tirana have made no joint efforts to promote their systems, although an association of public transport operators exists. In contrast, other East European capitals, Budapest in particular, have carried out marketing campaigns and public relations strategies for their public transport systems, similar to those of western-style for-profit enterprises (TCRP 2003).

The bus service quality still lags behind other European counterparts. The governance of its operation merits a substantial level of investment in order to strive for the best possible results. What specific steps to take in order to improve it is a matter of debate.

One part of the uncertainly stems from the fact that it is unclear how profitable private bus companies are in reality. While the ombudsman concluded that the private bus companies were making profits equal to one-third of their gross revenues, the companies indicated that they were losing money and could not afford to improve their services. Counterclaims on these issues can be made freely. Sometimes, untrue claims about business losses provide a cover for profit maximization strategies, while in other cases price regulations and performance requirements drive regulated businesses into the ground. Without a substantial level of economic transparency, formulation of policy, pricing, and standards takes place in the dark.

Were the public sector in Tirana able to provide financial support to bus companies, some authors believe that performance-based incentives would be the optimal way to manage the information asymmetry brought about by privatization – the private

information about costs that is not shared with the public (see Hooper 2008). However, operational subsidies to private bus companies do not seem to be a realistic solution as the City maintains that it simply cannot afford them. In fact, the public Institute of Transport Studies in Tirana has repeatedly recommended that the last line in public ownership be privatized in order to reduce public expenses (ITS 2006).

Assuming that the claims of bus companies regarding costs are truthful, one type of help would be to allow bus companies to gradually increase fares, more in line with operating expenses. The local government could then require lower fares for certain groups, such as senior citizens of fixed incomes, students, handicapped people, and, possibly, the unemployed. However, based on the experience of other East European countries, this strategy might backfire driving away a portion of the customers.

A second step would be the provision of dedicated bus lanes on all bus routes, or at least on the routes with the highest ridership. In view of current sustainability concerns, bus lanes are a desirable measure regardless of the public transport ownership type. Their benefits would be manifold: (1) higher bus speeds would make bus travel more attractive, even for higher income residents, leading to higher revenues for bus companies (2) less air pollutants would be emitted by buses sitting idle in traffic benefitting the public as a whole (3) mobility and accessibility would improve for disadvantaged groups and (4) with narrower right-of-ways, fewer cars would be able to travel on the main roads, creating a more pleasant urban environment for Tirana's residents and visitors.

Bus lane projects might qualify for international assistance funds because they are one-time capital investments, while operational subsidies to bus companies are an ongoing expense for which it is very difficult to obtain financial assistance from abroad. At present only a few dedicated bus lanes exist in the center, which are shared with bicycles. The City has announced plans to add 23 km of bus-only lanes. Although the majority of the public is in support of their extension, one portion of the car ownership elite argues that the public sector should focus on accommodating car travel instead. In any case, public policies and investments such as the construction of dedicated bus lanes and the authorization of higher fares also need to be accompanied by improvements in vehicle quality and service speed by private operators.

Informal transport will remain an important mode for poor squatters in the peripheries, who commute to the capital for work. In the short-term, it is unrealistic to expect the formal bus companies to largely extend their services to areas that are covered today by informal operators. Furgons' operational model – driver/owner and "competition on the road" as opposed to the monopoly operation rights that formal companies enjoy – is not problematic per se. Most importantly, furgons operate at a profit. Most criticism of informal transport is directed at the quality of the vehicles and the unruly driving. Therefore, the public sector should consider taking steps, which could aid small transport operators, including small credits to buy regular urban mini-buses and the creation of terminal stations for them, while regulating their operation.

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The awarding of seaport terminals to private operators: European practices and policy implications

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Abstract

The awarding of port services to private operators has become one of the most important tools for port authorities to retain some control on the organization and structure of the supply side of the terminal market. This paper discusses the awarding of terminals in European ports from an EU legal and policy context. It also seeks to provide in-depth information on current practices and perceptions of port authorities around Europe on tendering and contractual arrangements linked to the awarding of terminals. The relevant issues relate to the terminal awarding processes, the duration of the terminal award contract and the contract stipulations. The paper also seeks to understand whether the practices are influenced by factors such as terminal size, the competitive environment in which the port operates and the geographical location.

Keywords: Concessions; Terminal; Seaport; Legal system; Governance; European Union.

1. Introduction

The awarding of port services to private operators has become one of the most important tools for port authorities to influence the prosperity of the port community (Notteboom, 2007; Pallis et al., 2008). Through the awarding procedures and the contract, port authorities can in principle retain some control on the organization and structure of the supply side of the terminal market, while optimizing the use of scarce resources such as land. This paper contains the main findings of a survey on the awarding of terminals in Europe. The survey was commissioned by the European Sea Ports Organisation (ESPO) in response to the European Commission's ports policy communication which was published in October 2007. With this paper, we aim to provide a better understanding of current practices of port authorities in Europe.

In a first part, the paper discusses the EU legal and policy context governing the awarding of terminals in European ports. The remaining sections of the paper seek to

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provide in-depth information on current practices and perceptions of port authorities around Europe on tendering and contractual arrangements linked to the awarding of terminals. The paper also seeks to understand whether practices are influenced by factors such as terminal size, the competitive environment in which the port operates and the geographical location. Due to confidentially reasons, this paper only contains aggregated results grouping terminal projects and ports considered.

2. The EU context: rules on service concessions and the European ports policy communication

2.1. The uncertain status of terminal awarding regimes under EU law

The granting of rights of use to ships, goods and terminal operators is subject to the general rules of the EU Treaty, such as the provisions regarding freedom to provide services and the prohibition of abuse of a dominant position. The awarding of long-term rights of use to port service providers, especially in cargo-handling, can be governed by a number of legal constructions (Van Hooydonk, 2002), including the rather rigid EU Directives on public procurement and the more flexible regime governing service concessions which seems to be the preferred option for port authorities. Essential elements of service concessions include the transfer of responsibilities to the concessionaire and the fact that a significant risk inherent in the delivery of the services lies with the concessionaire (Petschke, 2008).

