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THE STATE OF LOGISTICS IN FINNISH WHOLESALE COMPANIES

Master´s Thesis
in Logistics

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1 INTRODUCTION

1.1 Motivation for the research

The Finnish wholesale trade constitutes of more than 12000 companies, excluding agencies and vehicle wholesaling. That is around five percent of all companies in Finland in 2006 (Tilastokeskus.a). The wholesale business employs around 85000 people (3,4 percent of all employed people in Finland) and The Finnish wholesalers pay more salaries combined than Finnish retail trade. The wholesale companies are bigger in size than retailers evaluated by any of the following; the number of employees, turnover or profit. A notable part of the wholesalers are located at the Helsinki region. (Tukkukauppa yhteiskunnallisena toimijana)

When trying to define wholesaling its many aspects have to be taken in to consideration. The simplest definition says wholesaling is the part of commerce that isn't concentrated on private consumption. The most common task of wholesale business is to supply retailers with the products coming from the industry. Other and equally important task of wholesalers is to provide the industry with machines, raw materials and goods, that the manufacturers use and upgrade in their production. (Santasalo & Koskela 2001, 7)

Many wholesalers are engaged in importing goods. However in many cases the wholesalers themselves do not carry out the actual transportation of the imported goods. The transportation and forwarding are often outsourced. (Tukkukauppa maahantuontiyrityksenä)

Traditionally wholesalers have had the role of intermediaries in the supply chains (Tang, Shee & Tang 2001, 55). Buying the produced goods from producers and selling them to retailers and industry (Kotler & Armstrong 1996, 446). In time the wholesalers' role as a pure intermediary has changed, because of the concentration of the industries and differentiation on supply chains. Also technological development and the use of Internet especially in business-to-business trade have changed the role of wholesalers. The use of wholesalers in the supply chains has been questioned and especially large retail chains have started to buy directly from the producers and exchange information directly with the industry. The traditional value chain of factory, wholesaler, retailer and end-customer is disappearing. (Haapanen 1993; 50, 213–215)

Large retail chains Kesko and SOK have an important role in the Finnish wholesaling business. They supply their own outlets according to their needs and no actual wholesalers are used. Prenegotiated prices and other terms are used. The buyers

of these large chains have a lot of power and no real selling efforts are needed. (Santasalo & Koskela 2001, 8)

Most Finnish wholesalers are still small and operate on special branches supplying and serving retailers, second tier wholesalers, municipal organizations and industry with their specific assortments. According to Kotler and Armstrong (1998, 446–447) the wholesalers have many other important roles in the supply chain than just buying and supplying the goods. These other channel functions like warehousing and passing information inside the supply chain are defined more deeply in third chapter.

The purpose of this research is to find out how logistics is implemented inside the Finnish wholesale trade. The research tries to find out what wholesalers do in supply chains. The efficiency of wholesalers' activities is affected by logistics costs. This research tries to find what are the background variables, in other words tasks that need improvement, that help in reducing logistics costs. Hypotheses are created to test these background variables with logistics costs using cross tabulation and other statistical methods. These background variables are information technology, outsourcing, supply chain position, location, logistics competence and logistics performance measurement. The role of wholesalers in Finnish trade and business has changed over years. The aim is to find out through the hypotheses and discussion, what is the wholesalers' current role and how it has developed.

1.2 Finnish wholesale trade

1.2.1 The size of the Finnish wholesale trade

Wholesale trade has a big role in the Finnish economy. In 2005 wholesale trade gained revenues of over 52 billion. That is 33 percent of Finland's gross domestic product. Figure 1 illustrates the revenue index for the Finnish wholesale trade.

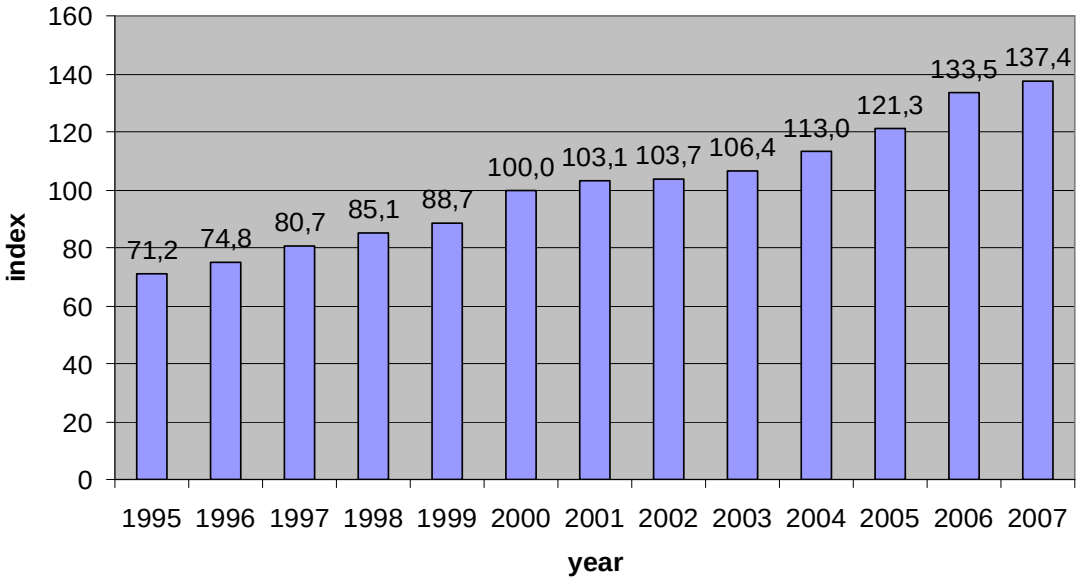

Figure 1 Finnish Wholesale Revenue Index between 1995 and July 2007 (100 = year 2000) (Tilastokeskus.b)

The revenue gained by the Finnish wholesale trade has risen steadily from middle 90's. Some bigger transitions in the revenue have happened in 2000 and 2006.

The wholesale trade is also a big employer. During the second quarter in 2007 wholesale trade employed 102 000 workers (4 percent of Finnish employed people). The amount of people employed by the whole trade sector during the same period was 322 000. (Tilastokeskus.c.) Figure 2 shows the number of people employed by the wholesale business including entrepreneurs from the early 90's until last year.

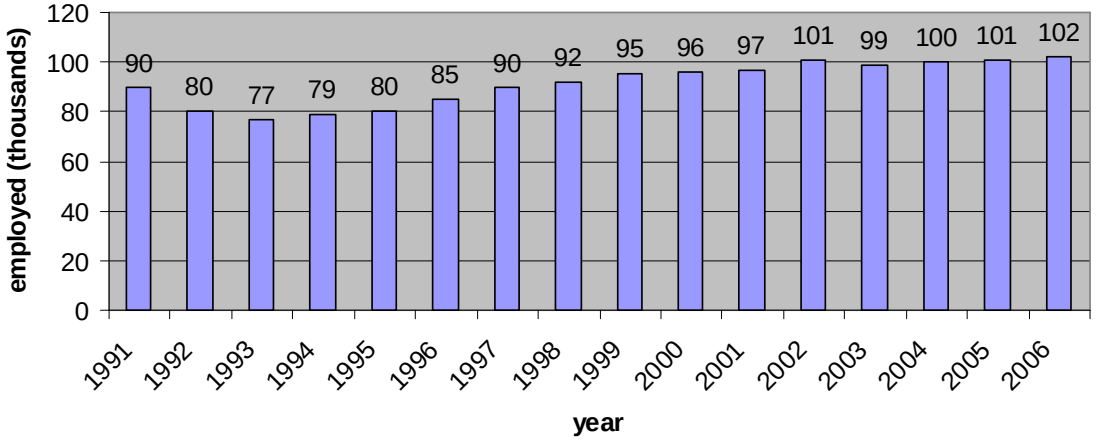

Figure 2 The Number of People Employed by the Finnish Wholesale trade including entrepreneurs between 1991 and 2006 (Thousands) (Tilastokeskus.d.)

The number of people employed by the Finnish wholesale trade has grown steadily after steep decline caused by the depression in 1991 and 1992. Also in 2003 the number of people employed fell by 2000 people from year 2002. Table 1 presents the standard industrial classification of Finnish wholesale industry.

Table 1 The standard industrial classification of Finnish wholesale branch (Tilastokeskus.e)

51	**Wholesale trade and commission trade, except of motor vehicles and motorcycles**
511	Wholesale on a fee or contract basis
512	Wholesale of agricultural raw materials and live animals
513	Wholesale of food, beverages and tobacco
514	Wholesale of household goods
515	Wholesale of non-agricultural intermediate products, waste and scrap
518	Wholesale of machinery, equipment and supplies
519	Other wholesale

The standard industrial classification in Finland has been updated in 2002. The classification divides wholesale and commission trade, excluding motor vehicles and motor cycles, into seven main subcategories. (For more detailed classification on whole sale industry see appendix 1) The seven main subcategories all have a different value to the Finnish wholesale business. Figure 3 illustrates how the total revenue of the wholesale trade in Finland divides in to these seven subcategories.

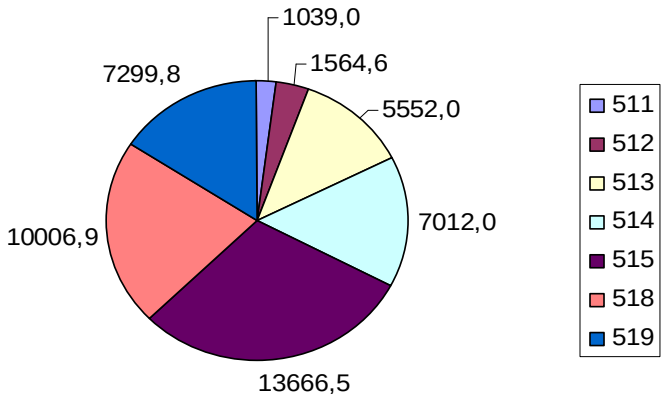

Figure 3 The Distribution of the Total Revenue of the Finnish Wholesale Trade in 2003. (Million euros)(Tilastokeskus.f)

The figure illustrates the distribution of the total revenue of the wholesale trade in 2003. The total revenue amounted 46,1 billion euros. The two biggest subcategories in revenue were the wholesale of non-agricultural intermediate products, waste and scrap and the wholesale of machinery, equipment and supplies. Those to categories combined amounted for over 51 percent of the revenue of the Finnish wholesale business. The wholesale of household goods (15,2 percent) and the wholesale of food, beverages and tobacco (12 percent) follow the two big categories with the total of over a fourth of the revenue of the wholesale industry as a whole. The wholesale on a fee or contract basis constitute for 2,3 percent of the total revenue and wholesale of agricultural raw materials and live animals constitute for 3,4 percent. The remaining revenue is gained from the category 519: other wholesale. (Tilastokeskus.f)

1.2.2 Logistics performance of Finnish wholesale trade

Multiple performance measures for logistics functions are presented in chapter 2.2.2. Table 2 presents some of these measures calculated among a group of Finnish wholesalers.

Table 2 Logistics performance measures among companies in Finnish wholesale branch 1997–2006 (median) (Balance Tilasto)

Logistics performance measure	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Return on investment (%)	26,3	24,4	22,2	22,9	22,7	20,7	19,8	20,4	19,8	20,7
Profit of equity (%)	27,3	26,9	22,9	23,2	22	20	19,1	20,1	20	20,6
Equity/capital (%)	38,4	40,3	40,1	40,7	41,6	42,9	43,4	41,8	42,6	44,4
Inventory turn over (times/year)	6,64	6,76	6,64	6,64	6,76	6,76	6,76	7,02	6,76	6,64
Inventory days of supply (days)	55	54	55	55	54	54	54	52	54	55
Cash-to-cash cycle time (days)	50	53	53	53	53	54	53	53	56	57

Return on investment among Finnish wholesalers is around 21 percent. The number has decreased sligtly over the last decade. Return on investment should be high enough to add up to the level of return from alternative investment targets. The amount of equity in capital has increased over the last ten years and medians at 44 percent. Equity in capital helps companies to survive even few unprofitable years. Some profit is also expected from investing your own capital in the company. The profit of equity among Finnish wholesalers is around 21 percent. Inventory turn over measure tells how many times the inventory of a company turns in a year. At turn over rate of 6,7, the average

inventory of the company is used in 55 days. Cash-to-cash cycle time tells how many days does it take to convert the cash paid to suppliers into cash received from customers. Among Finnish wholesalers the cash-to-cash cycle time is 57 days and it has increased over the last decade. (Balance Tilasto, retrieved 1.4.2008)

1.3 The research structure

The introduction gives some background for the research. The research problem and subproblems are presented. Statistics over the Finnish wholesale trade is also included in first chapter. Chapter two deals with the different aspects of logictics. First the concepts of logistics costs and logistics performance measurement are presented. The use of information technology and outsourcing in logistics are also covered.

The role of wholesalers in supply chains is the topic of the third chapter. The tasks and different types of wholesalers are presented. The wholesalers' positions in different marketing channels are demonstrated.

Chapter four introduces the completion of the research and research methods. The used data is described and analysed. The research hypotheses, which are derived from the theory, are presented. The validity and reliability of the research is debated.

The analysis part of the research is done in chapter five. Each of the eleven research hypotheses, which deal with the different aspects of logistics, is tested using the appropriate statistical methods. The sixth chapter contains discussion over the results of the analyses of the research hypotheses. Conclusions over the research: theory, analysis and discussion, are made in chapter seven.

2 KEY ELEMENTS OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

The key elements of logistics and supply chain management are presented in the following chapters. These are logistics costs, performance measurement, information technology and outsourcing

Logistics can be defined in many ways. The definition used in Logistics Survey 2006 (Ministry of Transport and Communications Finland 2006, 8) emphasizes the magagement side of logistics. It defines logistics as managing the material, equity and information flows of companies between companies operating in supply chains and supply networks.

From the actual logistics activities viewpoint logistics can be described as efficient movement of finished goods or raw materials to consumers and industry. This includes transportation, warehousing, materials handling, packaging, inventory control, site selection, order processing, forecasting and customer service. (Rushton, Oxley & Croucher 2000, 6)

Cooper and Ellram (1993) define supply chain management as an integrating philosophy to manage the total flow of a distribution channel from a supplier to ultimate customer. Other definitions add value creation and effectiveness to the concept (Coyle, Bardi & Langley 1996, 9).

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2.1 The Costs of Logistics

Different researchers have varying views on what kinds of costs are included in logistics costs. Cooke (2006, 35) refers to so-called Alford-Bangs formula to determine the value of logistics. The formula adds together three cost components: inventory-carrying costs, transportation costs and administrative costs. Daganzo (2005, 15–16) claims that logistics costs result either from movement or holding. Movement costs are divided to handling costs and transportation costs. Holding costs include rents and costs related to waiting. According to Pouri (1997, 202) logistics costs include purchasing and procurement costs, warehousing costs, transportation and distribution costs, and the control and handling costs of shipment modes. The classification of logistics costs used in Logistics Survey 2006 (Ministry of Transport and Communications Finland 2006, 24) is presented in figure 4.

