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Selection Criteria of Transportation Mode: A Case Study in Four Finnish Industry Sectors

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ABSTRACT *This paper takes a closer look at the very basics of logistics and it analyses the selection criteria of transportation services from the industrial point of view as the main research problem. It also tries to establish a better understanding of which industrial sectors are using which mode of logistics services and why. According to the analysis, the high value and especially high price/kg ratio of products, short life cycles and worldwide markets are typical reasons to use rapid modes of transport. The high price/kg ratio of products and the short life cycles, for example in the electronics industry, cause high price erosion and support selecting transport based on speed, as proportional transport costs remain small, even when using expensive transportation modes. Based on the results, some of the future logistics needs were identified, and the aim is to help logistics service providers offer the exact services needed, providing better competitiveness for Finnish shipping companies operating in global markets. Logistics service providers are, for example, expected to have more powerful supply chain management capabilities than a single-service provider can typically offer. Additionally, logistics service providers should have compatible operating systems with different parties of various supply chains to enable deliveries to different customer groups according to their industry's required speed.*

Introduction

This paper analyses the current selection criteria of transportation services from a Finnish industrial point of view as the main research problem. It also aims to understand better the current and future logistics service needs by finding out which industrial sectors are using which mode of logistics services and why. Identifying the future transportation needs of industrial companies is challenging. At the moment four major trends drive development: globalization; a concentration on core competencies; the shortening of product and service life cycles; and the enlargement of e-business in supply networks (Kanerva and Purola, 2001). Probably the most powerful of these is globalization development. According to other studies, four factors drive globalization: global market forces, technological forces, cost structures, and political and economic factors. Global

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market forces include both intensifying competition and the promise of new markets and new customers; technological forces include the easier use of the best technologies and expertise worldwide. Globalization is also about taking advantage of the different cost structures in potential operation locations, i.e. in selecting the location for a production site. Political and economic factors include, for example, taxation, customs, the availability of an educated workforce and the protection of currency risks (Simchi-Levi *et al.*, 2000; TT, 2003).

Focusing on companies' core competencies is the second major trend. Instead of having all operations inside the company and trying to maximize economies of scale and scope, it is suggested that companies should concentrate on their core competencies and organize their structure to support that principle (Lonsdale and Cox, 2000). According to earlier research results, companies should concentrate on their core competencies and outsource support activities to operators concentrating on those areas of expertise (Quinn, 1999).

Shortening product life cycles is the third trend. The life cycle model describes the development of product markets. The model is suitable not only for simple products, but also for product groups whose life cycle ends as new innovation become common (Kotler, 2000). The product-specific logistical actions are dependent on a product's position in its life cycle. For example, in the start-up and growth phases, speed to market and flexibility are essential, whereas in the maturity and decline phases, cost efficiency and minimizing inventory levels are the most important (Rushton *et al.*, 2001).

The fourth major trend is the enlargement and increase of e-business in supply networks, making supply chain partners develop, organize, and change their operations models and enterprise resource planning (ERP) systems so that fluent and automatic information exchange is possible. This is required to achieve and realize the identified savings potential offered by information integration in supply networks. According to recent studies, major factors driving the development in this area are the transparency of information and its real-time distribution to necessary parties in the supply network, managing the whole supply network, and the new operations models and services based on more integrated and intense cooperation (Auramo *et al.*, 2002; Burke, 2002).

The present research takes a closer look at the basics of logistics and analyses the selection criteria of transportation services from the industrial point of view as the main research problem. It also tries to establish a better understanding of which industrial sectors are using which mode of logistics services and why. It first preselected a handful of industrial sectors operating in Finland for this analysis. The focus area was the logistics service need of the selected industrial sectors today as well as in the future. Then the transportation modes used today, the selection criteria and potential problems encountered were sorted out. Based on the research, changes in logistics service needs arising from the developing manufacturing strategies of the Finnish companies in the selected industrial sectors were identified. Based on this, future logistics needs have been outlined and the aim is to help logistics service providers offer the exact services needed, providing better competitiveness for Finnish companies operating in global markets.

Research Methods

Research work was started with a literature study (see above and below). In the second phase, semistructured focus interviews were used as the research method.