The granting of service concessions is subject to general EU legal principles of equality of treatment, transparency, proportionality and mutual recognition which the European Commission clarified in a horizontal interpretative communication (European Commission, 2000). It was however for a long time unclear to what extent these principles were applicable to the variety of terminal awarding regimes existing in Member States (Van Hooydonk, 2002). Whereas in some countries these are governed by public law and take the form of public service contracts or public domain concessions, in others these are governed by private law and take the shape of ordinary lease agreements. In yet other cases a variety of unilateral permits, authorisations and licenses exists, whereas some countries or ports do not seem to have any particular regime or form whatsoever (ESPO, 2005). Also, the notion ‘services’ caused considerable confusion since service concessions would normally concern activities whose nature and purpose, as well as the rules to which they are subject, are likely to be the State's responsibility and may be subject to exclusive or special rights (European Commission, 2000). Privatisation processes have however more or less liberalised cargo handling services in most Member States and the European Court of Justice even ruled that these services are of a commercial nature and not different from any other economic activities (European Court of Justice, 1991).

2.2. The port services’ Directive: a failed attempt to provide legal certainty

The European Commission published in 2001 a Directive proposal on market access to port services (European Commission, 2001). The aim of the proposal was to establish rules for market access to port services including the use of transparent selection procedures. The political debate, animated by aggressive trade union protests, focused

on labour-related aspects of the proposal. The essence of the Directive was however about the way in which port authorities would use terminal awarding agreements to regulate market access for potential service providers, thus ensuring market contestability and intra-port competition (De Langen and Pallis, 2006; Verhoeven, 2006; Pallis, 2007). The Directive proposal also set rules to avoid discriminatory behaviour of port authorities that were directly or indirectly engaged in the provision of port services themselves.

Although the Commission's initial proposal was quite dogmatic, the compromise that was painstakingly devised afterwards by Council and Parliament did acknowledge the strategic role of port authorities and took into account the need to ensure continuity of investments and legal certainty for existing agreements. Influenced by continued labour unrest as well as internal political meddling, the European Parliament however rejected the final compromise on the Directive proposal in November 2003. In 2004 a second version was published (European Commission, 2004) which also failed to find political support, mainly because some of its key features did not respect the compromises already reached on the first proposal (Verhoeven, 2006). The uncertainty regarding the status of terminal awarding regimes under EU law therefore continued to exist.

2.3. The soft law approach of the European Ports Policy Communication

Following the rather traumatic double failure of the port services' Directive, the European Commission took its recourse to 'soft law' and published, after an extensive process of consultation, a Communication on a European Ports Policy (European Commission, 2007) which contained a chapter with guidance on the use of port concessions. The Commission confirms that terminal awarding agreements granted by a public port authority are to be considered as service concessions under EU law, regardless what their status is under national law (public or private law, contract or unilateral measure etc.). The key element is not the actual cargo handling service itself which – as explained above – is a normal commercial service, but the fact that access to port land is a precondition for providing this service. The granting of the use of a piece of port land would thus be a measure through which the port authority disposes of a public good of which the availability is limited and which allows the performance of the commercial cargo handling activity which would not be possible without the availability of this public good. The public aspect would even be stronger in case port infrastructure is financed by public means. Only if the port and its real estate would be fully private, run as private companies and if all its components would be fully financed by private means an exemption from the rules governing service concessions would seem to be feasible (European Commission, 2008).

The application of EC Treaty rules and principles on service concessions is elaborated in the above-mentioned horizontal interpretative communication of the Commission (European Commission, 2000). This guidance has now been specifically applied to the port sector through the concessions chapter of the European Ports Policy Communication. The Commission first of all identifies the basic principle that public authorities granting a concession are bound by a transparency obligation, implying that their initiative must be adequately advertised, that the procedure must be fair and non-discriminatory and that it can be reviewed. Such obligation of transparency consists in ensuring, for the benefit of any potential candidate, a degree of advertising sufficient to enable the concession to be opened up to competition and the impartiality of the selection procedure to be reviewed. The transparency obligation would not only apply

to concessions involving cargo handling services, but also those concerning technical-nautical services (pilotage, towage and mooring). Here the Commission is more precise about the use of selection procedures, stipulating that these must be given 'adequate, European-wide publicity'.

Seen from a port governance point of view, the Commission clarifies some important additional points. First it says that the transparency obligation does not hinder port authorities from setting selection criteria which reflect the commercial strategy and development policy of a given port that will be the basis for granting the concession. This is an important recognition of the discretionary power of port authorities, which was a crucial issue during the debate on the port services' Directive. In addition, the transparency obligation would only apply to contract awards having a sufficient connection with the functioning of the internal market, excluding for instance cases of very modest economic interest which would make contract awards of no interest to economic operators located in other Member States. The second important point relates to the length of concessions. According to the Commission, durations must be set so that these do not limit open competition beyond what is required to ensure that the investment is paid off and there is a reasonable return on invested capital, whilst maintaining a risk inherent in exploitation by the concessionaire. This again corresponds with the perspective of the port authority, wishing to ensure a balance between a reasonable payback period for the investments made by terminal operators, on the one hand, and a maximum entry to potential newcomers, on the other (Notteboom, 2007). The Commission adds that, when a concession expires, renewal is considered equivalent to granting a new concession and is therefore bound by the above-mentioned transparency obligation. This raises an important question regarding the common practice of prolongations whereby a concessionaire makes additional investments before the expiry of his concession. Also, it is not clear to what extent clauses on possible prolongations can already be included in the initial concession agreement. A third point is that the Commission accepts provisions in concession agreements which aim at ensuring that the terms of the concession are respected and at protecting the legitimate interests of ports and local communities, notably with regard to overall quality and performance of port services. A condition is that these provisions do not infringe Treaty rules or Community legislation. The Commission would thus allow the active use of concessions as intelligent governance tools, an issue which is elaborated further in this paper. The final point relates to the safeguarding of rights of workers in case of transfer of activity further to a selection procedure. This would mean that, subject to conditions, new concessionaires may be obliged to take over staff employed by the previous concessionaire. It remains to be seen to what extent this may impose an entry barrier to new operators and thus reduce market contestability.