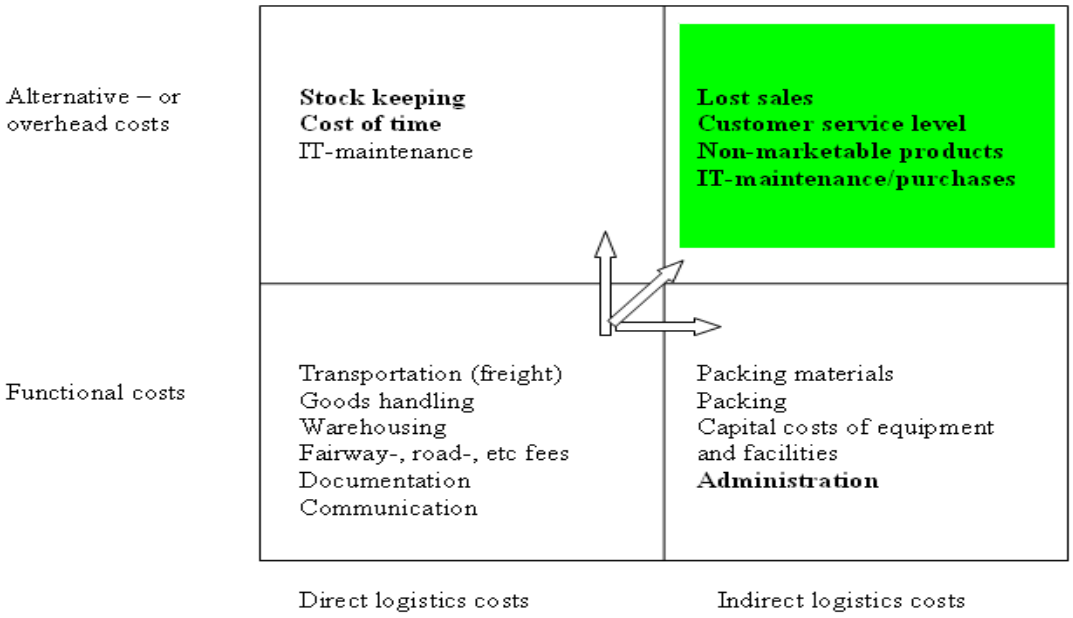

Figure 4 Taxonomy of logistics costs (Ministry of Transport and Communications Finland 2006, 24)

The figure divides logistics costs in to four groups. The grouping is based on the nature of the different logistics costs. First logistics cost are direct or indirect and secondly logistics costs are either functional costs or alternative/overhead costs. The three arrows in the figure illustrate the fact that the importance of indirect and alternative costs increases when competition brings cost pressure. (Ministry of Transport and Communications Finland 2006, 24)

2.1.1 Direct logistics costs

Functional direct logistics costs include transportation, goods handling, warehousing, fairway-, road-, and other fees, documentation and communication. These costs are related to the handled products and can be traced to the products in an economically feasible way.

According to Logistics Survey 2006 (Ministry of Transport and Communications Finland 2006, 50) transportation costs have decreased slightly since year 1990. The survey was done among Finnish industrial and trade companies. In 2006 the average transportation costs of these companies were around five percent of turn over. Among trade companies the transportation costs were highest among micro-sized companies and lowest among large companies. (Ministry of Transport and Communications Finland 2006, 50–52)

According to Logistics Survey 2006 transportation costs are expected to rise by year 2010. Either small or large, international or domestic, trade or industry, over 50 percent of companies in each of these groups estimated that transportation costs will increase. Reasons for the rise in transportation costs include global sourcing, the volatility and long term rise in fuel prices and smaller shipment sizes (Blanchard 2006, 1). (Ministry of Transport and Communications Finland 2006, 56)

Warehousing costs have stayed at the same level between years 1990 and 2006 based on the Logistics Survey 2006. They average on around 2,5 percent of turn over. A majority of the respondents expect warehousing costs to stay at the same level by 2010. Among trade companies the answer alternatives “warehousing costs will rise” and “warehousing costs stay the same” got equal amount of responses. (Ministry of Transport and Communications Finland 2006, 50,56)

Alternative or overhead direct logistics costs include stock keeping, cost of time and IT-maintenance. Stock keeping and IT-maintenance can be seen as supporting activities to other business functions. Costs related to stock keeping and IT-maintenance cannot be traced to certain products in feasible way because they are related to various activities within the company. Overhead costs are thus shared among the various activities. (Types of overhead cost)

2.1.2 Indirect logistics costs

Indirect costs can be described as costs that are related to the particular cost object but cannot be traced to it in an economically cost effective way. Indirect costs are allocated to the cost object using a cost allocation method. The allocation can be based for example on sales, operating profit or assets employed by the certain cost object. (Horngren, Bhimani, Foster & Datar 1999, 32;140)

Functional indirect logistics costs in figure 4 (page 16) include packing materials, packing, capital costs of equipment and facilities and administration (Ministry of Transport and Communications Finland 2006, 24). Packing costs among Finnish industry and trade companies count for around one percent of turn over. It can also be noted that among trade companies packing costs seem to decrease as the size of the company increases. (Ministry of Transport and Communications Finland 2006, 50,52)

Trade companies were also asked to evaluate whether packing costs will increase, decrease or remain the same until 2010. Over 50 percent of companies in each size group from micro sized to large companies thought that packing costs will remain the same, around one percent of turn over. (Ministry of Transport and Communications Finland 2006, 56)

Logistics administration costs include indirect management and support personnel. Support personnel contain employees at central distribution, planning and analysis and the transport department. Also some of the soft- and hardware costs are considered to be logistics administration costs. (U.S. Department of Transportation; Federal Highway Administration)

According to Logistics Survey 2006 logistics administration costs among Finnish industry and trade companies have grown rapidly between years 2000 and 2006. Logistics Survey 2006 also reports that among trade companies the logistics administration costs are highest among micro sized and large companies and lowest among medium sized companies. When it comes to evaluating the level of the logistics administration costs in 2010, most trade companies think that they will remain the same. The frequency of companies estimating the logistics administration costs to increase by 2010 is the biggest in the groups of small and micro sized companies. (Ministry of Transport and Communications Finland 2006, 50–52; 56)

2.2 Measuring supply chain performance

2.2.1 Performance measurement

As logistics and logistics competence have become important factors in creating and maintaining competitive advantage in any business, logistics measurement and controllership have increased their importance in companies and supply chains. They are used in allocating and monitoring resources. The objectives of logistical controllership by performance measurement are to compare performance against operating plans and to identify alternatives for better efficiency and effectiveness. Timely and accurate assessment of the performance of overall system and individual system components is important to any supply chains and other interorganizational systems. The position of logistics controller in a firm is devoted to logistical controllership and is concerned with continuous measurement of the firm's performance. (Bowersox & Closs 1996, 668–669, Handfield & Nichols 1999, 61)

According to Handfield and Nichols (1999, 61) an effective performance measurement system has three main functions. The first of these tasks is to provide the basis to understand the system. Secondly the performance measurement system influences behavior throughout the supply chain and thirdly the system provides

information regarding the results of system efforts to both supply chain members and outside stakeholders. (Handfield and Nichols 1999, 61)

In today's business world performance measurement is computer-based and the quality of the information is good. The freshness of the information together with flexible reporting methods assures a quick response to emerging market opportunities. Developing and implementing performance measurement systems has three objectives. These objectives are monitoring, controlling and directing logistics operations. (Bowersox & Closs 1996, 669–670)

Monitoring deals with historical logistics systems performance and is used to report about the performance to management and customers. Service level and logistics costs components are typical monitoring measures. *Controlling* measures track the present performance. They are used to elevate the logistics process in order to give it an approval when it exceeds control standards. *Directing* measures are designed to motivate personnel. For example employees are 'paid by performance' to achieve higher levels of productivity. (Bowersox & Closs 1996, 670)

The perspective of performance measurement varies from all activity-based measures to entirely process-based measures. The perspective used in a company or in a single measuring must be evaluated and determined. Activity-based measuring focuses on single tasks which aim for example to process orders. Some typical logistics activity-based measures are delivery time per order, inquiry time per order and order selection time per customer. Activity-based measuring focuses on the primary work efforts and don't measure the performance of the whole process of satisfying customers. Process-based measuring pays attention to the supply chain. It considers the customer satisfaction delivered by the supply chain as a whole. Process measures examine for example total performance cycle time or total service quality. These measures are used to illustrate the collective effectiveness of all the activities required to satisfy customers. The use of process measures is having a lot more attention than measuring and sub optimizing single activities. (Bowersox & Closs 1996, 671) Handfield and Nichols (1999, 62) state that the measurement of the combined performance of the supply chain is the most important target of the measurement activity.

Internal performance measures can be defined as comparing different activities and processes to previous operations and goals. Bowersox and Closs (1996, 671) classify internal performance measures into five categories. Table 3 illustrates these five categories and the different performance measures included in each category.

Table 3 Five categories of internal performance measurement (Adapted from Bowersox & Closs 1996, 672–674)

Logistics cost	**customer service**	**Logistics productivity**	**logistics asset management**	**logistics quality**
total-cost analysis	fill rate	units shipped per employee	inventory turns	frequency of damage
cost per unit	stockouts	units per labor dollar	inventory carrying costs	dollar amount of damage
cost as a percentage of sales	shipping errors	orders per sales representative	inventory levels	number of credit claims
inbound freight	on-time delivery	comparison to historical standards	return on net assets	number of customer returns
outbound freight	back-orders	goal programs	return on investment	cost of returned goods
warehouse costs	cycle time	productivity index		
administrative costs	customer feedback			
order processing	sales force feedback			
direct labor	customer surveys			
comparison of actual vs. budget				
cost trend analysis				
direct product profitability				

Cost as a logistics performance measure is used to determinate the actual cost that has incurred while executing certain logistics tasks. Budgeting process in a company or a supply chain creates cost expectations which are then used in logistics performance measurement. Customer service performance measures examine a company's relative ability to satisfy customers. Productivity in performance measurement is divided in to static, dynamic and surrogate measures. Productivity is the relationship between output and the input needed to produce the output. Asset measurement is used in utilizing capital investments into facilities and equipment and secondly to utilize working capital application in to inventory. Quality performance measures are designed to establish the effectiveness of a series of activities instead of individual activities. They are specially used in process based measurement, like when measuring the performance of the whole supply chain. (Bowersox & Closs 1996, 672–674)

Handfield and Nichols (1999) state that the performance measures to manage supply chain performance vary according to product line, industry, customer type and other factors. Figure 5 illustrates a model of integrated supply chain performance measures.

Performance area	**Primary measures**	**Secondary measures**
Customer satisfaction/Quality	Perfect order fulfillment Customer satisfaction product quality	Delivery-to-commit date Warranty costs, returns, allowances Customer inquiry response time
Time	Order fulfillment lead time	Source/make cycle time Supply chain response time Production plan achievement
Costs	Total supply chain costs	Value-added productivity
Assets	Cash-to-cash cycle time Inventory days of supply Asset performance	Forecast accuracy Inventory obsolescence Capacity utilization

Figure 5 Integrated supply chain performance measures (Pittiglio, Rabin, Todd and McGrath 1994)

Integrated supply chain performance measures in figure 5 are divided in four performance areas. These areas are customer satisfaction/quality, time, costs and assets. Each of these performance areas include primary and secondary measures which can be used in performance measurement. Making a choice which measures to use depends on the product line, industry, customer type and other factors. (Pittiglio et al. 1994; Handfield & Nichols 1999, 65)

The performance measurement classifications presented above are very similar and same performance areas; assets, costs, quality and customer service, are included. Bowersox and Closs (1996, 673) add productivity to these performance areas. Overall the measures included cover the wide range of performance measurement and give a good overview of the performance measurement field.

2.2.2 Key measures of supply chain performance

The main measures from the classifications presented in chapter 2.2.1 are presented in the following chapter. Most of these measures are also included in the reserch questions of this research.

One of the key actions in supply chains in every business is balancing the inventory. Balancing on the right inventory level is an important task. With too little inventory sales are lost and too big inventories cause unnecessary investments and costs. Maintaining a balanced investment in inventory can be aided by periodical inventory turnover analysis. The basis of the analysis is to calculate the average inventory turnover rate of the business. The formula of calculating the inventory turnover rate is annual cost of goods sold divided by the average inventory level. (Milling 1990, 31)

Return on investment made in inventory must be great enough to warrant risk taking and provide rewards in terms of return. This return should add up to the level of return from alternative investment targets. Wholesaler should also have some extra return for the time and effort it has expended with the inventory. Return of investment is calculated by dividing income (operating profit) by investment. (Sakki 1997, 81; Danenburg, Moncrief & Taylor 1978, 178)

Each item in inventory should be self-supporting and profitable. If the item is not profitable it should be discontinued and replaced with another item. The inventory turnover rate has an effect on the return of investment. If the turnover rate decreases, the return on investment also decreases until a point where it actually causes costs to the distributor to carry a certain item in the inventory. (Danenburg et al. 1978, 178)

Another measure on capital is the percentage of equity in the balance sheet. This is also called to capital adequacy. If the level of equity in balance is high, a company can survive a few unprofitable years. This is calculated by dividing equity with the capital in the balance sheet. (Sakki 1997, 81) When investing your own capital in a company, some profit can also be expected. The profit of equity is calculated as: (operating income – taxes – interest charges). (Sakki 1997, 81)

Perfect order fulfillment is the percentage of orders meeting deliver performance and time with complete and accurate documentation with no shipping damage. It is calculated as: (total orders shipped on time and in full-orders without faulty

documentation—orders with shipping damage)/(total orders). (Huang, Sheoran & Keskar 2005, 384)

Order fulfillment cycle time on the other hand is the average actual lead time achieved from purchase order from suppliers authorized by the customer to final installation or order completion at customer end. The cycle time is calculated as: (sum of lead time required for each order fulfillment from purchase order authorization to final installation/order completion)/(total number of orders). (Huang et al. 2005, 384) Inventory days of supply is the total gross value of inventory at standard cost before reserves for excess and obsolescence (Huang et al. 2005, 385).