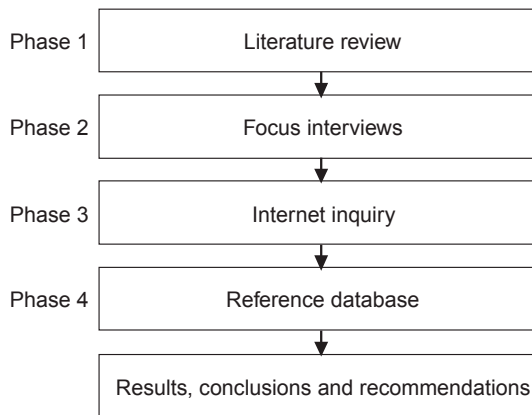


Figure 1. Phases of the research project

Ten logistics directors/managers were selected for focus interviews from companies operating in the selected industrial sectors. In the interviews, a two-phased inquiry form was used. The first one included 19 open questions to define the industry sector, the operational geographical areas, the unit locations, the transport modes and transport routes used, the selection criteria and the importance of different transport modes, the supply chain structure, the recent changes and estimations of the future changes, as well as the company's position in the future supply network. Also, the company's benefits and/or disadvantages based on the location in Finland were stressed out in today's situation as well as in the future. In the second phase of the inquiry, the information was acquired by obtaining answers to 21 fixed statements regarding the criteria in transport mode selection, the importance of different aspects such as price and service speed, as well as the nature of company's logistics service needs. The interviews were carried out in January 2004. In the third phase of the research, an Internet inquiry was conducted to enhance the results and strengthen their reliability. In the inquiry the same questions were used as in the focus interviews, with open questions from the focus interviews also added. Altogether, 49 logistics managers/directors answered the inquiry. In the fourth phase of the research, a database of DHL Finland's transports in 2002 was used as an additional reference information source. The database included information on truck, express, air and sea freight use, and the destination of the shipments. The phases of the research work are described in Figure 1.

Background Data on Selected Industrial Sectors

Four different types of industrial sectors were chosen for the focus interviews. One requirement in the selection process was that the respondents should have a view on the whole supply chain in the focus industry. The researched industrial sectors were the electronics industry, the pharmaceuticals trade, the heavy machinery production industry and the constructional product industry including technical wholesale. Material received from other industrial sectors was combined to create one general reference group for comparison purposes. The research focused on industrial sectors that were expected to encounter considerable changes in logistics actions in the near future. The expected reasons for this

Table 1. Value of production in the selected industry sectors, 2001 (Statistics Finland, 2003)

Branch	Electronics	Pharmaceutical	Machinery	Construction
Gross value of production (€, billions)	22.3	0.68	11.4	6
Export (%)	80	64	57	24
Export to the European Union area (%)	40	65	45	50
Exports outside the European Union (%)	60	35	55	50

were, for example, European Union enlargement and the identified tendency of manufacturing companies relocating their operations to countries where the cost of labour is significantly lower than in Finland. The classification used was from Statistics Finland (2004), which is the classification standard in Finland. Table 1 describes the key figures from these four industrial sectors.

According to Statistics Finland, the electronics industry includes, for example, the production of electronics and optical products, information and communication apparatus, and radio and television set manufacturing, as well as the manufacture of medical devices and watches. In Table 1, mobile phone manufacturing represents the major stake in this field. The pharmaceutical trade market in Finland was around €1.5 billion in 2003 (Lääketeollisuus ry, 2004). Comparing this information with the value of production in Table 1 shows that the majority of sales in Finland are imported products. In the heavy machinery production industry, the most important groups are paper machines, power engines, elevators and transfer devices, and agriculture and forestry machines. For the constructional product industry including technical wholesale, there was no directly identical group and the figures in Table 1 were combined from two different groups. These contained the metal products not in the heavy machinery production industry category, and plastic products for building, pipes and building boards.

Background of Transport Mode Selection in the Focus Areas

The importance of logistics operations for a commercial enterprise can be illustrated by the fact that 10–25% of every sales dollar is spent on logistics (Bowersox *et al.*, 1999). For example, in Finnish companies, the cost of logistics is, on average, 10.2% of sales (Kanerva and Purola, 2001). According to Ballou (1999), transportation and warehousing usually represent the most important single elements in logistics costs for most companies.

According to the Finnish Customs, the foreign trade of Finland in 2002 was €54 billion export and €42 billion import. The total volume of exports in 2002 was 39.5 million tonnes and the volume of imports was 60.7 million tonnes. Calculating from the basic figures, the average price/kg for exported products was €1.37/kg and for imported products was €0.70/kg.