2.4. Further initiatives

It is important to underline again that most of what is explained above is based on the interpretation of the European Commission and has therefore the status of 'soft law'. For the time being there is no secondary legislation in place which confirms these principles although the Commission is considering the development of a horizontal Directive on concessions (Petschke, 2008). Neither is there solid jurisprudence of the European Court of Justice available in the field of port concessions. Port authorities could therefore choose to take the risk of ignoring the principles that the Commission set out in its ports policy communication. This hardly seems a responsible strategy

however. Leaving aside the possibility that a legislative approach may still be forthcoming, it would be unwise to ignore the above-cited principles simply because it is likely to incite litigation from operators who were not granted a concession in a given port. The question should therefore rather be whether the guidance provided by the Commission provides sufficient legal certainty for port authorities and recognises and empowers their strategic role of port authorities.

The Commission's guidance can be qualified as being very supportive to the position of the port authority, confirming its discretionary power in the selection of operators and the setting of concession conditions. Apart from specific questions already raised above, such as the prolongations of concessions and take-over of personnel, two fundamental problems however remain which are inherent to the 'soft law' nature of the Commission's communication. First, contrary to for instance the port services Directive, the communication does not foresee transitional rules for existing agreements since it is not introducing new legislation but simply giving an overview of principles based on the fundamental rules of the Treaty. It is however common knowledge that many concessions in European ports were not granted on the basis of the transparency obligation required by the Commission. This leaves a great deal of uncertainty as regards existing agreements. Second, it could be argued that the interpretative guidance of the Commission may not be sufficient to empower the position of port authorities and ensure a level playing field among them that would match the bargaining power of terminal operators as well as political influence often exercised in the granting of concessions (Verhoeven, 2008).

It is obvious that these concerns could have been more adequately addressed through legislation which would undisputedly have created greater legal certainty. The future will demonstrate how effective the soft law approach will be. In this respect, two pending issues should be noted. First, there is the already mentioned possibility that secondary legislation on concessions may still be forthcoming, but then at a more horizontal, cross-sector level. This is however not certain and in any case not expected to happen before 2010. Second, there is the survey on current practices regarding the awarding of seaport terminal contracts in Europe which the European Sea Ports Organisaton (ESPO) commissioned in 2008 and of which the results are summarised in this paper. The survey is a first step towards the publication of a code of good governance on port concessions which ESPO is preparing to complement the soft law guidance provided by the Commission. It is hoped that in this way a number of the unanswered questions may be solved in a practical manner.

3. Set-up of the survey

In order to shed light on terminal awarding practices in Europe, the first part of the survey contained questions related to the situation in Europe. In total about 80 port authorities around Europe received the survey. Answers were obtained for 43 terminal projects in European seaports, resulting in a response rate of 54%. Two thirds of these projects relate to greenfield developments (i.e. the terminal site is either reclaimed from the sea or encompasses land not previously used for port or industrial activities), while the remaining cases relate to brownfield sites (i.e. site has been used before for other port or industrial activities). About 44% of the terminals considered started operations recently. For about a quarter of the projects, the awarding and contracting procedures

are already completed, but the terminal has not started up operations yet. In 13% of the cases the awarding procedure is completed, but the contract with the future operator is not finalized yet. For the remaining cases the awarding procedure has not been started up yet or the awarding procedure is ongoing.

Table 1: Distribution of responses to the survey (43 terminal projects in Europe).

Terminal Size	*No.*		*No.*
0-5 ha	4	Hamburg-Le Havre range	12
5-50 ha	17	Scandinavia/Baltic	10
50-100 ha	6	Mediterranean	12
>100 ha	9	Atlantic range	5
Not indicated	7	United Kingdom/Ireland	0
TOTAL	43	Black Sea	3
		Other	1
		TOTAL	43

Table 1 depicts the distribution of responses to the survey. Large, medium-sized as well as small terminal projects are represented in the survey. About 61% of all responses relate to container terminal projects (26 in total). We estimate that this represents about 35 to 40% of all container terminals in Europe that have started/will start operations or have been/will be awarded in the period 2003-2010. The survey results are mainly providing a good representation of the current situation in the European container terminal industry.

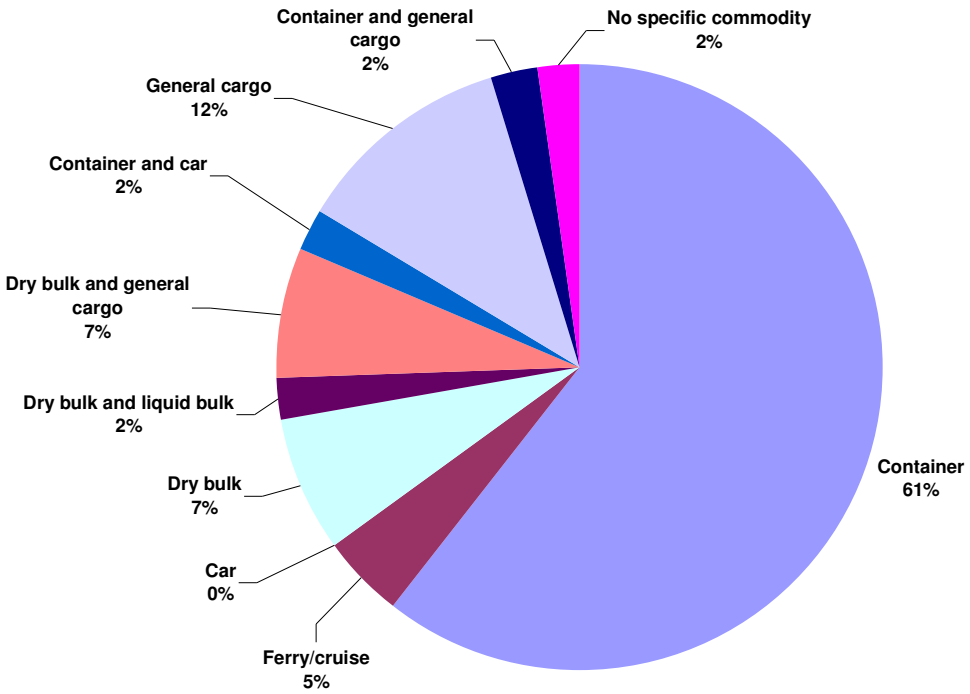

Figure 1: Distribution of responses according to terminal type.