Cash-to-cash cycle time is a measure of the time required in days to convert cash paid to suppliers into cash received from customers, including the inventory required. It is calculated as: (inventory days of supply + days sales outstanding – days of payables). The durability of the cash-to-cash cycle time can be altered by payment times. (Huang et al. 2005, 385)

2.3 Information Technology in Logistics

2.3.1 IT in SCM

The ability to make strategic decisions quickly, based on accurate data is a key aspect of supply chain management. To carry out this task successfully requires an efficient and effective information system. The flow of information has to be managed as effectively as the flow of products. The exchange of substantial quantities of information among buyers, suppliers and carriers should be the base for every supply chain. This helps in increasing the efficiency and effectiveness of the supply chain. (Zacharia 2000, 291)

As the Internet has brought the customers closer to the firms, supply chain management's role has been emphasized even more. The Internet has been viewed as an excellent channel for information that is used to interconnect supply chain partners. The extensive use of outsourcing and external alliances results partly from advances in communication capabilities (Bowersox & Daugherty 1987). (Zacharia 2000, 291)

The objectives of information technology in supply chain management are: (Simchi-Levi, Kaminsky & Simchi-Levi 2003, 267)

- Providing information availability and visibility
- Enabling a single point of contact for data
- Allowing decisions based on total supply chain information
- Enabling collaboration with supply chain partners

Zacharia (2000, 293) has created an information systems supply chain model. This model is illustrated in Figure 6.

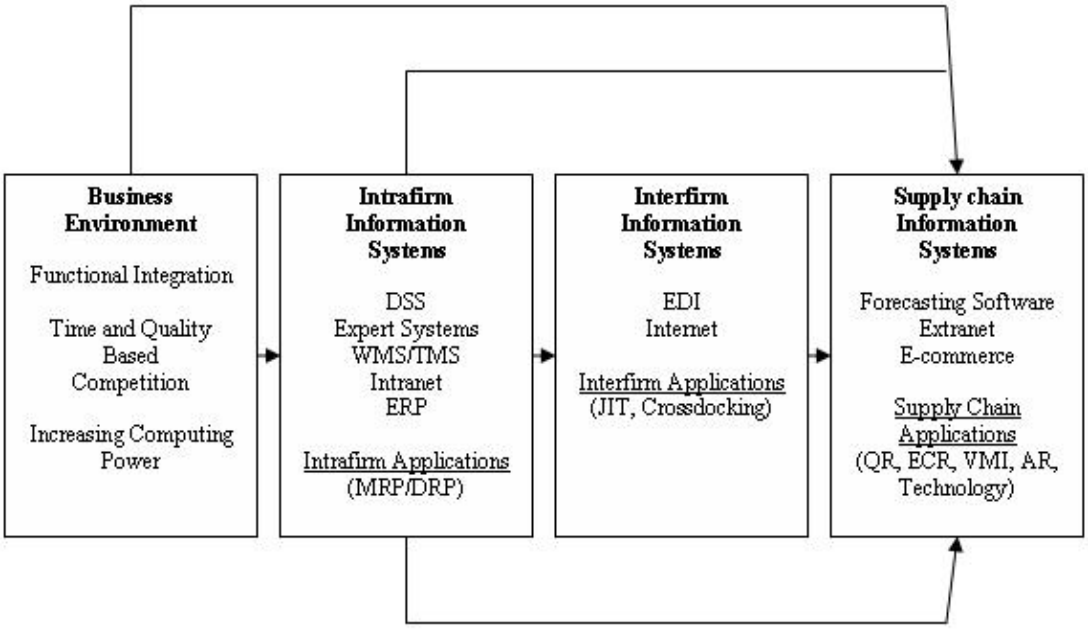

Figure 6 Information systems supply chain model (Zacharia 2000, 293)

The model has four main stages, which illustrate the development of a company's information system development. An evolution from one stage to the next one is suggested (see the short arrows between the different stages). The long arrows above and below the boxes of different stages suggest that bypassing some stages is possible. Developing supply chain information system following and responding for example to the current business environment or existing intrafirm information systems is possible but by following all the stages of the model a more effective supply chain information system can be established. (Zacharia 2000, 292)

The competitive environment of virtually any business is nowadays changing rapidly and demands a lot from companies. Markets are international, dynamic and more and more customer driven. More variety, better quality and better service are required. Product life cycles get shorter. According to the figure above there are three major

trends that have caused the turbulence in business environment. These are functional integration, time and quality based competition and increasing computing power. (Zacharia 2000, 292–294)

The main benefit of integrating functions in any business is the reduced costs. The integration has a decreasing effect in inventory and it helps in utilizing transport and warehouse assets more effectively. Duplicate efforts are eliminated. The integration can only be implemented by improving information sharing between different functions. Developing appropriate information systems is key element to efficient information sharing and functional integration. (Zacharia 2000, 294)

Mentzer (1999) defines time and quality based competition as the elimination of waste in form of time, effort, defective units and inventory in manufacturing distribution systems. As the product life cycles are shortening and product choices are extensive firms compete with quality products, consistent product availability and faster delivery to meet customer demand. This has led to the evolvement of the information systems to meet the requirements that time and quality based competition sets. In order to survive in the rapidly chancing business environment, companies need to achieve adequate agility and flexibility in their operations. Flexibility helps companies to support wide customer base and responsiveness achieved by flexibility improves the efficiency of the all the functions in companies. Agility and flexibility are achieved by the evolvement of information systems. (Zacharia 2000, 295)

The colossal increase in computing power has been the basis for the development of information systems. Sophisticated information systems are used at all levels of the organization and they facilitate centralized strategic planning and daily execution of the plans on a decentralized basis. For example the industry practices for distribution and product support are restructured by the evolution of information technology. (Zacharia 2000, 296)

Intrafirm information systems contain specific applications within the company. They are used to encourage collaboration by different functions within the company. Intrafirm information systems are included in the information system supply chain model because many companies find breaking internal functional barriers difficult. Effective intrafirm information systems create a solid ground for more effective supply chain information systems. The intensive use of information delivered by intrafirm information systems provides better visibility of physical goods as they move within the firm. Information passed by information systems influences strategic decision making and brings significant reductions in costs. Competitive advantages are achieved by high levels of information. (Zacharia 2000, 296–298)

The demand for interfirm information systems has grown from the increase in uncertainty in the business environment of any company. Interfirm ties are made with both suppliers and buyers. The need to secure a reliable source of supply has found to

be the main reason for creating supplier partnerships. Interfirm information systems are developed and executed with single supplier or customer to facilitate information flow concerning the flow of the physical goods, services and finances. The benefits gained from interconnecting information systems are more efficient manufacturing scheduling, reduced inventories, improved efficiency of loading and distribution operations, lower prices and better value to the customer. The main reasons for why companies use interfirm information systems are the increasing product variety and focusing on a company's core business. Increased customer service requirements and subcontracting require close relationships with subcontractors. (Zacharia 2000, 302–303)

Supply chain information systems can be defined as information systems that go across multiple organizations and facilitate the flow of information from a source to a customer. Developing supply chain information systems is a valuable initial element in managing a supply chain. Supply chain partners need to have access to information on those supply chain activities they do not control. Accurate information is critical for a supply chain to function effectively. This is important especially for planning and monitoring processes. Open sharing and frequent updating of information such as inventory levels, forecasts, sales promotion strategies and marketing strategies reduce uncertainty between supply partners and lead to enhanced performance. (Zacharia 2000, 310–311) The different technologies and applications of the information system supply chain model (Figure 3) are approached in the following chapter.

2.3.2 Typical IT Applications in Business

This chapter presents the different technologies used in companies in information sharing inside the company and with business partners. Some technologies are designed to make supply chain tasks like distribution more effective.

2.3.2.1 Electronic Data Interchange

Electronic data interchange (EDI) is a communication tool for business transactions. EDI can be described as computer-to-computer inter-organizational communication with messages in standardized format transmitted trough Value Added Networks (VANs). Because of the standardization the use of EDI between companies requires high degree of cooperation and coordination from both parties involved. Thought it can be quite expensive, EDI offers advantages especially for larger companies. These are for example real-time exchange of data, greater coordination of activities between business

partners and fewer errors, because the data only needs to be keyed in once. (Levary & Mathieu 2004, 23; Nickerson 2001, 381)

The main reasons for adopting EDI by a company are the aim for cost reduction and internal efficiencies (Sohal, Power & Terziovski 2002, 97). Walton and Marucheck (1997, 35) show in their study that EDI provides improved supplier reliability because of better information gained when EDI is used in a company frequently on daily basis.

Many small companies have seen the implementation of EDI as too expensive and complex. Also the gains have been seen to be too small compared to the big investment the traditional EDI requires. Also small companies rarely have the required expertise to implement the complex EDI systems (Mak & Johnston 1997, 1).

2.3.2.2 Internet-Based EDI

Internet-based EDI provides a cheaper and less complex way for small companies to enter EDI network. Internet-based EDI is specially used in transactions between big companies who already have traditional EDI and small companies who do not have it. There are several factors why companies choose the Internet-based EDI. First of all the Internet has global network architecture and offers distinctive throughput capabilities for the companies using it. The use of Internet-based EDI is charged without any dependency to the amount of data transferred. This direct pricing and also the low cost world wide access attract especially small companies to use Internet-based EDI. The Internet also provides a way for non-EDI-enabled trade partners to reach to EDI users. For example business documents can be filled on web pages without the non-EDI-user investing in any additional systems. Internet Service Providers (ISPs) provide the most of the services of the traditional EDI to the users of Internet-based EDI with lower costs. The Internet-based EDI has become the prevailing technology in transferring data electronically. A survey of nearly 200 North American manufacturers and distributors in 2000 revealed that Internet-based EDI would replace the traditional EDI channels within the three following years (Survey spotlights needs… 1998). (Mak & Johnston 1998, 1; Mak & Johnston 1997, 2)

2.3.2.3 Internet, Intranet and Extranet

The development of Internet in general has been a major factor in advancement of technology and communication capabilities. Internet provides access to numerous organizations, individuals and information sources world wide. (Handfield & Nichols 1999, 33)

According to Zacharia (2001, 306) the Internet has the potential to change the structure of supply chains and it also presents a new way to develop relationships with partners and customers. By facilitating electronic applications, the Internet may change the relationship between different partners of a marketing channel. For example wholesalers have taken the role of retailers by selling their products in the Internet straight to customers. According to Bauknight (2000) Internet provides radical improvements to the performance of many supply chain activities. Information systems also play an important role in supplier reliability and supplier partnerships through the fact that they help in reducing the cost of supplier coordination and enhance buyer-supplier relationships. (Zacharia 2001, 306–307)

Internet can also be used in communicating within the firm without having to build a separate network. An Intranet is a network that utilizes the Internet as the communication platform but limits the access only to members within the firm. This facilitates communication among a company's scattered departments, divisions and regional locations. For example information about inventory and order and shipping status can be shared via Intranet. (Zacharia 2001, 300)

Extranet expands the Internet-based communication. The access to Extranet is limited to members of the supply chain, such as manufacturer, carrier, distributor and retailer. Extranets are used to check inventory levels for automatic restocking. Also the product specifications of each customer for mass customization can be given to the manufacturer using Extranet. Direct link between customers and manufacturing increases the product's speed to market. (Zacharia 2001, 314; Nickerson 2001, 191)

2.3.2.4 Electronic commerce

Electronic commerce is associated with buying and selling of information, products and services via computer networks, including the Internet (Kalakota & Whinston 1996, 1; Nickerson 2001, 21). E-commerce is used by consumers and between companies. Electronic business-to-business (B2B) commerce is more common than business-to-consumer (B2C) electronic commerce.

Electronic commerce applications include for instance supply chain management, procurement and purchasing, remote banking, on-line marketing and advertising and home shopping. All the functions of the transaction are implemented electronically. These include product presentation, order entry, payment, distribution, customer service, product support and data acquisition. (Kalakota & Whinston 1996, 4; Nickerson 2001, 21; 377–379)

2.3.2.5 Enterprise resource planning

To facilitate information sharing within the company, enterprise resource planning (ERP) systems have been created. They were born as manufacturing resource planning systems have been added with applications from other functions of the company, like accounting and finance. The single integrated system streamlines data flows throughout a company and delivers gains in company efficiency (Davenport 1998, 123–124). ERP systems help in reducing inventories, shortening cycle times and lowering costs (Minahan 1998, 127). The software for ERP is available from many companies, like SAP, QAD, Aldata and Oracle. According to Auramo and Kauremaa (2004, 11) SAP R/3 is the most popular software for ERP (47 percent of respondents having it among a survey of 36 Finnish trade and industry companies). (Zacharia 2001, 300; Nickerson 2001, 328)

2.3.2.6 Decision support systems

Intrafirm information systems include also decision support systems (DSS), like warehouse management systems (WMS) and transportation management systems (TMS). Decision support systems are expert systems that are developed to meet the needs of particular functions. They are based on the experience of experts and provide consistency to decision making. They provide data and analytic models to help decision making in solving problems with many difficult-to-define variables. (Zacharia 2001, 298–299)

Warehouse management systems are used inside the warehouses in directing labour, providing inventory and location control and managing the flow of orders and processes. It can bring accuracy improvements, labour savings and better space utilization. These will support better customer service and quicker turn in inventory. According to Mason, Ribera, Farris and Kirk (2003, 143) nowadays WMS can also be utilized for order management and consolidation as well as comprehending the wide list of stock keeping units. (Zacharia 2001, 299)

Transportation management systems are used as decision support tools for planning and optimization of transportation as well as the transportation execution. TMS provide monitoring for freight payment auditing, transportation planning, carrier performance, trailer loading and road mileage. The automated monitoring of these functions by TMS increases labour efficiency and that leads to improvements for the transportation unit of the company. (Zacharia 2001, 299–300; Mason et al. 2003, 143)

2.3.2.7 Radio frequency identification

The emerging technology of radio frequency identification (RFID) has gained a lot attention lately and is increasingly used in industry and other business, particularly in logistics and supply chain management to replace traditional bar codes (Ngai & Riggins 2008, 507; Tzeng, Chen & Pai 2008, 602). A lot academic research has been published on RFID during the last decade. For example Jansen and Krabs (1999), Angeles (2005) and Twist (2005) have studied RFID in logistics and supply chain management. RFID in retailing have been studied among others by Eckfeldt (2005), Kärkkäinen (2003) and Prater, Frazier and Reyes (2005).

What is ground breaking in RFID is that it is wireless and the data on radio frequency tag, which contains a micro chip, can be read or changed remotely after the tag has been attached to the object. RFID has substancially changed a company's capability to obtain real time information about the location and properties of the tagged objects, which can for example be products, pallets or containers. (Tzeng et al. 2008, 602)

2.3.3 IT in Finnish manufacturing and trade companies

The use of the different technologies presented in the previous chapter varies in different companies. The value of the company, the number of business partners and the geographical spreadness of the partners have an effect on what methods and technologies companies use in their interchange with the partners. How ever the size or the branch does not seem to have any impact on the technologies used. (Auramo & Kauremaa 2004, 29–30)

Auramo and Kauremaa (2004) have studied the use of different electronic technologies in logistics in 36 Finnish progressive companies from trade and industry. The study was conducted by expert interviews, questionnaires over phone and some company interviews to define and confirm the phone interviews. The results of the study are divided in to two main topics: the technologies used in purchasing and on the other hand, the technologies used in selling. (Auramo & Kauremaa 2004, 2–3;6) The technologies used in making purchasing orders and receiving bills from purchases are presented in Table 4.