Analysing the transportation modes used is important. However, it must not be done with too narrow a mind. Measuring by the value of products, 72% of foreign trade was transported by sea and 13% by air, both in import and export. Road

transportation was used for 13% of exported goods and for 7% of imported goods. The rest includes transportation by train, mail and pipeline transportation (Finnish Customs, 2003). However, when measuring by the volume of goods transported, the picture is totally different. A total of 91% of exported tonnes used sea freight, 6% used road freight, 2% were transported by rail and the rest by other means. For imports, 68% of goods arrive by sea, 20% by rail, 7% by road and 5% using other means of transport. Especially interesting is that less than 0.1% of tonnes are transported by air, whereas measured by value the figure is 13% (Figure 2).

Road freight was the fastest growing transportation mode in the European Union in the last three decades. In 1999, road freight presented some 75% of the share of transportation when measured in tonnes-km. At the same time, the share was 73% in Finland. The reason for the high popularity of road transport is the flexibility of service and responsiveness to changing customer needs, especially in short range distribution. For long-haul transportation, trucking is also in many cases the cheapest solution, especially if flexibility is required in routing (Pöllänen and Mäntynen, 2002).

However, most Finnish foreign trade is transported by sea. The reason for this seems to be simple: the price/kg of sea freight is low when compared with other modes of transport, especially in export from Finland. However, another reason related to this is that Finland is an 'island' when looked at from the main markets

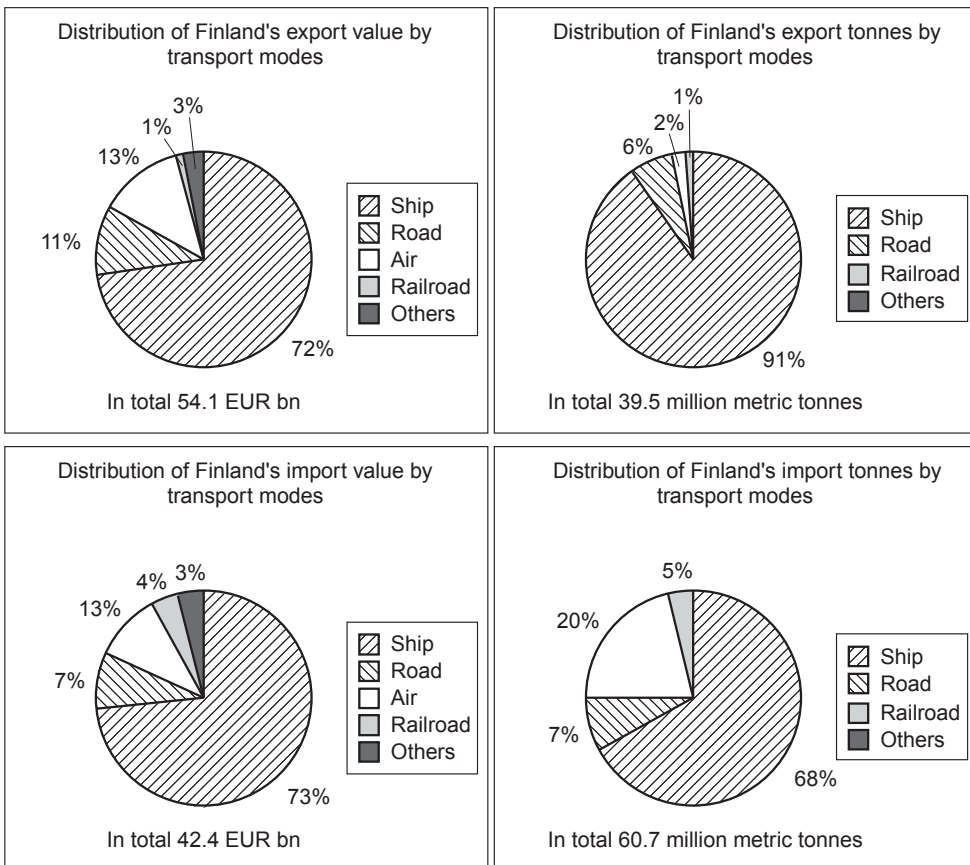


Figure 2. Transportation of Finland's foreign trade, 2002 (Finnish Customs, 2003)

in Western Europe and a logistics point of view. Furthermore, the statistics in Figure 2 are a bit misleading. For example, all trucks travelling by ship are compiled as sea freight in the statistics.