Some important remarks should be made with respect to the terminal projects considered in the survey. First and foremost, port management systems differ significantly in Europe. The survey was mainly relevant for 'landlord' ports in Europe, thereby excluding quite a number of European ports mainly situated in the United Kingdom, Scandinavia but also elsewhere. Second, ongoing port reform programs imply that quite a number of European ports are in a transition phase. Newer EU Member States such as Poland, Bulgaria and Romania have recently witnessed a shift from state-owned and state-operated ports to a landlord-type of port management system. For example, the Polish 'Law Act on ports and harbours' demands from port authorities to execute privatization of port terminals/operators which formerly were state-owned companies. Such activities are in progress in Gdynia since 2001 and up to now two of the four terminals have been privatized, while the other two are still owned and controlled by the State. Countries like France and Spain are presently undergoing major changes in their respective national port policies.

4. Survey results: the terminal award process

4.1. A classification of awarding procedures

Terminals may be awarded by several methods, including without limitation, by direct appointment, private negotiation from a qualified pool, or using a competitive process. The survey revealed that, for the given port project sample, competitive bidding is the most common procedure used in concession granting today (table 2). Quite remarkably, direct appointment seems to be more common among larger terminals. Processes of private negotiation from a qualified pool are mainly used for smaller terminals. Mediterranean ports massively opt for competitive bidding processes, while the Baltic ports show the largest diversity in awarding methods. It is difficult to quantify to what extent national and supranational legislation, port privatization schemes and legal disputes have contributed to this situation. Any competitive bidding should comply with the principle of equality, which states that every candidate should be equally treated and compared and that there will be no favoritism in the awarding of the concession or no substantial reduction of competition.

Table 2: The type of awarding process used.

	ALL	*Size of terminal*			*Region*			
		<50 ha	50-100 ha	>100 ha	Baltic	H-LH range	Med	Other
Type of awarding process for the specific terminal prjects								
Awarding by direct appointment or direct adjudication	**14%**	5%	17%	22%	33%	15%	0%	11%
Awarding through a process of private and bilateral negotiations from a qualified pool of market players	**11%**	19%	0%	0%	22%	23%	0%	0%
Awarding through a competitive process (including public tendering or competitive bidding)	**75%**	76%	83%	78%	44%	62%	100%	89%
	100%	100%	100%	100%	100%	100%	100%	100%

In only 21% of the projects following a competitive bidding process, potential candidates were invited by the port authority. In 83% of the cases, the port authority published an open call for tender. It has to be stressed that such an open call in quite of number of cases does not involve a public tendering procedure. It often involved an open assessment procedure with room for negotiations and the submission of improved proposals during the process. In 68% of the 'open call for tender' cases the terminal is awarded on the basis of the offers of the eligible candidates, followed by one or more negotiation rounds. In the remaining cases the terminal is awarded on the basis of the offers of the eligible candidates without any negotiations or the possibility for candidates to submit a revised proposal during the awarding process. Some ports use different types of tendering procedures depending on specific criteria: for example, a limited or 'light' version for smaller facilities and a full version for larger terminals.

In the cases where terminals were directly appointed, port authorities did so mainly for strategic reasons (e.g. the creation of intra-port competition or the securing of further expansion possibilities for efficient incumbent firms) or because the terminal project represented a marginal extension of an existing facility (for instance the extension of an existing container terminal with one berth).

Table 3: The geographical and market scope of the awarding process.

	ALL	*Size of terminal*			*Region*			
		<50 ha	50-100 ha	>100 ha	Baltic	H-LH range	Med	Other
Regarding the awarding process, how extensive was the related publicity?								
Announced on a national scale	**17%**	18%	25%	11%	33%	0%	11%	40%
Announced on a European scale	**38%**	64%	0%	0%	33%	33%	33%	40%
Announced on an international scale	**46%**	18%	75%	89%	33%	67%	56%	20%
	100%	100%	100%	100%	100%	100%	100%	100%
What kind of terminal operators are involved in the awarding process?								
Local operators	**12%**	19%	0%	11%	20%	17%	0%	13%
Local and national operators	**16%**	19%	20%	0%	10%	8%	17%	38%
Local, national and foreign operators	**72%**	62%	80%	89%	70%	75%	83%	50%
	100%	100%	100%	100%	100%	100%	100%	100%

In case of a competitive bidding process, in almost half of the cases the port authority announced the awarding process on an international scale, 35% on a European scale and only 17% on a national scale (table 3). Not surprisingly, larger terminals show the most international focus. The awarding process for Baltic ports tends to be much more locally-oriented than the Hamburg-Le Havre range and the Med range. A possible explanation lies in the lower direct liner connectivity of the Baltic region to the international trade routes. Hence, Baltic ports are typically focused on intra-Baltic trade, shortsea services from the rest of Europe and feeder services in relation to the mainports in the Hamburg-Le Havre range. When asking about the kind of terminal operators

involved in the awarding process, 72% of the respondents pointed out that the bidding process involved local, national and foreign operators, whereas the remainder only included local and or national operators. Also here, large terminals have the widest coverage (table 3).

In case the awarding of the terminal takes place via a competitive process, a wide diversity exists in stages/rounds included in the awarding process (table 4). In about 38% of the cases, the terminal is awarded to one of the candidates in only one round. One third of the projects considered involves the reduction of the number of candidates in a first round (via a qualification/eligibility stage or selection stage). The remaining candidates take part in a second round (for example they get an invitation to tender). The final awarding is made in the second stage. Almost equally important is an awarding process covering more than two rounds, typically including a selection stage and two or more rounds to narrow down the number of candidates. Large terminals are characterized by more complex awarding processes, while an awarding process of only one round is frequently used for small and medium-sized terminals. The Mediterranean ports generally opt for a one-round process, while northern European ports often opt for several rounds.