Table 4 The most typical technologies used in purchasing transactions by industry and trade (n=36) (Auramo & Kauremaa 2004, 3)

	Purchasing order		Purchasing billing	
	a	b	a	b
Letter	19 %	100 %	97 %	100 %
Phone	39 %	100 %	0 %	—
Fax	86 %	100 %	6 %	100 %
E-mail	44 %	56 %	3 %	100 %
Extranet	22 %	25 %	3 %	0 %
EDI	39 %	71 %	33 %	50 %
B2B-integration systems	11 %	—	0 %	—

a= the percentage of companies using the method
b= the percentage of companies that have used the method over five years of all companies using the method

Purchasing orders are still made dominantly by telephone, fax or e-mail. EDI has also been used for long time, but has not reached the same level of use than the technologies mentioned above because it requires big investments and is expensive to use. However it is still a competitive technology in transferring simple data with big volumes. (Auramo & Kauremaa 2004, 4) Extranet and B2B- integration systems are cheaper and faster ways to purchase. When using Extranet in buying companies only need to use their Internet connection and can provide a lot of information to a large number of suppliers. In B2B-integration system a large portion of buying can be done by a single connection to the service provider. (Auramo & Kauremaa 2004, 5)

In purchasing billing the conventional technologies still dominate. Letters and EDI are the main billing technologies. The newest billing technology with no company using it over five years is extranet. (Auramo & Kauremaa 2004, 3) The most typical technologies used in transactions with customers by Finnish progressive companies are presented in table 5.

Table 5 The most typically used technologies in Selling Transactions (Industry and Trade n=36) (Auramo & Kauremaa 2004, 7)

	Order receiving		Confirmation of order		Invoicing	
	a	b	a	b	a	b
Letter	22 %	100 %	11 %	100 %	75 %	100 %
Phone	53 %	100 %	8 %	100 %	0 %	—
Fax	67 %	100 %	56 %	100 %	6 %	100 %
E-mail	42 %	73 %	19 %	71 %	0 %	—
Extranet	28 %	20 %	22 %	13 %	3 %	0 %
EDI	44 %	44 %	33 %	58 %	44 %	63 %
As an EDI to a service provider	0 %	—	3 %	100 %	19 %	57 %
XML	3 %	0 %	6 %	50 %	3 %	0 %

a= the percentage of companies using the method
b= the percentage of companies that have used the method over five years of all companies using the method

Table 5 shows that traditional technologies are mainly used in selling transactions as well. In both order receiving and confirmation of orders letters, phone, fax and e-mail are the dominating technologies, but more advanced technologies like extranet and XML have and will be adopted by companies. EDI is used with major customers. In invoicing EDI has gained users and letters are no longer the only way to send invoices. Also Extranet and XML are already used in some companies in invoicing. (Auramo & Kauremaa 2004, 7–8)

Selling in trade and industry require more technologies and ways to conduct transactions than buying. Suppliers are more easily adapted to the company's operations and technologies than customers. (Auramo & Kauremaa 2004, 7)

2.4 Outsourcing of Logistics

2.4.1 Previous research and the size of the trade

A lot of research on outsourcing logistics functions has been made during last two decades concerning multiple topics inside logistics outsourcing (Berglund 1997, 25). Some major survey studies have been made from the point of view of logistics service buyers. An example of these surveys is the Third-Party Logistics Study –survey which is done annually in North and South America, Western Europe, Asia and Pacific Ocean

regions by Georgia Institute of Technology, Capgemini, DHL and SAP. The survey establishes the views of the managers of logistics service buyers on current state and development of logistics outsourcing. (2006 Third Party Logistics: results and Findings of the 11th Annual Study 2006; Ashenbaum, Maltz & Rabinovich 2005, 42) Individual studies on logistics outsourcing have been made in Europe and USA by among others Berglund (1997), McKinnon (1999), Andersson and Norrman (2002), Rabinovich et al. (1999) and Andersson (1995).

The size of the transport industry and inparticularly third party logistics has grown rapidly world wide during the last decade (Ojala, Andersson & Naula 2006, 7). The logistics spending in USA in 2003 was 936 billion US dollars and the size of the TPL industry in USA and Canada in 2004 was 104 billion US dollars (Eyefortransport 2005; Armstrong 2005). The size of the TPL market in Europe is estimated 35–40 billion US dollars in 2003 (Eyefortransport 2003).

The most rapidly growing market area for logistics spending is China with estimated 30 percent growth in TPL market size from year 2004 to year 2005 (China Third Party Logistics Market Report 2006). Logistics spending in China in 2003 was 300 billion US dollars (Eyefortransport 2005) and the size of the TPL trade in 2005 13 billion US dollars (China Third Party Logistics Market Report 2006).

2.4.2 The development of logistics outsourcing

Originally outsourcing has been based on simple one time decisions to choose the cheapest alternative to perform logistics tasks. Outsourcing was conducted on an arm's length basis with minimum information passing between the logistics service providers and shippers. As the driving forces to source have become more strategic during the late 90's, the relationships between shippers and service providers have also changed. (Skjoett-Larsen 2000, 112)

The relationship between buyer (or shipper) and seller (or provider) of logistics functions can be seen on a continuous scale. Bowersox, Daugherty, Dröge, Rogers and Wardlow (1989) see the scale going from single transactions to integrated service agreements. This scale is presented in figure 7.

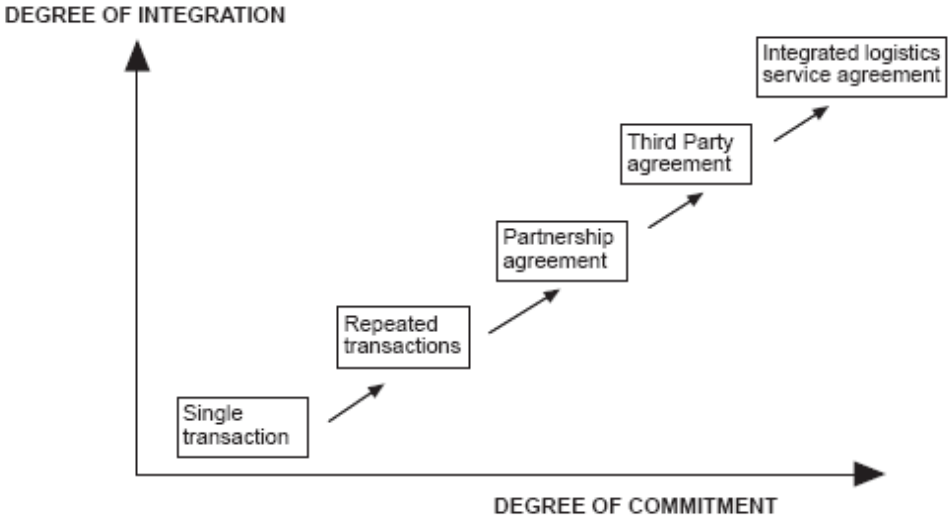

Figure 7 Relationships between shipper and TPL provider (Bowersox et al. 1989, 217)

In single transactions agreements are short term and carry no further commitments. Price is the main goal in decision making. As moving up the scale the agreements become more formal and the last three steps in the scale can be seen as forms of strategic alliances. In partnerships the partners are still independent, but collaborate to achieve more efficient systems and procedures. In third party agreements services of the providers are tailored to suit the requirements of the client. This requires specific investments and training and is based on mutual trust and information exchange. Integrated logistics service agreement takes a step even further in collaboration. The service provider takes over the whole logistics process, including management and control of logistics activities, facility management and personnel management. (Skjoett-Larsen 2000, 113–114)

Third party logistics (TPL) can be defined as outsourcing some or all company's logistics functions to third-party logistics providers. These functions include for example transportation, warehousing and some value added services like final assembly. TPL providers execute these functions on behalf of the shipper using their own resources and assets. (Love 2004, 18; Steindl & Schilk 2005, 9) According to Berglund (1997, 18) a TPL provider is a company that for external clients manages, controls and delivers logistical operations. According to Lynch (2000, 99) the term TPL was originally used already in 1970's to describe shipper's agent and in 1980's the term came into wider use. Some researchers (for example Steindl & Schilk 2005, 12) say that third party logistics providers were not born until 1990's along with information technology development.

The main difference between 3PLs and 4PLs is that fourth-party logistics providers do not own the equipment and warehouses they use (Steindl & Schilk 2005, 8). This is also a part of a 4PL definition made by van Hoek and Chong (2001, 463) which says that 4PL is a supply chain service provider that participates rather in supply chain coordination than in the actual supply chain operational services. Fourth-party logistics provider is information based and coordinates multiple asset-based logistics providers (TPLs) on behalf of its clients. (van Hoek & Chong 2001, 463) Fourth-party logistics service providers were born by the development of information technology at the end of the 1990's (Kulik 1999).

2.4.3 Outsourced functions and the underlying reasons to outsource

Multiple researches have been conducted to find out what companies outsource. Rabinovich et al. (1999) state that companies outsource bundled transactional and physical functions within inventory and customer service areas. Outsourcing Logistics USA 2007 –survey, which was conducted among 389 U.S. manufacturers and retailers, shows that the most common outsourced services among these companies are warehousing (61 % of all respondents), transportation (48 %) and reverse logistics (19 %). The most significant motion to be made from this study is that the percentage of companies outsourcing warehousing has grown rapidly from the response rate of 34 percent in 2006 to 61 percent in 2007. (Outsourcing Logistics USA 2007)

The 2007 Third-Party Logistics –study lists the most commonly outsourced logistics services in four different regions: North America, Western Europe, Asia-Pacific and Latin America. The results of that study are presented in table 6.

Table 6 Outsourced logistics services worldwide (percent of respondents) (2007 Third-Party Logistics 2007, 13)

Outsourced Logistics Service	All Regions	North America	Europe	Asia Pacific	Latin America
Domestic Transportation	83%	77%	91%	85%	79%
International Transportation	79	68	87	89	71
Warehousing	69	71	68	73	60
Customs Clearance and Brokerage	67	65	58	78	64
Forwarding	51	51	51	60	38
Shipment Consolidation	43	44	44	45	37
Product Labeling, Packaging, Assembly, Kitting	34	31	33	34	41
Transportation Management	32	33	41	27	24
Reverse Logistics	31	32	33	29	29
Cross-Docking	31	36	35	26	25
Freight Bill Auditing and Payment	25	51	18	14	10
Fleet Management	15	11	21	12	13
Supply Chain Consultancy	14	18	11	11	17
Order Entry, Processing and Fulfillment	14	13	7	15	28
Customer Service	13	10	10	17	18
LLP/4PL Services	11	13	11	10	10

Table 6 shows that on all the surveyd areas transportation, warehousing, customs clearance and brokerage together with forwarding are the most frequent outsourced logistics functions. Some regional indifferencies can however be found. For example in North America outsourcing of transportation is less common than in other regions. In Europe almost 90 percent of transportation is outsourced.

Logistics Survey 2006 (Ministry of Transport and Communications Finland 2006, 89) has asked 1773 Finnish trade and industry companies what logistics functions they have outsourced. As table 7 shows the most frequently outsourced logistics function in Finland is transportation with 91 percent. Freight forwarding is outsourced in nearly 70 percent of companies. Other main outsourced functions are warehousing and logistics information systems. (Ministry of Transport and Communications Finland 2006, 89)

Table 7 Outsourced logistics operations among Finnish trade and industry companies (N=1532) (Ministry of Transport and Communications Finland 2006, 89)

Logistics function	**Percent of all respondents**
Transport	91
Freight forwarding	68
Order processing	14
Warehousing	25
Inventory management	12
Product finalisation	22
Logistics IT-systems	36

Studies on reasons for outsourcing are numerous. Andersson (1995, 147) gives three major reasons for outsourcing: reduction of costs and investment and improvement of service, improved strategic flexilibility and the need for structural change. According to Skjoett-Larsen (2000, 112) the reasons have changed from reducing costs to more strategic reasons; to increase market coverage, improve service level and increase flexibility. Another more strategic reason to outsource is to achieve economies of scale (Kakabadse & Kakabadse 2005, 185).

Berglund (1997, 34–37) divides the benefits of outsourcing into four different groups. The grouping is based on the nature of the benefits. Operational benefits include gaining access to services or production factors not achievable in own organisation and the possibility to improve the performance of operations that have been previously managed inside the organisation. Economic benefits include lowering costs generally and gaining more stability and visibility in to costs. Managerial benefits involve redirecting management to concentrate into core competencies and other more productive functions and also accessing managerial skills that the company does not yet possess. Strategic benefits of outsourcing are gaining flexibility geographically and in changing conditions, opportunity to focus on core competencies and the possibility to share the risks with service providers. (Berglund 1997, 34–37)

Two major studies on Finnish companies have been made to find out why they outsource their logistics functions. In the study from years 1996–1997 (Ministry of Transport and Communications Finland 1997, 112) the main reasons for outsourcing for Finnish retailers and manufacturers were to gain flexibility and to lower fixed cost and direct labour costs. The results from the other study from year 2001 show that providing better service for customers has become one of the main reasons to outsource. The others were gaining flexibility and lowering fixed costs. Gaining access to new technologies easier was also an important reason to outsource. (Ministry of Transport and Communications Finland 2001, 113)

3 THE ROLE OF WHOLESALERS IN SUPPLY CHAINS

3.1 The main tasks of the wholesalers

The following chapters present the main supply chain tasks that wholesalers carry out. These main tasks are purchasing products from industry, warehousing the products and distributing them to retailers, industry and other wholesalers. Managing and passing information about the products and inventories is also one of the main tasks of wholesalers.