However, if the journey is long or the schedule is critical, air freight is a rapid and safe way to convey carriage from one place to another. The downsides of air freight are cost and environmental effects. The use of air freight is typically limited because of its costs. So service speed, a product's high price/kg value and a high need for security are therefore three main reasons to use air freight (Allaz, 2002).

The fastest growing air freight sector is express freight managed by express freight companies, also known as integrators. Express freight has grown 27% annually between 1995 and 2001, and growth is predicted to be many times that of normal air freight also in the future. While traditional air freight companies handle mainly transports from one airport to another, express freight companies manage the whole journey, with door-to-door deliveries using proper transportation modes and sustaining related information systems (Laitinen, 2002).

In Finland, the proportion of rail freight is twice as high as the European Union average. Rail freight is an affordable transportation mode especially for long journeys, but the problem with it is the requirement of a combination of different transportation modes if the company does not have its own blind track. Most Finnish foreign trade by rail is directed to Russia either directly or by transition. For example, rail transport from Finland to the far east of Russia by the Siberian railroad and continuing by sea freight to South Korea takes about one-third less time than direct shipment by sea. In the future, rail freight will become even faster when the rail connection through North Korea is completed (Mäkelä *et al.*, 2002; Tuisku, 2003).

After all, product characteristics are the major factor affecting the selection of transportation mode (Rushton *et al.*, 2001). Generally, express freight is the fastest mode of transportation and air freight is only a little slower. If the journey is long and the structure of railway network suitable, rail freights are faster than road transports. Sea freight is the slowest mode of transportation and is best suited to bulky products and raw materials. In principle, the costs are negative proportional to speed. But what are the typical selection criteria when choosing a transportation mode? Industrial sector practices, product characteristics, the price of the service, market and customer expectations, as well as manufacturing or delivery network schedules are all very typical issues that affect the selection situation.

Results

Following the above presented assumptions and realities regarding transportation mode selection, the change trends and main problems encountered in logistics services by the selected industrial sectors were identified. In research phases II and III, the information was collected based on in-depth interviews and inquiries.

Identified Change Trends and Consequent Logistics Problems

The focus of the 15 biggest Finnish industrial manufacturing companies has recently been changing from Finland to countries where the cost of labour is significantly lower. The number of employees in those companies in Finland has reduced by some 6000 between 2000 and 2003. At the same time, the number of

employees in those same companies outside Finland has grown by some 16 000. Altogether these 15 major Finnish industrial manufacturing companies employ some 300 000 employees, of which already more than two-thirds are based abroad (Kivistö, 2004). However, especially in other than the electronics industry, the growth has been mainly achieved through the acquisition of existing foreign companies.

Based on the respondents' views, the relocation of industrial manufacturing companies to countries where the cost of labour is significantly lower than in Finland will also gradually intensify the relocation of subcontractors. The relocation development of manufacturing companies would also significantly reduce the need for logistics services in that particular industrial sector. This would also harm notably the overall competitiveness and economical profitability of logistics services, as Finland is a very small market area where the same logistics service providers operate with several customer groups. However, grocery retailers and their wholesale structure, for example, are very confident that their logistics service structure is needed locally and are not therefore afraid of the relocation tendency. This view is basically based on the high frequency and flexible logistics service levels required by retailers that cannot be achieved operating with, for example, a Nordic hub warehouse located beyond the Baltic Sea.

At the moment the growth of the Finnish electronics industry has calmed down (ETLA, 2003). The manufacturing operations of the most simple product groups are being relocated to countries where labour costs are lower, or which are located closer to the markets. However, when designing and verifying the manufacturing operations of new products and ramping up the production during product introductions, Finnish factories will also be very competitive in the future. This is due to a high R&D knowledge level, experience of global markets and operations, and flexibility. The same kinds of requirements are also needed by the logistics service providers so that they can provide the services. High flexibility and variability of logistics service modes, direct and frequent connections, high service quality and delivery accuracy, and finally a global service network are definitely required. At the moment, the respondents in the electronics industry are seeing air freight operations as problematic, especially when heading to North America. This is due to, for example, tightened safety regulations causing delays and problems in the supply chains. Additionally, there have occasionally been capacity problems in the Asian routes.