Table 4: The stages in the awarding process.

	ALL	*Size of terminal*			*Region*			
		<50 ha	50-100 ha	>100 ha	Baltic	H-LH range	Med	Other
In case of awarding of the terminal via a competitive process, what kind of stages/rounds does the awarding process include?								
The terminal is awarded to one of the candidates in only one round	**38%**	41%	60%	0%	0%	22%	64%	43%
In a first round the number of candidates is reduced via a selection stage. The remaining candidates take part in a second round (for example they get an invitation to tender). The final awarding is made in the second stage	**32%**	29%	40%	20%	50%	33%	18%	43%
The terminal is awarded in more than two rounds, typically including a selection stage and two or more rounds to narrow down the number of candidates	**29%**	29%	0%	80%	50%	44%	18%	14%
	100%	100%	100%	100%	100%	100%	100%	100%

The survey also gives insight into the methodology used to award terminals. In about 48% of the terminal projects, the port authorities used some sort of uniform awarding formula or system for all terminals in the port. For large terminals of more than 100ha this figure amounts to 75%. In the remaining 52% of the cases the method was determined ad hoc based on the specificities of the terminal project under consideration (only 25% for large terminals).

4.2. Competitive bidding: the selection phase

Table 4 revealed that in almost two thirds of the cases, the competitive bidding procedure consists of two or more stages. The first phase typically involves a selection or qualification stage based on experience and financial strength of the candidates. The first stage in the bidding procedure reduces the number of potential bidders thereby avoiding the risks of non-compliance by unreliable bidders. In approximately 86% of the competitive bidding procedures considered, the selection stage includes minimum requirements related to the financial strength of the candidates. The most commonly-used financial parameters relate to a threshold value for the turnover of the candidate (mentioned by 38% of the respondents who use minimum requirements related to the financial strength of the candidates), a threshold value for the cash flow of the candidate (22%) and a maximum value for the ratio between the amount to be invested by the company and the turnover or net accruals of the company (28%).

In approximately 92% of the competitive bidding procedures considered, the selection stage included minimum requirements related to the relevant experience of the candidates. The experience of the candidate can for instance be demonstrated by the management of facilities for similar cargo in the same or other ports. The candidate thus has to credit his experience in the activities related to the project by giving proof of specific antecedents in the exploitation of terminals. The most common ways for port authorities to ask proof of relevant experience relate to:

- Experience in any part of the world in the operation of terminals of the same kind as the terminal that is being awarded (mentioned by 62% of the respondents who use minimum requirements related to the relevant experience of the candidates);
- A minimum worldwide terminal throughput (in tons, TEU, number of passengers, etc..) required to be eligible as a candidate (24%);
- Experience in any cargo handling operations in ports located in any part of the world (24%);
- Experience in the operation of terminals of the same kind and in the same region as the terminal that is being awarded (6%);
- Experience in any cargo handling operations in the same region as the terminal that is being awarded (3%).

4.3. Competitive bidding: the final awarding phase

Table 5 gives an idea of which documents and plans candidates have to submit to the port authority in view of the final awarding of the terminal. A technical implementation plan is compulsory in nearly all terminal projects under consideration, while requesting a financial plan and a marketing plan is a very common practice as well.

In about 70% of the terminal projects, each bidder had to quantify the staff requirements and also had to present studies of environmental and territorial impact covering aspects such as the impact of the terminal operations on the environment and the alternatives to eliminate, reduce or mitigate certain effects.

When asking about whether or not the port authority uses a formalized system in the final awarding stage, 41% of the respondents indicated they have no specific quantitative mechanism in place, but make a final choice based on a qualitative overall appreciation of the proposals. In 59% of the cases, the respective port authorities use some sort of scorecard system: various aspects of the proposal are rated and the results

are added up to a weighted or unweighted score, based on a score for each of the evaluation criteria related to the elements in the proposal.

Table 5: Components to be included by the candidate in view of the final awarding stage.

	ALL	*Size of terminal*			*Region*			
		<50 ha	50-100 ha	>100 ha	Baltic	H-LH range	Med	Other
Share of cases that incorporate the following elements in the documentation candidates have to prepare in view of the final awarding stage(s)								
Technical implementation plan of the terminal ordered by stages according to the growth of the traffic	**98%**	95%	100%	100%	90%	100%	100%	100%
Financial plan, including:	**78%**	75%	83%	88%	30%	91%	100%	86%
Expected cash low	**46%**	40%	67%	63%	20%	55%	67%	43%
Expected prices and maximum charges the operator expects to charge	**32%**	35%	50%	25%	10%	18%	58%	43%
Costs of the operation (including manpower, equipment, fuels and other inputs and supplies)	**37%**	35%	50%	50%	20%	27%	50%	43%
Marketing plan that defines the demand of services for the terminal and justifies the prevision about the magnitude and requirements of the installations, including projections of yearly throughput for a number of years	**76%**	80%	67%	75%	60%	73%	92%	71%
Employment impact: requirements of staff	**71%**	75%	83%	50%	30%	82%	83%	86%
Environmental plan covering aspects such as the impact of the terminal operations on the environment and the alternatives to eliminate, reduce or mitigate certain effects	**73%**	65%	100%	63%	60%	73%	75%	86%

The survey also contained a section on the importance of the various criteria used in the final awarding of the terminal (see figure 2). The overall results show that the expected throughput is considered as the most important criterion in about 50% of the terminal projects considered. In about 23% of the cases, the port authorities attributed the second highest priority to the throughput criterion. Price bids play an important role as well, but in 30% of the terminal projects the price bid was not part of the awarding process due to the specificities of the pricing system used by the port authority (see next section for a more detailed analysis). Other important criteria used in view of the final awarding stage of a terminal include the contribution to the economic development of the region/country, the financial proposal (others than the price bid) and the technical proposal for the terminal. It is interesting to observe that in about three quarters of the terminal cases, the respective port authority explicitly or implicitly includes criteria

related to the preservation or introduction of intra-port competition in the port. Other factors related to the market structure within the port (such as whether the candidate is an incumbent firm or not) are less frequently used as criteria in the final awarding phase. Other factors that were occasionally mentioned by respondents relate to the expected time gap between the awarding of the terminal and the start of the operations, the inland transport issue, the feeder network concept and the risk profile of the candidate (loyalty concerns).