3.1.1 Purchasing

In a simple definition the objectives of purchasing are stated to be: to acquire the right quality of material, at the right time, in the right quantity, from the right source, at the right price (Baily, Farmer, Jessop & Jones 2005, 3–4). A broader definition illustrates the objectives of purchasing as follows:

- To supply an organization with a flow of materials and services to meet its needs.
- To ensure continuity in supply by creating relationships with the existing sources and by creating alternative sources to meet sudden changes in needs.
- To buy effectively and cleverly with the ethical prospects of buying in mind.
- To create and maintain co-operation between the departments of the company to ensure effective operation of the organization.
- To develop and educate personnel, company policies and procedures and organization to ensure the achievement of these objectives. (Baily et al. 2005, 4)

Ballou (1992, 545) states that the activity of purchasing involves buying raw materials, supplies and components. Purchasing includes the following activities:

- Selecting and qualifying suppliers
- Rating supplier performance
- Negotiating contracts
- Comparing price, quality and service
- Sourcing goods and services
- Timing purchases
- Setting the sale terms
- Evaluating the received value
- Measuring inbound quality (can also be done by the quality controllers of the company)
- Predicting price, service and demand changes
- Specifying the form in which goods are to be received (Ballou 1992, 545)

The nature of buying has changed over the years. According to Baily et al. (2005, 12) There are two different types of relationships in purchasing. (Figures 8 and 9)

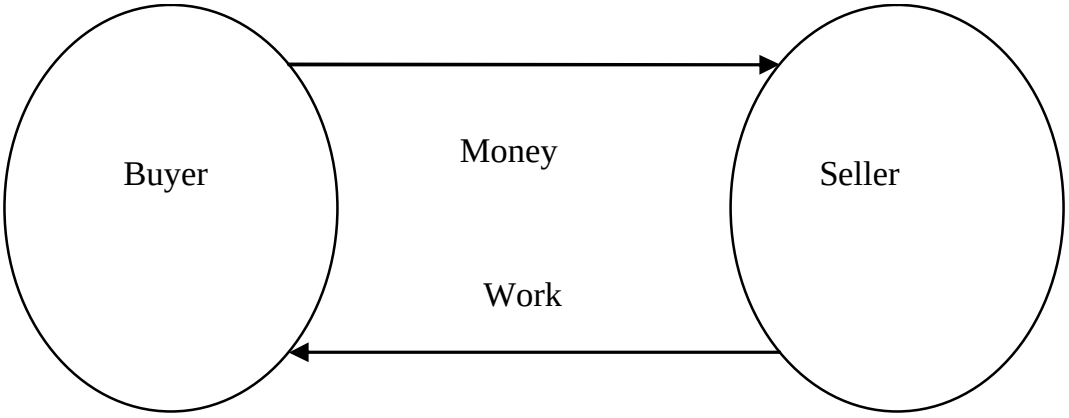

Figure 8 The transactional relationship (Baily et al. 2005, 13)

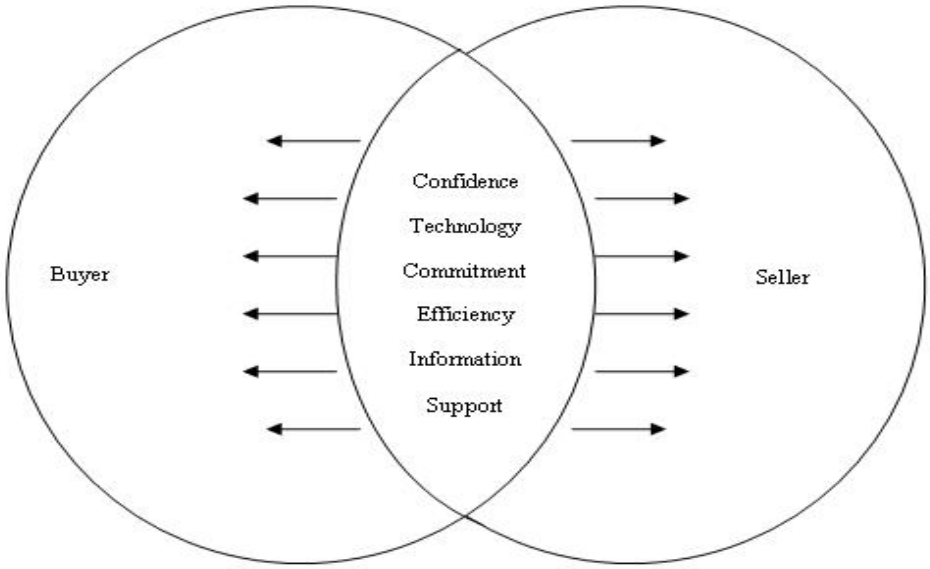

Figure 9 The ‘mutual’ relationship (Baily et al. 2005, 13)

The transactional view of buying (figure 8) is based on idea that purchasing is concerned with simple exchanges. The buyer and seller interact with each other on an arm’s-length basis. The transactional buying is still in use and considered appropriate when buying low-cost items that have multiple competing suppliers. In the recent years the development of mutual relationships (Figure 9) has had a lot attention. The benefits of mutual relationships rise from sharing and exchanging information. In mutual relationships companies try to build satisfactory outcomes for things like technology together. Confidence and support are invested with the aim for adding value for both sides. This can not be achieved by single transactions. The companies seek overlapping interests and come closer to each other. (Baily et al. 2005, 12)

As supply chain management strategies have become a way to respond to competition, purchasing needs to be integtrated into the supply chain. The role and objectives of purchasing function have changed. The model for the evolution of the purchasing role toward managing in SCM context illustrates the changes in objectives of purchasing role. The model has four stages; traditional, partnership/relational, operational and strategic approach to managing in SCM context. In traditional approach relationships between the buyer and suppliers are transactional and arm’s length in nature. The objective is to buy at the lowest price. In partnership/relational approach strong buyer-suppliers relationships are built and the aim is to manage to flow of goods from source to customer. In operational approach the flow of information is also managed. The aim is at optimizing the total system by improving efficiency and reducing costs. This is achieved by reductions in inventory and cycle time. In strategic

approach the emphasis is on redesigning business processes to optimize the performance of the entire system and create competitive advantage for the company (Giunipero & Brand 1996, 32). (Nix 2000, 211–212)

3.1.2 Warehousing

The main functions performed by a warehouse are receiving the goods from the source, storing the goods until they are required, picking the goods when they are required and shipping the goods to the appropriate user. Even though there are different warehouses, like finished goods warehouse, raw materials storage and in-process inventory, all the functions mentioned are performed in each of them. The differences occur in management, user and source. (Tompkins 1998, 2–3)

The costs of warehousing can be divided in two main groups. These are the cost of capital tied in the inventory and the inventory carrying cost. The capital cost of inventory equals the value of the goods in the inventory. The inventory can be physically placed in warehouses, production or retailing/wholesaling outlets. The capital cost of warehousing can also be seen as the opportunity cost of investing the capital in some other purpose. According to Sakki (1986, 22) the cost of capital tied in the inventory is approximately 20 percent. Bowersox, Closs and Cooper (2002, 289–290) estimate that the capital cost can be anything from the prime interest rate up to 25 percent. Capital cost is fully dependent on the financial value of the inventory. (Sakki 1986, 22)

Inventory carrying costs include many different costs that develop from the maintenance and use of the physical warehouse, either own warehouse or outsourced warehousing. The cost of the warehouse building itself includes the cost of the lot, the cost of the real estate and the costs of heating and lightning. The cost of the warehouse (storage costs) equals the total annual depreciated expense of the warehouse (Bowersox et al. 2002, 290–291). Other inventory carrying costs are the cost of workforce, the cost of the machines and appliances, the cost of internal transportation and the insurance costs. Other indirect warehousing costs include the costs of obsolescence and shortage. (Sakki 1986, 21; Naula, Ojala & Solakivi 2006)

3.1.3 Distribution

When creating an effective logistics strategy, a full understanding of transportation economics and pricing is required. Bowersox et al. (2002, 356) see transportation costs as one component of the transportation economics. According to the model (Bowersox

et al. 2002, 356) there are seven factors which effect transportation costs. These factors are

- distance
- volume
- density
- stowability
- handling
- liability
- market.

The distance of the transport has a direct effect on the cost of the transportation. It contributes variable expenses like labor and fuel. The cost curve of distance and cost does not begin from the origin because of the fixed costs, like shipment pick up and delivery which are not dependent on the distance. The cost curve increases at a decreasing rate, because when the distance grows the fixed costs are spread over more kilometers. This results in lower per kilometer charges. This phenomenon is called the transportation economy of distance or the tapering principle. (Bowersox et al. 2002, 330, 356)

The transportation scale economies are also affected by the volume of the load. Transport cost per unit of weight decreases as the load volume increases. This is due to the fact that the fixed costs are divided to more kilograms when the load has more volume. That is why small loads are often collected into larger loads. The volume of the transportation is limited by the size of the transportation vehicle. When the vehicle is full, another vehicle is needed and new fixed costs emerge. (Bowersox et al. 2002, 356–357)

Density and stowability in transportation pricing have both to do with how the products are packed. Density refers to the weight and volume of the products. Some products are lighter than others and are that for transported with lower costs. This is because most transportation costs are allocated by weight. Also the amount of air inside the packages influences the weight and therefore the cost of the transportation of the products. Stowability has to do with the shape of products transported. Products with odd shapes cause wasted cubic capacity, because empty spaces remain in the vehicle. (Bowersox et al. 2002, 357)

The handling of the loads also causes expenses. Special handling equipment is needed to unload the different vehicles in for example ports, truck terminals and rail yards. The use of different kinds of boxes and pallets in transporting product also affects the handling costs. (Bowersox et al. 2002, 358)

The liability in transporting goods means that if the products are for example damaged or disappeared, possible claims from the shippers or receivers can be expected. The carriers usually have an insurance to protect against the claims. Improved

packaging and decreased sensitivity of the products reduces the risk of damage and transportation costs at the same time. (Bowersox et al. 2002, 358)

Market factors influence transportation costs. The ideal situation is that when a truck drives a load to a destination, it returns with a load of equal volume. The reality often is that trucks return to their origin empty or with smaller loads. This is due to the imbalances in manufacturing and consumption locations. If the truck returns empty, the cost of the way back is also a cost of the load that was already delivered. (Bowersox et al. 2002, 358)

3.1.4 Managing and Passing supply Chain and Market Information

Information is considered to be crucial for logistics and distribution system. Only continuous flow and transfer of information enables a distribution system to function adequately and effectively. An appropriate company strategy needs to be developed for information requirement. Also passing the information forward to retailers and other customers is important. (Rushton, Oxley & Croucher 2000, 445; Kotler & Armstrong 1996, 447)

The quality of information can be evaluated from three different angles. The availability of information is one of them. Often logistics managers do not have the information they need for decision making, because they actually don't know what information they need and don't know how to ask for it. On the other hand often the staff gives managers only the information that is convenient and cost-effective to find. This information usually is not adequate. (Coyle et al. 1996, 400)

The accuracy of the information also affects the quality of information. The used cost accounting and magamement control systems for example are often outdated and give false information. The produced information is not valid enough for logistics managers to make adequate decisions. (Coyle et al. 1996, 400)

The effectiveness of communication is the last factor on the quality of information. To be useful for managers, information needs to be communicated effectively. Effective communication includes knowledge of what the recipient of the information can perceive, expects to perceive and what is intented to do with perceived information. (Coyle et al. 1996, 401)

Inside a company logistics information flows are divided in to two types of flows: incorporating coordination and operational activities. Coordination flow includes activities related to scheduling and requoirements planning throughout the company. The flow of information in operational activities goes through order management, order processing, distribution and transportation and shipping to procurement. (Coyle et al. 1996, 401–402)

Information flows between companies, for example between a shipper, a carrier and a consignee, are numerous. Between shipper and consignee, among others purchasing order information and point of sale data are exchanged. Between shipper and carrier, information in the form of pickup notification, bill of lading, shipment status and invoice or freight details are exchanged. Between carrier and consignee, information on pickup, routing, shipment status and freight invoice is passed on. (Coyle et al. 1996, 402–403)

3.2 Additional marketing and channel functions performed by the wholesalers

In modern business world with technical and strategical advances and internationality, the question of why wholesalers are needed in the supply chains is often asked. Kotler and Armstrong (1996, 446) ask this question and also give an answer that explains the use of wholesalers. Why won't the manufacturers sell directly to retailers, consumers or industry? The answer is that there are numerous tasks that need to be performed in the marketing and logistics channels besides the main tasks of buying, warehousing and distribution. Wholesalers defend their position in the supply chain by doing these additional tasks better and more cost effectively than manufacturers or retailers could. Kotler and Armstrong (1996, 446–447) give a nine count list of channel functions that wholesalers often perform better than other channel members.

- Selling and promoting
- Buying and assortment building
- Bulk-breaking
- Warehousing
- Transportation
- Financing
- Risk bearing
- Market information
- Management services and advice

Selling and promoting performed by the wholesalers help the manufacturers to reach even smaller retailers and other customers at a lower cost by using the wholesalers numerous contacts and trustworthiness among the retailers. Wholesalers can be used by retailers as assortments builders. The wholesaler builds the desired product assortment savings the retailers a lot of time and work. Wholesalers buying in bulks save the retailers money. Even thought the retailer only buys a small amount of the good in question, the bulk discounts are received by the wholesaler. Wholesaler with numerous customers does not have to worry about warehouse turnover or items not been able to be

sold. When wholesalers hold inventories, the inventory costs and risks of the manufacturers and customers can reduced. Quicker deliveries to the retailers can be executed by the wholesalers because usually wholesalers are sited closer to retailers and other clients than manufacturers are. Wholesalers can do financing to both sides of the supply chain. Wholesalers finance production by ordering early and paying invoices early. In financing retailers wholesalers give long payment times. Wholesalers take some of the risks of the industry by bearing the costs of goods non-marketable. Wholesalers take the risk of theft, damage, spoilage and obsolescence. Wholesalers give market information to the customers and industry about competitors, new products and price changes. Management services and advice include salesclerk training, store display and layout improvements, and setting up accounting and inventory control systems. (Kotler & Armstrong 1996, 446–447)

Stern & El-Ansary (1992, 108) have also created a model of value added tasks performed by the wholesaler-distributors. The wholesaler's existence is up to performing these value adding tasks for both the suppliers and customers. The following figure (Figure 10) illustrates the model.