The pharmaceutical trade market in Finland is notably bigger than the value of domestic production. The majority of sales in Finland are therefore imported products (Table 1). This industrial sector has recently become increasingly more intercontinental and this has led to a rapidly increased number of products and product variety on the market. A major factor behind this has been the acceptance of generic substitution. Based on this pharmacies are allowed to offer consumers other medicines 'identical' to those prescribed by the doctor. This has obviously changed the market share of products due to more open price competition, thus increasing the logistics service needs. For example, this has increased the requirement for punctual and rapid deliveries of smaller and smaller delivery lots in international trade as well as in domestic markets. Problems have been encountered in air freight similarly as in the electronics industry. Additionally, there have been capacity- as well as customs-related problems in road freight services heading to Russia and Eastern Europe. An industry-specific problem area was also identified in pharmaceutical trade interviews. For example, the availability of

thermo units was seen as a notable problem, which is probably caused by the reduction in average lot size of the deliveries.

The importance of South East Asia and especially China is increasing rapidly in the heavy machinery production industry. Subcontracting and especially assembly operations are being relocated from Finland to China. The intensifying competition and status of product life cycles typically force companies to concentrate on their core competencies leading to increasing subcontracting and changing logistics service needs. In the heavy machinery production industry, the considerable product size has occasionally been identified as one major problem. Finding suitable transportation equipment was especially seen as the core problem. Additionally, problems regarding sea freight were typically the inaccuracy of the schedules and damage during transportation.

In the constructional product industry, there is consolidation development going on. Bigger units are being formed and operations reorganized. Standardization development has also intensified international trade in this sector. The wholesalers are also expanding and developing their service models and increasing their role in the supply chain. This is done, for example, by taking material flow responsibility on the site, offering punctual deliveries even up to the installation site and by offering vendor-managed inventory services on construction sites. In the constructional product industry including technical wholesale, the problems in logistics operations were typically connected to dispersed information and material flows. The suppliers were especially willing to get feedback from their delivery performance to improve their operations. Additionally, in this industrial sector the seasonal sales peaks were affecting the reliability of operations and complicating both operations and the work of management.

Finding the Basic Needs and Criteria for Selecting the Transportation Mode

In research phases II and III, inquiries were conducted in both the in-depth interviews and on the Internet. In the inquiry the information was acquired by obtaining answers to both open questions and statements regarding transport mode selection in the following way: "Our company widely uses sea (rail, road, air and as fast as possible express) freight in its transports". The answer options were 5 = I totally agree, 4 = I partly agree, 3 = I neither agree nor disagree, 2 = I partly disagree and 1 = I totally disagree. Table 2 has a summary of the research results from project phases II and III. There is an average from every studied industry. In the column named 'total' there is an average from all answers given by respondents to the statements.

Based on our results, high valued or high price/kg valued products, short product life cycles and worldwide markets are typical in the electronics industry. The short life cycles cause high price erosion, so rapid transportation modes are needed. A high price/kg supports speed, as proportional transport costs remain small even when using expensive transportation modes.

The electronics industry opts for speed over cost when choosing a transportation mode. Quality and safety are seen as essential requirements for transport as well. If express freight is not used, speed is considered a part of good scheduling. In shipments to other continents, air and express freights are the most commonly used transportation modes depending on the company. Express freight is used in shipments to places without regular deliveries or direct flight connections. Nokia

Table 2. Use of different transportation modes in different industries according to answers

	Electronics	Pharmaceutical	Machinery	Construction	Other sectors (reference group)	Total
Sea freight	2.22	2.67	3.90	2.14		3.02
Rail freight	1.00	1.33	1.60	1.57		1.64
Truck freight	3.89	4.33	4.40	5.00		4.64
Air freight	4.33	4.67	2.90	1.29		2.47
Express freight	3.56	3.67	2.20	1.57		2.31
Number of respondents	9	3	10	7	30	59
in-depth interview	3	2	1	3	1	10
internet respondents	6	1	9	4	29	49

Numbers after the transportation modes are averages of the answers received.

1, Does not use; 5, = very important.

Networks, for example, has aimed to increase its use of sea freight in internal shipments, but generally sea freight is only used for deliveries of heavy and large equipment. In shipments to Europe, companies use either air or express freight depending on the urgency. Road transport is used only in deliveries to neighbouring areas unless the company has such a large volume or size of products that air freight capacity from Finland would become a problem. None of the studied electronics companies used rail freight.