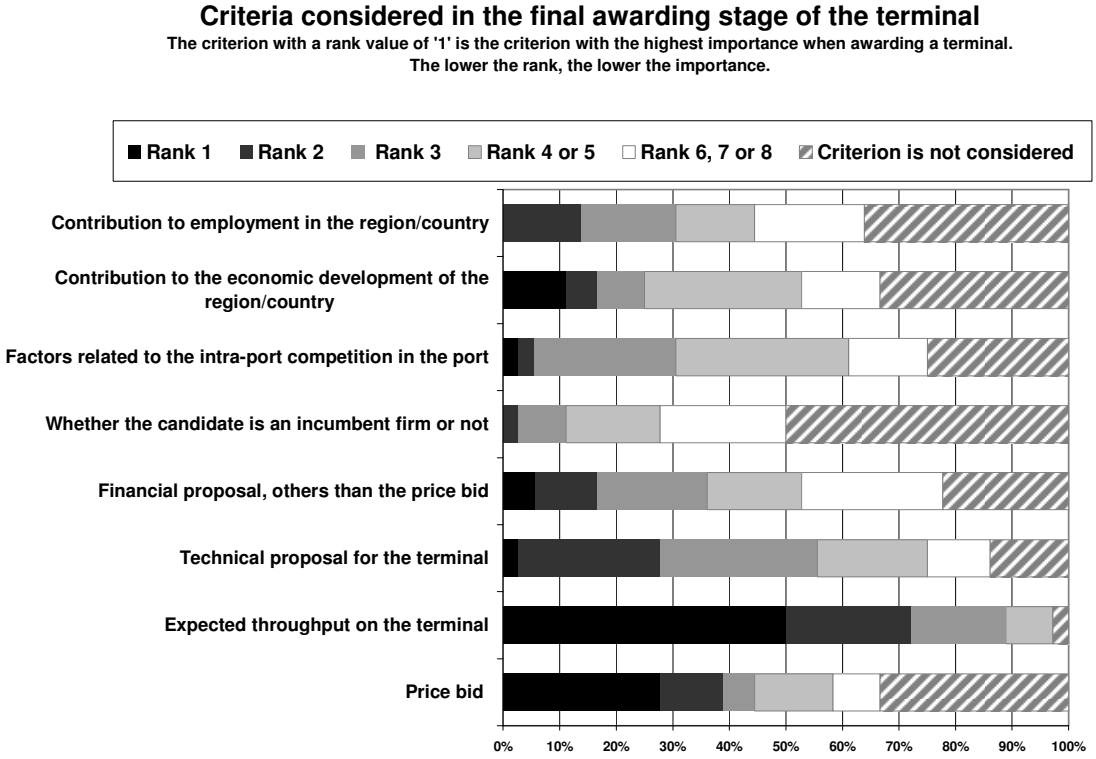

Figure 2: Criteria used in the final awarding stage – all terminals.

The throughput criterion is an important issue, also for smaller terminals. Port authorities seem to attach greater value to whether or not the candidate is an incumbent firm in case the awarding process concerns a smaller facility. Safeguarding intra-port competition and the contribution to the economy are higher for large terminals. In 30 to 35% of the cases involving smaller facilities, the latter factors are not even considered in the final awarding stage.

5. Survey results: the duration of the terminal contract

An internal survey by the European Sea Ports Organization (ESPO) held a few years ago (ESPO 2005) revealed a big variety in terminal contract durations in European ports. It is not in line with reality in the port sector to try to fit everything in one set of average durations. The existence of a wide variation in durations is confirmed in the survey (table 6). Contract durations in the sample ranged from 4 to 65 years. Two thirds

of all terminal contracts have a term of 21 to 40 years. Not surprisingly, larger facilities tend to have longer contract durations.

In 58% of the terminal award procedures included in the survey, existing laws impose minimum and or maximum limits on the duration of the terminal award contract. Legislators have developed thresholds on concession durations in view of safeguarding free and fair competition in the port sector.

Table 6: The term of the terminal award.

Duration of the contract	*ALL*	*Size of terminal*		
		<50 ha	50-100 ha	>100 ha
Less than 10 years	**6%**	7%	0%	0%
11-20 years	**18%**	33%	17%	0%
21-30 years	**38%**	47%	50%	13%
31-40 years	**24%**	0%	33%	63%
More than 40 years	**15%**	13%	0%	25%
	100%	100%	100%	100%

About 59% of the port authorities in the survey sample point out that the duration is determined ad hoc based on the specificities of the terminal under consideration. The remaining respondents underline they deploy some kind of uniform formula or system to determine the contract durations for all terminals in the port.

Table 7: Criteria used for the determination of the contract term.

Duration of the contract	*ALL*	*Size of terminal*		
		<50 ha	50-100 ha	>100 ha
Factors that play a role in the determination of the duration af the contract. Share of cases that consider the specified factor				
Investment levels by the terminal operator	**75%**	79%	50%	75%
Investment levels by the managing body of the port or the government	**38%**	37%	50%	50%
Level of dedicated layout/equipment at the terminal versus level of multifunctional use of the terminal	**15%**	5%	17%	25%
Type of terminal/commodity handled on terminal	**15%**	5%	33%	38%
Location of the terminal in the port (for example a strategic deepwater location)	**10%**	5%	17%	25%
The status of the terminal site (greenfield site versus brownfield site)	**13%**	11%	0%	38%
The existing and expected future level of competition between market players in the port	**8%**	5%	0%	13%

While clear rules of thumb on the determination of the contract duration seem hard to find, the survey clearly indicates the duration mainly varies with the amount of the initial investment required both from the terminal operator and the port authority. Many of the other factors considered in table 7 have direct implications on the required investment levels, e.g. the type of terminal/commodity handled on the terminal, the level of dedicated layout/equipment at the terminal, the location of the terminal in the

port and the status of the terminal site (greenfield site versus brownfield site). These other factors do not play a strong role in case of smaller terminals. Surprisingly, port authorities in the sample generally seem not to take into account the existing and expected future level of competition between market players in the port (intra-port competition) when deciding on the contract duration. In other words, the number of players in one specific terminal market segment inside the port area does not seem to have an impact on the contract term (the figures for large terminals are significantly higher though). Other factors that can play a role in the setting of the contract duration relate to the compliance with the development policy of the port, land lease and other easement rights and the refurbishment of historical sites within the concession area.