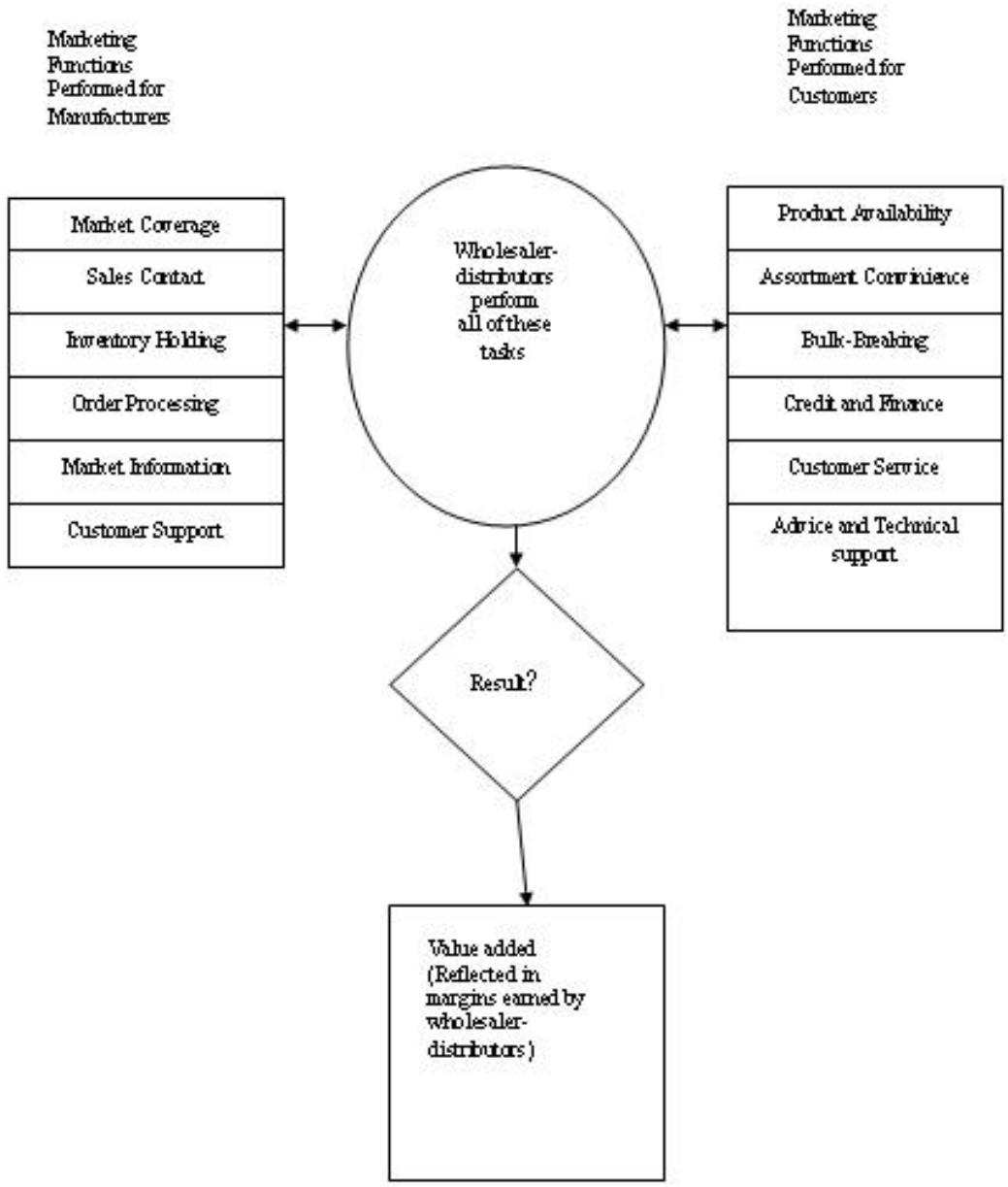

Figure 10 Value added by wholesaler-distributors through the performance of marketing functions (Stern & El-Ansary 1992, 108)

On the left hand side of the figure are the marketing functions that wholesalers perform for the manufacturers. Because most manufacturers have numerous customers on large geographical areas, wholesalers perform the Market coverage function in order to help the manufacturer reach the necessary market coverage at justifiable cost. Sales contact function is often performed by wholesalers, because using wholesalers as sales contact reduces significantly the manufacturer's sales costs. Instead of contacting all your customers, you only need to keep in touch with few wholesalers. Less sales people are needed at the manufacturer's work force. By executing the Inventory holding function wholesalers help manufacturers to reduce their stocks and the risks associated

with holding large inventories. Manufacturers can also plan their production more competently, because wholesalers provide them a ready outlet. By performing the Order processing function wholesalers can lower the manufacturers order processing costs. When orders are received and delivered in larger quantities, the order processing costs per client are reduced. Wholesalers are often closer to the customers than manufacturers. That is why wholesalers carry out the Market information function in order to give the manufacturer information about customers' product and service demands. Customer support function includes set up, adjustment, product exchanges and returns, repair and technical assistance. Wholesalers can perform these tasks for the customers more effectively and with less costs than manufacturers them selves could. (Stern & El-Ansary 1992, 108–120)

The right hand side of the figure illustrates the marketing functions performed by the wholesaler-distributors for the customers. The most important of these tasks is the Product availability function. The wholesalers provide their customers products ready from the warehouse closer to the customers than manufacturers. Because of the closeness wholesalers are sensitive to the customer requirements the product availability wholesalers offer is hard to beat by any manufacturer. Instead of ordering from thousands of manufacturers customers can order from only a couple of wholesalers if the wholesaler is performing the Assortment convenience function. Wholesalers collect from the numerous manufacturers an assortment that customers can use in order to simplify their ordering processes. The Bulk-breaking function of wholesalers allows the customers to order products in smaller quantities than the manufacturers' batch sizes are. The wholesaler buys the batches and divides them in to smaller amounts, the size the customer wants. The Credit and finance function includes both long payment times for the customers and the reducing of the customer's inventory by the use of the wholesaler's warehouses. Customer service function includes delivery, repairs and warranty. By executing these tasks wholesalers save their customers a lot of labor and costs. Many complicated products need same advice and assistance given to the consumers and industrial customers for the proper use of the product. Wholesalers perform the Advice and technical support function and train the customer's personnel to give the advice and assistance. Performing all these tasks results in adding value in margins earned by the wholesaler-distributors. (Stern & El-Ansary 1992, 108–120)

3.3 Different types of wholesalers

3.3.1 Merchant wholesalers

Merchant wholesalers are independently owned businesses that take title to the merchandise they handle. They buy and sell goods to industry, retailers, other companies, public authorities and farmers. The goods sold include consumer and investment goods and raw materials and semi-finished goods. Wholesale merchants sell retailers either one or multiple lines of goods. One line wholesale merchants include for example hardware, medical and clothing wholesalers. Industrial distributors provide inventory, credit and delivery to their industry clients. Their products include equipment, raw materials and semi-finished goods. Wholesale merchants and industrial distributors are called full-service wholesalers because of the wide set of services they provide for their customers: for example carrying stock, using a sales force, offering credit and making deliveries. (Kotler & Armstrong 1996, 447–448; Santasalo & Koskela 2001, 7)

Limited-service wholesalers offer only a few services to their suppliers and customers. Limited-service wholesalers include among others cash-and-carry wholesalers and mail-order wholesalers. (Kotler & Armstrong 1996, 447–448)

Some wholesalers have exclusive rights for their brands in distribution on certain markets. They operate as reprentatives for the brands. The representatives have been chosen by the manufacturers based on a tender. Brand representation is a common form of wholesaling specially in technical wholesaling. The wholesaler is often responsible also for assembly, maintenance and quarantee repairs of the products it represents. (Santasalo & Koskela 2001, 8)

3.3.2 Manufacturers' sales branches and offices

Wholesaling that is carried out by sellers and buyers themselves instead of through independent wholesalers, is executed by manufacturers' sales offices and branches. Sales branches and offices are set up to improve inventory control, selling and promotion. As sales offices do not carry inventory, the branches do. (Kotler & Armstrong 1996, 450) Sales branches are often located far away from the actual company or the manufacturing. They display the company's products and arrange for financing and service. (Encyclopedia Britannica)

3.3.3 Agents and brokers

The thing that separates agents and brokers from merchant wholesalers is that they do not take title to goods. Agents and brokers perform only a few functions and their main function is to aid in buying and selling. They operate as intermediaries between the sellers and the buyers and conduct business on behalf of their clients. Their earning comes from a commission that is based on the selling price. Agents and brokers generally spezialize by product line or customer type. (Kotler & Armstrong 1996, 449; Santasalo & Koskela 2001, 9)

A broker brings buyers and sellers together and assists in negotiation. A broker is used on one sale basis for example in real estate business. Agents on the hand represent buyers and sellers on more permanent basis. Manufacturers' agents have a formal agreement with each manufacturer they represent covering prices, market areas, order handling, delivery and quarantees and commission rates. Manufacturers' agents are usually small businesses with only the sales force as employees. Especially small companies with no ability to hire their own sales people hire agents to do their selling. Some agents specialize as selling agents, who sell a producer's entire output. They serve as a sales department for the client and have influence on prices, terms and conditions of sale. (Kotler & Armstrong 1996, 449; Santasalo & Koskela 2001, 9)

3.3.4 Wholesaling by large retail chains

Large retail chains have an important role in Finnish wholesaling. The two main retail chains Kesko and SOK have dominance in grocery retailing and Kesko is the biggest hardware retailer in Finland. (A.C. Nielsen Finland Oy; RaSi Ry)

What makes retail chains different than other wholesalers is that they have their own retail outlets which buy most of their products. Retail chains do many other tasks than just wholesaling. They participate in retail marketing, administration, financing and procurement and ownership of business locations along with retailing. (Santasalo & Koskela 2001, 8–9)

3.4 The wholesalers' positions in distribution channels

The distribution channels in both business-to-business and business-to-customers marketing are numerous. Figure 11 illustrates three basic distribution channels for customer marketing. (Kotler and Armstrong 1996, 391–392)

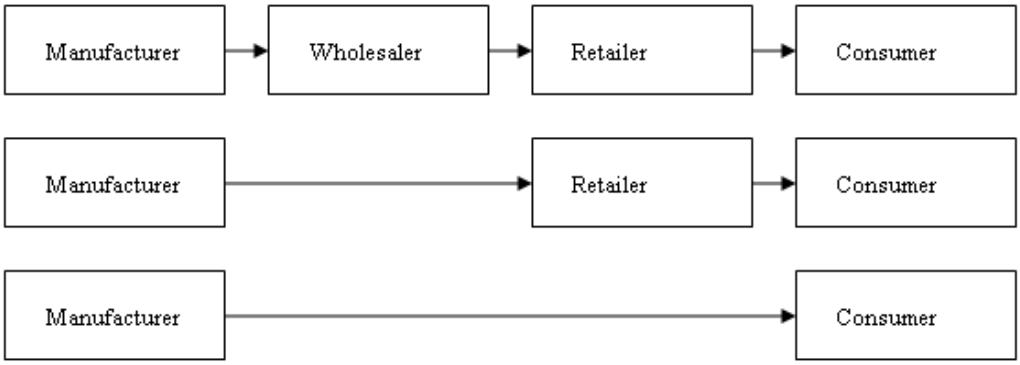

Figure 11 Customer marketing channels (Adapted from Kotler and Armstrong 1996, 392)

Wholesalers usually function as intermediaries between manufacturers and retailers. The distribution can also happen with only one or no intermediaries at all (two lower marketing channels in figure 11). In these cases it is either the retailer or the manufacturer who performs the marketing functions that wholesalers do in the upper channel of the figure. (Kotler and Armstrong 1996, 391–392; Rosenbloom & Warshaw 1989, 31)

Wholesalers also have an important role in business marketing channels as industrial distributors. They sell primarily to manufacturers and perform a broad variety of marketing channel function. These include stocking, delivery and a wide product assortment. They also have their own sales force. Business marketing channels usually have many intermediaries, which are for example manufacturer's representatives or sales branches and industrial distributors. Manufacturers can though sell even directly to business customers. (Kotler and Armstrong 1996, 391–392; Webster 1976, 11)

The use of intermediaries in marketing channels by the manufacturers means giving up control over the sales function. Still many manufacturers use intermediaries because the benefits they bring to the manufacturer are nomerous. Intermediaries are more efficient in making the goods available to markets. They have more contacts and experience and their specialization and scale of operations helps intermediaries to offer manufacturers better market reach that manufacturers themselves could achieve. Wholesalers perform the marketing functions with lower costs and higher efficiency than manufacturers. Using wholesalers reduces the number of transactions inside channel. For customers wholesalers can provide the right assortment, which is transformed from the assortments of multiple manufacturers. (Kotler and Armstrong 1996, 389–390; Rosenbloom & Warshaw 1989, 33)

4 THE COMPLETION OF THE RESEARCH AND RESEARCH METHODS

4.1 The research approach

Scientific research is divided into empirical and theoretical research. Empirical research is based on observations on reality and these observations are ultimately based on human senses. In theoretical research researchers use the existing theories as the basis of their study. In this research the data is collected through Internet and phone surveys. That makes this research empirical.

According to Arbnor and Bjerke (1997, 49) there are three methodological approaches to business research: analytic approach, systems approach and actors approach. In logistics research the analytic school and the systems school are widely used (Gammelgaard 2004, 484–487). The research approach can be either qualitative or quantitative. In quantitative research descriptions on events and situations are presented and interesting aspects of phenomena are documented. The main character of positivistic research is the aim for finding causations. This research is quantitative and positivistic. Thus the approach is this research is analytic. (Hirsijärvi, Remes & Sajavaara 2001, 123–129)

Quantitative research can also be called hypothetic-deductive research. Based on the hypothetic-deductive method, theory develops from real-life findings. Hypotheses are conducted from this theory and the hypotheses are then tested using the surveyed data. The use of research hypotheses makes this research hypothetic-deductive. Hypotheses are mostly only used in explanatory research. This research is explanatory. (Hirsijärvi, Remes & Sajavaara 2001, 133,148)

The measurement in quantitative research happens on ordinal or at least interval scale. In this research the measurement happens mostly on nominal scale. Measurement on nominal scale can not include any mathematical operations, which makes the measurement fairly basic. Using quantitative methods in marketing research, which is often criticised, is possible in this case, because of the way the data is collected; using surveys. (Niiniluoto 2002, 188–189)

4.2 Description of the data

The empirical data used in this research was collected for the Logistics Survey 2006 at Turku School of Economics. The survey was done for the Finnish ministry of transport

and communications. The data was collected during the spring in 2006. The authors of the research were Tapio Naula, Lauri Ojala and Tomi Solakivi from the marketing department at the Turku School of Economics. The surveys were mainly conducted by Internet polls and some phone inquiries were also made.

The Internet poll included 26 multiple-choice questions for trade companies. Overall the survey was responded by 2255 companies, of which 788 represented trade. The companies involved in this analysis were chosen by their answer to research question no. 8 (See appendix 2). Any company that had answered to be a first tier distributor (solely or among other tasks) has been included in the analysis of this study.

This research deals with many aspect of wholesaling. The research hypotheses are tested using multiple topics and questions from the survey. These topics include information technology, outsourcing, supply chain position, location, logistics competence and logistics performance measurement. Table 8 illustrates the different research questions used to test the research hypotheses.