Products in the pharmaceutical trade almost always go from one continent to another by air freight to fulfil the quality and speed requirements set. Transportation inside Europe is usually by road because the faster air freight requires more handling, reducing the added value obtained by the increased speed. Express freight in the pharmaceutical trade is important even if volumes are low. Sea freight is used only in product groups with a lower price. Therefore, in the pharmaceutical trade managers also seem to opt for speed over cost when choosing a transportation mode. However, additional requirements were also recognized in this industrial sector. To make the supply chain function well, handling should be minimized. In addition, acting according to the special circumstances of the product, like maintaining the right product temperature in the whole supply channel, were reported as important.

In the heavy machinery production industry, the most important factor in selecting the transport mode is price. If the delivery channel is reliable and punctual, the speed is not so important. All modes of transport were reported as needed and used in the most balanced way of the analysed industrial sectors. However, the most important mode of transport was clearly road transport. If the supply chain only covers European countries, road transport is mostly used. Transportation needs between continents are predominantly covered using sea freight, mainly due to the typically considerable product size. Air freight or express freight is used, for example, in spare part deliveries or if there is a problem in the manufacturing schedule. Rail freight has been used only for deliveries to Russia or China.

Table 3. Selection criteria for transportation modes

	Electronics	Pharmaceutical	Machinery	Construction
1. Criteria:	quality	speed	price	price
2. Criteria:	speed	convenience	reliability	scheduling
3. Criteria:	price	safety	punctuality	punctuality
4. Criteria:	convenience	fluency	speed	convenience

In the constructional product industry and technical wholesale, the price of the transportation mode is the most important selection criteria based on products' low price/kg ratio. Therefore, logistics costs seem to represent a notable share of the total cost structure. Road freight is definitely the most important mode of transportation. Based on typically local operations and markets, the transportation needs cover fairly short distances, decreasing the need for, for example, sea or rail freight. Additionally, only the most urgent deliveries use air or express freight. The need for delivery speed and product availability increases, however, when coming closer to the customer end of the supply chain, where the wholesalers have to respond to retailers and installer needs.

As a summary of our research results, the transportation mode selection criteria of the selected industrial sectors are presented in Table 3. The prioritization of the selection criteria is also presented from each industrial sector's points of view. In table 3, quality covers reliability, accuracy and safety. Convenience represents the ability to take special product characteristics into account in operations. Delivery speed as such is not seen as important but instead it is reactive scheduling possibilities, direct connections and frequency in the delivery network that are required.

It is well known that the price of logistics services is usually a very important selection criterion (Table 3). Based on this, we also wanted to find out the respondents' attitudes towards the classical trade-off question in selecting logistics services, i.e. the trade-off between price and service speed. Figure 3 shows the

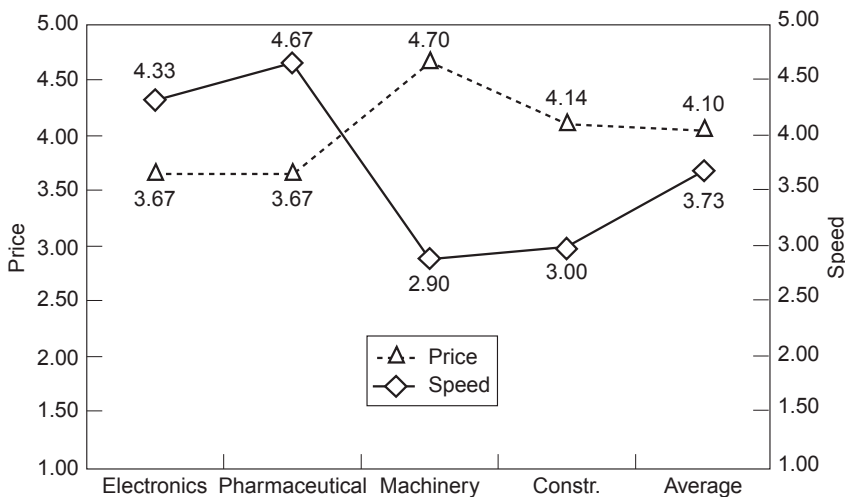


Figure 3. Importance of price and speed of the logistics service in selected industrial sectors

summarized results of this focus analysis, again according to the selected industrial sectors' points of view.