In 61% of the terminal projects the term of the contract was or is preset by the port authority. In the remaining cases, the term is the result of a negotiation between terminal operator and the port authority. Occasionally, the port authority might opt to leave it up to the bidder to indicate the term in years that he requires.

The duration of the agreement is of crucial importance both to terminal operators and port authorities. In general, long-term agreements allow private port operators to benefit from learning-by-doing processes and to achieve a reasonable ROI. Port authorities try to find a balance between a reasonable payback period for the investments made by terminal operators on the one hand and a maximum entry to potential newcomers on the other (Notteboom, 2007). As long-term agreements limit market entry, intra-port competition will only take place among the existing local port operators. As discussed in the next section, port authorities can include safety valves in the contract, so as to make the terminal available to other candidates in case the existing operator does not meet specific performance thresholds.

6. The survey results: contract stipulations

6.1. General overview

Once the terminal has been awarded, the port authority and the terminal operator draw up a contract. The contract typically stipulates that a private company is allowed to operate a specified terminal for a given duration. The design of the contract, starting with the rights and obligations of both parties involved is a key element. In principle, the port authority has no guarantee that the terminal operator will meet its objectives. As such, contracts often take the form of performance-based agreements to create incentives for the terminal operator to meet the objectives of the port authority. The results allow to identify key elements in terminal contracts (table 8).

The most commonly used clauses relate to minimum throughput requirements, environmental clauses and clauses with regard to changes in the ownership structure of the terminal (present in over 80% of the contracts). Slightly less widely used are renewal or extension clauses and stipulations that empower the port authority to end the contract. In about 40% of the cases the contract contains clauses on minimum investment levels required, modal split and or clauses referring to what happens if the contract is not extended after the end of the regular contract term. Clauses with respect to the conditions that allow for a renegotiation of the terms of the contract are not widely used (mentioned in only 25% of the cases). The sections below zoom into the

various clauses. The inclusion and enforcement of specific clauses depends partly on the existing balance of power between the port authority and the terminal operator.

Table 8: 'As is' survey: clauses in a terminal contract.

	ALL	*Size of terminal*		
		<50 ha	50-100 ha	>100 ha
Clauses included in the award contract between the managing body of the port and the terminal operator (as share of all projects)				
Throughput guarantees	**93%**	84%	100%	100%
Environmental clauses	**85%**	89%	67%	75%
Modal split clauses for hinterland transportation	**35%**	26%	50%	38%
Renewal clauses or extension clauses	**58%**	63%	50%	63%
Clauses with respect to the conditions that allow for a renegotiation of the terms of the contract	**25%**	32%	17%	38%
Clauses referring to what happens if the contract is not extended after the end of the reguar contract term	**40%**	42%	17%	63%
A minimum investment clause of x Euros over the total duration	**40%**	42%	33%	38%
Clauses with regard to what happens if the terminal ends up under a different ownership structure	**80%**	74%	67%	88%
Clauses that empower the managing body of the port to (unilaterally) end the contract	**70%**	74%	67%	88%

6.2. Throughput guarantees

Table 8 reveals throughput guarantees are included in more than 90% of the sample of terminal contracts. The port authority generally indicates upfront a minimum throughput to be guaranteed by the terminal operator. This should encourage the operator to market the port services to attract maritime trade and to optimize terminal and land usage. The survey results show that in 67% of the contracts with throughput guarantees, contract clauses explicitly mention that the terminal operator has to achieve a minimum cargo volume for the terminal as a whole. In only few cases port authorities put forward a minimum cargo volume to be handled per hectare of terminal area or per meter of quay.

The survey results made it clear that the threshold values in the throughput clauses are often determined via negotiations between terminal operator and the port authority (mentioned by respondents in 46% of the terminal cases). Also quite common is the fixing of the throughput guarantees by the port authority based on port benchmarking exercises (32%). The involvement of a public/government body, other than the port authority, in the setting of the minimum throughput requirements is far less likely to take place (mentioned in only 14% of the cases). One of the respondents referred to a system of minimal threshold values determined by the port authority based on port benchmarking exercises and final threshold values in the throughput clauses determined by the results from the awarding process.

The contracts typically contain provisions in view of protecting the terminal operator and the port authority against arbitrary and early cancellation. However, about 70% of the contracts also contain clauses that empower the port authority to (unilaterally) end the contract in case the terminal operator does not meet certain preset performance

indicators. In case the terminal operator does not meet the throughput guarantees as set in the agreement, 68% of the contracts in the sample explicitly refer to the payment of a penalty to port authority (e.g. a fixed amount per ton or TEU short) or, in the most extreme case, the terminal will be taken away from the operator. One of the respondents clarified the port uses a sanctioning system based on a fee to be paid by the terminal operator as a percentage of the amount of a year's lease payment. In only 3% of the analyzed terminal projects, the port authority leaves room for negotiations to determine the real fee to be paid. Quite a number of port authorities (i.e. 22%) use throughput clauses as a soft objective (an intention) and consequently do not impose a sanction in case the throughput figures are not reached.

6.3. Environmental clauses

Table 8 demonstrated that environmental clauses appear in 85% of all terminal contracts of the survey. In about 30% of these cases, the environmental clauses refer to the compulsory use of some sort of environmental management/reporting system, while maximum emission levels are included in 18% of the contracts. About 9% of the contracts only refer to specific technical equipment to be used to limit emissions (for example coldironing for vessels, electric yard equipment, etc..). About one fourth of all contracts combine several of the above environmental clauses. Occasionally, ports include clauses on existing or future contamination of the terminal site. Quite a number of respondents who do not include specific environmental clauses in the contract added that the terminal operations should comply with national environmental standards stipulated by the law.