Hypothesis	**Research question**
1	17: Which of the following methods are in use in your company for controlling orders and deliveries on a weekly basis?
2	17: Which of the following methods are in use in your company for controlling orders and deliveries on a weekly basis?
	20c: How many days is your customer order fulfillment cycle time (order-delivery)?
3	14a: How many percent of the following logistics functions are managed by an external service provider in your company now?
4	15: Check off an option if you consider it a significant motivator to use external logistics providers.
5	8: According to the figure below, which of the following options describes your firm's position in the production chain?
6a	26b: Rate the operational preconditions of your firm locality/localities in your country in general business perspective.
6b	26d: Rate the operational preconditions of your firm locality/localities in your country from the perspective of traffic infrastructure.
7	23a: We carefully keep track of our firm's logistics costs.
8	23b: Our firm follows logistics performance indicators together with our suppliers and customers.
9	21a: How high is the level of logistics competence in your company?
	21e: How high is the level of logistics competence of your competitors?
10	21d: How high is the level of logistics competence of your logistics providers?

Table 8 The used research questions in hypotheses testing

Some answers to the research questions were on scale, e.g. a five-step-scale from total disagreement to total agreement. Some numbers and percentages were also given. In some questions the respondents were asked to choose one or more alternatives, based on whether these arguments were true in their company.

4.3 Research hypotheses

This paragraph contains the research hypotheses which have been generated from the theories and literature presented in paragraphs 2 and 3. The ten hypotheses presented are aimed to reveal dependencies between multiple topics of the State of logistics 2006 – study and logistics costs. These topics contain information technology, outsourcing, location, competence, supply chain position and following logistics indicators.

The hypotheses are analyzed by using statistical methods. Data analyzed in the research is divided in to different categories according to the variables measured in each hypothesis. The data is collected from 357 Finnish wholesalers in an enquiry of 26 main questions. In this chapter the research hypotheses, the theory behind them and the way that they are analysed are presented.

4.3.1 Information technology's effect on logistics costs

An article by Williams, Esper & Ozment (2002, 703–706) is concerned with technology development and electronic supply chains in particular. The study reveals that the adoption of information technology in to supply chains results in costs savings on multiple logistics tasks in supply chains. Electronic supply chains allow companies the change logistics service providers and other partners rapidly and evaluate them more efficiently using performance measurement.

> *Hypothesis no. 1: Using information technology in supply chains reduces logistics costs.*

The level of information technology of companies is evaluated by their answers to the research question 17, in which respondents were asked to tell which technologies their company uses in controlling orders and deliveries. The internal and external use of these technologies is analyzed separately. Those companies who use mail, phone, fax, e-mail and web pages as Internet marketplaces in controlling orders and deliveries belong to the category of low level of information technology. Companies using Intranet/Extranet or EDI are on the medium level in information technology utilization. Companies using ERP or RFID, which is the most recent of these technologies, are considered to be on the high level in information technology usage.

The level of logistics costs is calculated by summarizing the percentages of turnover given by the respondents to the different logistics cost components. The companies are then divided in to three categories: low, medium and high logistics costs. Low logistics costs category consists of the companies whose logistics costs equal 23 or less percent of turnover. Logistics costs over 23 percent up to 38 percent of turn over constitute for medium level logistics costs. The companies with over 38 percent of logistics costs of

turnover belong to the group of high logistics costs. This same classification will be used in analyzing all hypothesis concerned with overall logistics costs. The statistical methods used here are cross tabulation and correlation coefficient.

4.3.2 Electronic business and it's effects on order lead times

Another important measure in making the supply chain more efficient and lowering costs is order lead time. A study of Finnish industrial companies (TT 2000, 13) revealed that almost 70 percent of the respondents stated that entering and utilizing electronic business has shortened their order lead times.

Hypothesis no. 2: Utilizing electronic business cuts order lead times.

Electronic business contains electronic commerce and other methods used to utilizing new technologies and their benefits. These include for example customer requirement using electronic market places, electronic data interchange and managing the supplies and order by using ERP. (TT 2000, 6) In the analysis of this hypothesis the companies are divided into three groups based on their use of technological methods. The groups are different compared to hypothesis no. 1, because using web pages as Internet marketplaces is considered to be a part of electronic business. The group not utilizing electronic business uses letter, telephone, fax and e-mail in their communications outside the company. The group using some methods of electronic business use web based portals and Intra/Extranet in their communications with customers and other interest groups. Companies with high level utilization of electronic business use EDI, ERP and RFID in managing their supply and procurement. Company belongs to the group of high level of usage of electronic business if it utilizes any of the three following technologies: EDI, ERP or RFID. The group with some usage of electronic business contains companies not using EDI, ERP or RFID, but using web based or Intra/Extranets. The group of companies not utilizing electronic business includes companies using only letter, phone, fax or email in their communications.

Respondents are asked to evaluate the average order fulfillment cycle time (or order lead time) of their own company in research question 20c. The responses of company lead time vary from 1 day up to three months and respondents are divided in to three groups based on their average lead time. The groups are lead time 15 days or over, lead time between 4 and 14 days and lead time 3 days or less. Cross tabulation is used in this analysis together with correlation coefficient.

4.3.3 Outsourcing's effect on logistics costs

An important topic in logistics today is outsourcing. Outsourcing logistics is a source of many improvements in supply chains. These are for example cost savings, competitive advantage and customer service improvements. (Boyson, Corsi, Dresner & Rabinovich 1999, 73) A study conducted by Lieb, Millen & Van Wassenhove (1993) reports logistics costs savings of 30 to 40 percent achieved by outsourcing. Andersson (1995, 155) also reports reduced logistics costs achieved by outsourcing and forming alliances with business partners.

> *Hypothesis No. 3: The Level of outsourcing in a company has an effect on the level of logistics costs.*

Research question 14a concerns with the level of outsourcing of different logistics functions. The given categories are

- 0 percent (1 point)
- less than 25 percent (2 points)
- between 25 and 50 percent (3 points)
- between 50 and 75 percent (4 points)
- over 75 percent (5 points) outsourced.

Respondents have evaluated each logistics function in terms of outsourcing separately. In this analysis the functions are divided in to three groups and each group is analyzed with logistics costs separately using cross tabulation. The first group of logistics functions is called core functions and consists of transportation, reverse logistics and freight forwarding. Complementary logistics functions are group number two and contain sales order handling, invoicing, warehousing, inventory management and product customization/finalization. Outsourcing logistics information systems is the third group in outsourcing logistics functions.

In core functions respondents are divided to high level of outsourcing or low level of outsourcing. The outsourcing of core functions is considered high if over 75 percent of transportation and over 50 percent of reverse logistics and freight forwarding are outsourced. In complementary functions respondents are divided in to groups of 'not outsourced' or 'some outsourced'. A company reaches the group of some outsourced if the five different complementary functions together exceed five points. In information systems the same groups of 'not outsourced' or 'some outsourced' are used. Two points are needed to reach the group of some outsourced. The same classification on logistics costs is used in this hypothesis that was used in hypothesis no.1. The analysing methods to use are cross tabulation and Chi-Square test.

4.3.4 Reasons to outsource logistics functions

The reasons for outsourcing business functions for companies are numerous. Current and future motives for outsourcing are considered to be different. The reasons transform from cost reduction related issues to more strategic reasons. These are for example concentrating on core competencies and creating higher value to customers. (Kakabadse & Kakabadse 2005, 186; Skjoett-Larsen 2000, 112)

Hypothesis No.4: The reasons for outsourcing logistics functions are becoming more strategic in nature.

Chapter 2.4 concerns with outsourcing and presents some study results on reasons for outsourcing. In analyzing this hypothesis the answers for question 15 are combined and the main reasons for outsourcing for these Finnish wholesalers are illustrated in a diagram.

4.3.5 Production chain position's effect on logistics costs

The role of wholesalers in distribution channels has been under discussion for long. Why are the wholesalers needed as intermediaries in supply chains? According to Rosenbloom and Warshaw (1989, 31–33) wholesalers have succeeded by performing marketing functions with lower costs than manufacturers. Childs and Batista (1997, 448) see that the primary function of wholesalers as intermediaries is in improving the efficiency of the distribution system. Wholesalers are therefore only economically useful if the services and functions they perform are cheaper than the cost of direct distribution from manufacturers to retailers and industry (Childs & Batista 1997, 448).

Hypothesis No. 5: The position in the supply chain effects logistics costs.

Many of the respondents have reported in research question 8 that they have multiple positions in the production chain. For example 34 respondents are both manufacturers and wholesalers. In order to find out whether production chain position effects logistics costs, the 357 wholesale respondents have been divided in to four groups:

- Manufacturer-wholesalers
- Wholesalers
- Wholesaler-retailers
- Manufacturer-wholesaler-retailers

For cross tabulation the respondents are classified according to logistics costs the same way as in previous hypotheses. Chi-Square test is also done.

4.3.6 Location's effect on logistics and transportation costs

Locating facilities is a demanding task. One of the factors effecting location decisions is the cost and availability to utilities (water, electricity and sewer) and the level of traffic infrastructure. Infrastructure and cost of utilities both effect the logistics efficiency. (Allen 1991, 64)

> *Hypothesis No. 6a: The location from the perspective of logistics efficiency affects logistics costs.*
>
> *Hypothesis No. 6b: The location from the perspective of traffic infrastructure affects transportation costs.*

Hypothesis no. 6a relates the respondent's evaluation on the operational preconditions of their locations from the logistics efficiency perspective and the overall logistics costs. Respondents were asked to evaluate their operational preconditions on a five category scale: very poor, poor, not high nor poor, high and very high. The cross tabulation is conducted by using this classification and the pre-mentioned categorization of overall logistics costs. Correlation coefficients are also calculated to show any correlations between the variables.

Hypothesis no. 6b evaluates the companies' operational preconditions from the perspective of traffic infrastructure. For the cross tabulation analysis the five category scale from research question 26 is used and based on transportation costs the respondents are divided in to three groups. Low transportation costs include firms with transportation costs 5 percent or less from turnover. Transportation costs over five percent and below ten percent of turnover constitute for medium transportation costs. Companies with 10 percent or over transportation costs from turnover belong to the group of high transportation costs. The same testing methods are used is in testing hypothesis no. 6a.

4.3.7 The effect of keeping track of logistics costs on logistics costs

In the pursuit of finding the most effective distribution channels and partners, companies need to divide logistics costs by function, territory, commodity, channel, method of sale, class of trade, order size, delivery and terms of sale et cetera (LaLonde & Pohlen 1996, 2). Following logistics costs as a whole by using total cost analysis instead of trying to reduce the cost of individual logistics activities is the key to real cost savings (Lambert & Burduroglu 2000, 6).

> *Hypothesis No. 7: Keeping track of company's logistics costs systematically reduces the logistics costs.*

Research question 23a asks whether respondents agree with the argument 'We carefully keep track of our company's logistics costs'. The question contains a five alternative answers from I completely disagree, I somewhat disagree, I do not agree nor disagree, I somewhat agree and I completely agree. Again for cross tabulation and Chi-Square test the same classification of logistics costs in to low, medium and high logistics costs is used.

4.3.8 Following logistics performance indicators in co-operationwith suppliers and customers and it's effect on logistics costs

Extensive measurement of logistics performance indicators is crucial to improving logistics processes. Measurement is viewed as a critical competence and is used to assess functional performance. (World Class Logistics 1995, 218)

> *Hypothesis No. 8: Keeping track of logistics performance measures together with suppliers and customers lowers logistics costs.*

In analysing this hypothesis the same five category answers from complete disagreement to complete agreement are used together with the logistics costs classification using cross tabulation and Chi-Square test to find any dependencies.

4.3.9 Company's internal logistics competence and it's effect on logistics costs

Implementing new technologies, like EDI in to a company improves logistics performance. EDI for example reduces order processing and inventory costs. In order to efficiently implement new technologies advanced logistics knowledge is required from the company's personnel. (Larson & Kulchitsky 1999, 90)

> *Hypothesis No. 9: The level of logistics competence inside the company affects logistics costs.*

In analyzing hypothesis no.9 the answers for research question 21a and 21e are used. In order to equate the estimates given by the respondents with the branch the company operates in, the companies are divided in to four categories based on how they see their own logistics competence and how they see the logistics competence of their competitors. In other words the division is made based on the estimates of respondents. Töyli, Häkkinen, Ojala and Naula (2008, 65) have done similar research on 424 Finnish small and medium-sized companies. Their focus is on financial performance of the companies. They have divided the companies in to quite similar four groups as was done in this study. However they measure the competence of the companies by using different logistics performance measures to evaluate the competence of the respondents.

The measures have to do with service level, opeartional metrics and logistics costs and are included in the survey.

Low level of logistics competence contains answers very low, somewhat low and not high nor low. Answers somewhat high and very high constitutes for high level of logistics competence. Integrating the different measures of company competence and competitor competence creates a four part figure, which is illustrated in figure 12.

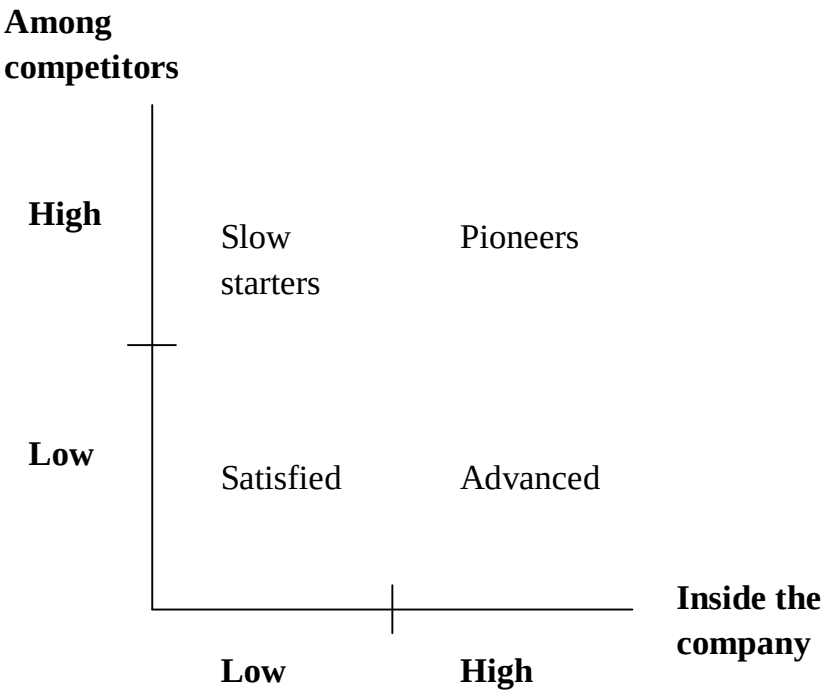

Figure 12 Logistics competence inside companies and among competitors

The pioneers themselves and also their competitors have high level of logistics competence. The companies with high own level of logistics competence and with competitors with low level of logistics competence, are advanced in logistics in their branch. Companies with highly competent competitors in terms of logistics, but low competence inside the company are called slow starters. When all companies in the branch have low level of logistics competence (satisfied), companies don't see any reason to improve their competence. In analyzing the hypotheses these four groups and logistics costs will be cross tabulated and also the Chi-Square test is done.