This focus analysis in Figure 3 also strengthens the assumption that the high price/kg ratio of products and short product life cycles, for example in the electronics and pharmaceutical industry, support selecting transport modes based on speed, whereas price is not as important selection criteria there. In more local industries such as the constructional industry, the price of logistics service is, however, a more important selection criterion. The research results from research phases II and III were next evaluated in the fourth phase of the research project. In the evaluation, a confidential database of DHL Finland's shipments in 2002 was used as an additional reference information source. This database includes information on truck, express, air and sea freight use and the destination of shipments. According to this phase, the results shown in Tables 2 and 3 and Figure 3 describe the overall situation well. This increased the validity and reliability of these results.

Conclusions and Recommendations for Further Research

Based on this research, the selection criteria of transportation mode are strongly dependent on the industry sector. Service price, speed, reliability, accuracy, scheduling, convenience and safety are typically the most important general factors. The high price/kg ratio of products and the short life cycles, for example in the electronics industry, cause high price erosion and support the selection of transport based on speed, as proportional transport costs remain small even when using expensive transportation modes. However, in more local industries such as the constructional industry, the price of the logistics service is a more important selection criterion. In the future, the importance of logistics costs or the price of these services to shipping companies will probably become even more important due to, for example, globalization development and enlarging supply chains. At least the cost efficiency of logistics service providers is now seen as notably more important than in, for example, a study by Joutsensaari *et al.* (2002). However, at present logistics service providers' reliability, accuracy, safety, convenience of service, service speed, fluency and punctuality are also some of the most important characteristics when selecting logistics services. Furthermore, based on our research results, some visions of the future logistics service needs may be drawn.

Nowadays the electronics industry is, at least for DHL's express freight services, the most important industrial customer group. The need for flexibility and speed in logistics services is growing as product variety and thus the number and frequency of product introductions increase. Additionally, the electronics and heavy machinery production industries are both interested in increasing their outsourcing and subcontracting activity in China, for example. East Asia as such is also seen as a substantial and growing market area for companies with manufacturing or assembly operations in the area. However, in the Finnish heavy machinery production industry and to some extent also in the electronics industry, there are also a notable number of subcontractors in Western Europe. Currently, it is typical that logistics operators' delivery promises and actual fulfilment vary, especially where the actual delivery time is concerned. For the customer, late arrivals are of course a substantial problem that possibly could harm the whole throughput of the factory. However, deliveries arriving too early may also harm manufacturing operations. The unloading

and warehousing space available may be very limited and in any case production planning has to be carried out according to agreed delivery schedules. A potential solution to these problems could be a centralized information and management service for logistics service providers between the operators and their customers. In this way, customers could control incoming and outgoing goods and component flows better and use trucks as a moving stock that can be delayed or hurried if needed. The centralized information and management service could also actively operate to increase the consolidation of different transportation flows.

In Finland the delivery structure of the pharmaceutical trades sector has recently undergone major changes due, for example, to the acceptance of generic substitution. This has meant that the number of products has quickly increased and pharmacies are now allowed to offer consumers other medicines 'identical' to those prescribed by their doctor. This has obviously changed the market shares and increased logistics service needs. The constructional product industry and especially technical wholesale seem to need even more focused transportation services. The better use of positioning technology would help logistics service providers deliver products to exactly the right place at the right time. This would reduce building contractors' transport routing needs, especially on building sites, and would enhance the efficiency of their own operations.

Moreover, all the companies from different industrial sectors seem to prefer outsourcing warehousing operations. Therefore, there seems to be a real need for warehousing services at a competitive price. Additionally, a logistics service provider is expected to have more powerful supply chain management capabilities than a single or local service provider. The most important desire is that the service provider has compatible operating systems with different parties of various supply chains and networks. The evolving service needs require a notably broader expertise area from logistics service providers in the future. These service characteristics are also strongly similar to the 4PLTM concept already presented by, for example, Gattorna (1998) and Bade and Mueller (1999). However, these requirements come directly from potential customer companies and thus seem slightly more realistic. Some of the companies taking part in this research, for example, were ready to give a fairly central role in their supply chain to a capable service provider that could lever benefits to all parties by operating in this position. However, the market leaders in their business sectors were more careful and willing to manage the supply chain themselves. These differing attitudes can be explained by the fact that the centralized service provider concept would presumably bring more benefits to smaller companies than to market leaders.

To direct the future research and development of service models, the feasibility of the service concepts should be tested with a pilot group of companies in real markets. Especially for companies with thin transport volumes but frequent transport needs, this would offer a way to increase their operations efficiency and service levels. However, the business model of the centralized service provider has to be solved first, requiring investments, for example, in information management and operations management tools as well as in other resources.

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