6.4. Modal split clauses for hinterland transportation

Recent terminal contracts increasingly adopt modal split specifications, particularly in a container terminal context. The results point to the inclusion of modal split clauses in 35% of all contracts considered (table 8). In half of these cases, the contract elaborates on some technical specifications and compulsory investments to be done by the terminal operator in hinterland transport infrastructures on the terminal site. In only 21% of the cases, the modal split clauses explicitly impose a specific modal split on the terminal operator to be reached by a certain year (for example: 40% road, 40% barge and shortsea and 20% rail by 2010). In about 14% of the cases, the modal split to be reached is specified for each year of operation. The modal split target is often formulated as a soft objective (an intention).

6.5. Renewal clauses or extension clauses

Many terminal award contracts (nearly 60% in the survey sample) contain stipulations on a possible prolongation of the terminal award beyond the official term. The most popular contracts arrangements are:

- Clauses referring to the conditions for renewal of the terminal use after the end of the regular contract term (mentioned by 39% of the respondents who included renewal or extension clauses in the contract);
- Clauses referring to an extension of the contract term if the terminal operator makes additional investments during the regular contract term (18%);

- Clauses referring to interim evaluations (for example every five years) during the contract term. The continuation of the terminal use is subject to a positive evaluation during the interim evaluations (18%).

Furthermore, many port authorities make a possible extension of the contract term subject to a direct negotiation between terminal operator and the port authority at the end of the regular term (38% of the cases). Port authorities opt for a public procedure in 30% of the cases. In some ports, the terminal operator can request a prolongation of the terminal contract based on major investments made by the operator throughout the contract term or in the last years of the contract term. Such request is then examined by the port authority.

6.6. Clauses referring to what happens if the contract is not extended after the end of the regular contract term

Some 40% of the contracts considered contain clauses referring to what happens if the contract is not extended after the end of the regular contract term. In 63% of these cases, the clauses explicitly refer to financial compensations for the value-added linked to investments made by the terminal operator in a specified period prior to the end of the contract term. In less than 7% of the sample, the port authority included clauses referring to arrangements with respect to employees/personnel linked to the terminal operations once the contract term ended.

Port authorities in Europe seem to follow different paths when it comes to dealing with the terminal superstructure at the end of the contract. In 30% of the cases under consideration, the port authority decides at the end of the contract term on what to do with the superstructure. Common approaches also include the removal/destruction of the superstructure by the terminal operator at the end of the contract term (28%) or the transfer of the assets to the port authority without any form of compensation (26%). The survey further revealed that it is not common practice for the port authority to financially compensate the terminal operator for the superstructure that was transferred at the end of the contract term (15%).

7. Discussion and conclusions

The European Commission has confirmed in its recent European Ports Policy Communication that terminal awarding agreements granted by public port authorities are to be considered as service concessions under EU law, regardless what their status is under national law of Member States. This means that terminal awarding agreements are subject to a number of basic principles with regard to equality of treatment, transparency, proportionality and mutual recognition. The guidance of the Commission however still raises a number of unanswered questions which need follow-up.

The survey made clear that a large diversity exists among European ports, particularly in terms of the specificities of the awarding procedures deployed. The survey results mainly capture current practices in ‘landlord’ ports in Europe, thereby excluding quite a number of European ports. Hence, the issue discussed in the report is not relevant for highly integrated ports. While performing the survey and analyzing the results, it became clear that the observed diversity is to a large extent the consequence of:

- The range of and priorities in objectives followed by the respective port authorities (e.g. micro-economic objectives such as profit maximization or throughput maximization and macro-economic objectives such as the creation of value-added for the community and employment);
- The specific local situations and markets the ports are operating in;
- The size difference among the terminals considered.

In other words, the specific design of the contract, its regulatory regime, the pricing regime and the way the terminal is awarded reveal the priorities of individual port authorities and as such play an important role in local port governance.

Notwithstanding existing differences, the terminal awarding practices in European ports seem to be converging with respect to some specific aspects. The vast majority of European port authorities are trying to optimize the use of scarce land via the inclusion of throughput specifications in the contract. They are also increasingly using the terminal awarding process in view of a broader environmental compliance of port activities and a sustainable development of the port.

Port authorities continue to use terminal award procedures also in view of shaping the structure and market organization of the terminal handling business in the port area, thereby in principle ensuring further capacity growth for efficient incumbent firms and ensuring intra-port competition by allowing new entrants in case a poor competitiveness urges the port to do so.

All of the above points make that port authorities should be given the possibility to work out awarding procedures for new terminals taking into account local objectives and the need for a sustainable and highly competitive port context. However, fierce competition and the fear of traffic losses increase the risk of putting port authorities in a weak position, eventually making them less observant and strict with regard to the editing and the enforcement of the rules in the contract. With the emergence of international terminal operator groups and shipping lines, port authorities are confronted with powerful and footloose players.

If further policy action at a national or supranational/EU level were to be envisaged, it should be aimed at empowering port authorities better to fully take up their responsibilities and to further develop their role as (local) regulator in an environment that provides legal certainty to all parties involved. The survey results seem to suggest this can best be done through guidelines on general principles instead of detailed legislative proposals.

Terminal awarding policies as part of governance structures are not static but evolve constantly in line with the requirements imposed by the market. The dynamics in the port environment urge the port authority to continuously evaluate the effectiveness of its terminal award policies in light of market trends. This further supports the argument for giving full ‘ownership’ and responsibility on terminal awarding procedures to the port authorities. A code of good governance, as intended by ESPO, could be a useful complement to the Commission’s guidance and avoid a rigid legislative approach.

Notes

The views and opinions expressed by the authors do not necessarily state or reflect those of the European Sea Ports Organisation (ESPO) or any member of ESPO. The

survey results are based on an aggregation of information provided by port authorities across Europe.

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