4.3.10 Logistics service provider's logistics competence and it's effect on logistics costs

Reductions in logistics costs are also sought through using third-party logistics or logistics service providers. TPL providers are able to operate with lower unit costs. Providing logistics services is the TPL providers main business function and it has a lot competence. Effective service logistics can lower the logistics costs by improving customer satisfaction and loyalty. (Cheung, Chan, Kwok, Lee & Wang 2006, 750; Coyle et al. 1996, 577)

> *Hypothesis No. 10: The level of logistics competence of the logistics service provider effects logistics costs.*

Again the same classification of logistics costs is used and cross tabulation and correlation coefficient are the statistical tools used here. The logistics competence of the logistics service provider is taken from the wholesaler's opinion about it asked in research question 21d.

4.4 Reliability and validity of the research

In scientific research the occurrence of mistakes is attempted to avoid. Thus in all reesearch the trustworthiness of the research is evaluated. There are many different measurement and research methods to do this evaluation. In this research we evaluate the reliability and validity of the research. (Hirsjärvi et al. 2001, 213)

The reliability of research is concerned with the accuracy of the research results. The research results need to be able to be dublicated. This means that if the same research is done twice, the results are the same. No random results are allowed from the research. (Hirsjärvi et al. 2001, 213; Heikkilä 2005, 30)

The validity of research means that the research method measures what it is was supposed to measure. Sometimes the objects of the research or not that clear, and this causes the researcher to research wrong things. In surveys the questions need to be structured in a way that they give the right answers and that the respondents realize the questions the same way the researcher does. (Hirsjärvi et al. 2001, 213; Heikkilä 2005, 29)

The questionnaire for this research was drawn up by a group of researchers at Turku School of Economics. Most of the used question models and methods were previously used in multiple international logistics studies. These methods were included in the questionnaire in order to enable further comparison between the research results.

A representing sample is a necessity for using Internet survey. The whole population needs to be informed about the survey and a link needs to be sended to them. The

population for this survey was collected by gathering e-mail addresses using the databases of two major business associations in Finland. (Heikkilä 2005, 69)

The answers to the survey were mostly given by a one person inside the company. This person might not have accurate data on all the topics of the survey. This might lead to the respondent to estimate the figures instead of giving accurate data. In Internet survey however the respondents have the ability the check these figures from collegues while they answer the survey.

According to Mentzer and Kahn (1995, 241) hypothesis testing was rarely used in logistics research during 1980's and 1990's. They base their findings on reviewing all articles published in Journal of Business Logistics from 1978 until 1993. Based on their findings Mentzer and Kahn (1995, 241) called on for more normative and exploratory research for logistics in the form of hypotheses testing in order to improve the theory base. As this research is quantitative, the use of hypotheses is appropriate.

The analysing methods used in this research aim in studying dependencies between variables. The methods for analyzing dependencies are numerous. In this research cross tabulation, Chi-Square test and correlation coeffiencies are used. Cross tabulation is used to find out the relationship between two categorized variables. Cross tabulation can be used as an analysis method for variables on any scale, from nominal scale to ratio scale.

On some of the hypotheses of this research to variables are on ordinal scale. In those cases correlation coefficiencies are calculated on the dependencies found in cross tabulation. Correlations vary between -1 and 1. The closer the correlation coefficient is to zero, the weaker the correlation between the two variables is. Correlations are then used together with the results of the cross tabulation to analyze the hypotheses. If the variables are on nominal scale, correlation coefficiencies can not be calculated. In these cases Chi-Square tests are made on the variables. The Pearson Chi-Square test shows what is the risk that dependencies occur between the variables by a chance. The other Chi-Square tests: Likelihood Ratio and Linear-by-Linear Association are not valid in this research, because they are used for quantitative variables and loglinear models.

5 THE LOGISTICS PERFORMANCE OF FINNISH WHOLESALERS

In the following chapters, the logistics performance of Finnish wholesalers is analysed by testing the research hypotheses presented in chapter 4.3. The logistics performance is evaluated by using logistics costs as the measure.

5.1 The relationship between technological level and logistics costs (H_1)

Hypothesis no. 1 deals with the level of technology used in respondent companies and its effect on logistics costs. The analysis is based on research question 17 and is divided in to two parts: internal use of technology and external use of technology.

For the purposes of cross tabulation the level of technology was divided into three groups: low, medium and high level of technology. The logistics cost were also divided to low, medium and high level.

5.1.1 Internal level of technology and logistics costs

The relationship between internal usage of different technologies and logistics costs is illustrated first. The segmentation of companies is presented in table 9.

Table 9 The relationship between internal level of technology and logistics costs

			logistics costs			
			low	medium	high	Total
Internal level of technology	low	Count	73	82	93	248
		% within Internal level of technology	29,4%	33,1%	37,5%	100,0%
	medium	Count	17	18	22	57
		% within Internal level of technology	29,8%	31,6%	38,6%	100,0%
	high	Count	29	16	7	52
		% within Internal level of technology	55,8%	30,8%	13,5%	100,0%
Total		Count	119	116	122	357
		% within Internal level of technology	33,3%	32,5%	34,2%	100,0%

The table shows that in the groups of low or medium level of internal technology the respondents divide evenly to the different cost categories. In the group high internal level of technology some changes can be noted. Over 55 percent of the companies in that group have low logistics costs. This could imply that when the internal technology level is high enough it has effect in logistics costs.

The Spearman's correlation coefficient –method is also used in analysing the relationship between internal level of technology and logistics costs. The answers to both variables are on ordinal scale and that enables the use of Spearman's correlation coefficient. The results from the analysis are presented in table 10.

Table 10 The logistics costs' dependence on internal level of technology

	Internal level of technology	
	Correlation coefficient	Significance level
Logistics costs	–0,165**	0,002

**= Correlation is significant

Table 10 shows that the correlation between internal level of technology and logistics costs is significant. With the significance level of only 0,002 the correlation of -0,165 is significant. The correlation is negative, which means that when the internal level of technology improves logistics costs reduce.

5.1.2 External level of technology and logistics costs

The level of technology used externally by the respondents and logistics costs are also compared by using cross tabulation. Table 11 illustrates the results.

Table 11 The relationship between external level of technology and logistics costs

			logistics costs			
			low	medium	high	Total
External level of technology	low	Count	64	62	82	208
		% within External level of technology	30,8%	29,8%	39,4%	100,0%
	medium	Count	41	40	35	116
		% within External level of technology	35,3%	34,5%	30,2%	100,0%
	high	Count	14	14	5	33
		% within External level of technology	42,4%	42,4%	15,2%	100,0%
Total		Count	119	116	122	357
		% within External level of technology	33,3%	32,5%	34,2%	100,0%

Table 11 shows that in the categories of low and medium logistics costs the respondents divide almost similarly to the three categories of external level of technology. On the other hand in the category of high logistics costs low technological level is more common. Over 39 percent of the companies with low level of technology externally have high logistics costs. In addition to this the group of companies with high logistics costs and high external level of technology is small, only five companies. These notions from the table back up the argument in hypothesis no.1 high technological level having at least some effect in lowering overall logistics costs.

The Spearman's correlation coefficient can also by used in analysing the external technology level's effect on logistic costs. The results from this analysis are presented in table 12.

Table 12 The logistics costs' dependence on external level of technology

	External level of technology	
	Correlation coefficient	Significance level
Logistics costs	-0,121*	0,022

*= Correlation is nearly significant

The table shows that the correlation coefficient for external level of technology and logistics costs is -0,121 with the significance level of 0,022. This means that the

correlation is significant. The correlation being negative means that when the level of external technology raises the logistics costs diminishes.

As a summary from analysing both internal and external technology levels, it can be noted that as the level of technology raises the logistics costs decrease. Crosstabulation showed that the level of technology has to be high for the costs to really decrease. The correlation coefficients show that the correlation between the two variables is at least nearly significant. Hypothesis no.1 can be checked true based in these analyses.

5.2 The relationship between utilizing electronic business and order lead times (H_2)

In analyzing hypothesis no. 2 the definition of electronic business by TT (2000) is used in assistance when categorizing the respondents to three groups: not utilizing e-business, utilizing some technologies of e-business and high level of utilizing e-business. Based on order lead times, companies are also divided in to three groups. Table 13 presents the results from cross tabulation.

Table 13 The relationship between utilizing e-business and customer order lead times

			How many days is your customer order fulfillment cycle time?			
			3 days or less	from 4 to 14 days	15 days or over	Total
utilizing electronic business	not	Count	56	26	19	101
		% within utilizing electronic business	55,4%	25,7%	18,8%	100,0%
	some	Count	71	39	22	132
		% within utilizing electronic business	53,8%	29,5%	16,7%	100,0%
	high level	Count	79	15	6	100
		% within utilizing electronic business	79,0%	15,0%	6,0%	100,0%
Total		Count	206	80	47	333
		% within utilizing electronic business	61,9%	24,0%	14,1%	100,0%

Companies not utilizing electronic business and companies utilizing some electronic business are divided similarly to the different groups of the length of the order

fulfillment cycle time, but of those companies who utilize e-business on high level, only 6 percent have order fulfillment cycle time of 15 days or over.

The variables of hypothesis no. 2 are on ordinal scale. Spearman's correlation coefficient is thus also used to analyze the hypothesis. The results from analysis are presented in table 14.

Table 14 The dependency between utilizing electronic business and order lead times

	The level of utilizing electronic business	
	Correlation coefficient	Significance level
Order fulfillment cycle time	–0,195**	0,000

**= Correlation is significant

The significance level being zero for the dependency illustrated in table 14 means that the correlation between utilizing electronic business and order fulfillment cycle time is significant. As the correlation coefficient is negative, any increases in the level of utilizing electronic business shortens the order fulfillment cycle times. The analysis of hypothesis no. 2 by crosstabulation and Spearman's correlation coefficient confirms the hypothesis to be true.

5.3 The relationship between the level of outsourcing and logistics costs (H_3)

Hypothesis no. 3 claims that the level of outsourcing logistics functions in a company affects the overall logistics costs. The higher the level of outsourcing of different logistics functions, the lower are the overall logistics costs. Research question 14/26 contains nine different logistics functions, which are categorized to three groups based on their nature. Based on logistics costs respondents are divided into three as well.

5.3.1 The relationship between the level of outsourcing core functions and the level of logistics costs

The group of core logistics functions contains transportation, reverse logistics and freight forwarding. Those functions are also the most frequently outsourced logistics functions in trade and industry as well (Ministry of Transport and Communications

Finland 2006, 65). The relationship between the level of outsourcing of core functions and the level of logistics costs is illustrated in table 15.

Table 15 The relationship between outsourcing core logistics functions and logistics costs

			logistics costs			
			low	medium	high	Total
Level of outsourcing: core functions	low	Count	62	63	69	194
		% within Level of outsourcing: core functions	32,0%	32,5%	35,6%	100,0%
	high	Count	57	53	53	163
		% within Level of outsourcing: core functions	35,0%	32,5%	32,5%	100,0%
Total		Count	119	116	122	357
		% within Level of outsourcing: core functions	33,3%	32,5%	34,2%	100,0%

No clear results or dependencies can be seen from the table. Respondents are divided quite evenly to different logistics costs groups based on their level of outsourcing core functions. Another method that can be used to reveal any dependencies between outsourcing core functions and logistics costs is the Chi-Square test, because it can be used on variables on any scale. Table 16 illustrates the results of the Chi-Square tests on the relationship between the level of outsourcing core logistics functions and logistics costs.

Table 16 The dependence between the level of outsourcing core logistics functions and logistics costs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,482[a]	2	,786
Likelihood Ratio	,482	2	,786
Linear-by-Linear Association	,481	1	,488
N of Valid Cases	357		

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 52,96.

The sig.-level in table 16 on Pearson Chi-Square row shows that the risk for any dependence between the variables occurs by a chance is 78,6 percent. This percentage together with the results from the crosstabulation of relationship between the level of outsourcing core functions and logistics costs proves that there is no dependence between the two variables.

5.3.2 The relationship between the level of outsourcing complementary functions and the level of logistics costs

The second group of outsourced logistics functions is the complementary functions (see a list in chapter 4.2.2.) Table 17 presents the cross tabulated relationship between outsourcing complementary logistics functions and overall logistics costs.

Table 17 The relationship between outsourcing complementary logistics functions and logistics costs

			logistics costs			
			low	medium	high	Total
Level of outsourcing: Complementary functions	not outsourced	Count	56	60	68	184
		% within Level of outsourcing: Complementary functions	30,4%	32,6%	37,0%	100,0%
	some outsourced	Count	63	56	54	173
		% within Level of outsourcing: Complementary functions	36,4%	32,4%	31,2%	100,0%
Total		Count	119	116	122	357
		% within Level of outsourcing: Complementary functions	33,3%	32,5%	34,2%	100,0%

Table 17 shows that the level of outsourcing complementary functions has no effect on logistics costs. Respondents are divided to the table almost evenly. The Chi-Square test is also used to analyze the relationship between outsourcing complementary functions and logistics costs. Table 18 presents the results from the analysis.

Table 18 The dependence between the level of outsourcing complementary logistics functions and logistics costs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,819[a]	2	,403
Likelihood Ratio	1,821	2	,402
Linear-by-Linear Association	1,811	1	,178
N of Valid Cases	357		

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 56,21.

The sig.-level on Pearson Chi-Square on table 18 shows that the risk for any dependence to occur between to two variables is approximately 40 percent. The risk being so high and the crosstabulation showing only minor changes in the percentages in

each square, no clear dependence between the level of outsourcing complementary logistics functions and the level of logistics costs can be found.

5.3.3 The relationship between the level of outsourcing logistics information systems and the level of logistics costs

The last group of outsourced logistics functions is information systems. Table 19 shows the cross tabulation of the level of outsourcing information systems and logistics costs.

Table 19 The relationship between outsourcing logistics information systems and logistics costs

			logistics costs			
			low	medium	high	Total
Level of outsourcing: Logistics information systems	not outsourced	Count	69	73	78	220
		% within Level of outsourcing: Logistics information systems	31,4%	33,2%	35,5%	100,0%
	some outsourced	Count	50	43	44	137
		% within Level of outsourcing: Logistics information systems	36,5%	31,4%	32,1%	100,0%
Total		Count	119	116	122	357
		% within Level of outsourcing: Logistics information systems	33,3%	32,5%	34,2%	100,0%

Table 19 shows that there is no dependency between the level of outsourcing logistics information systems and logistics costs. The respondents in both groups of outsourcing logistics information systems divide evenly to the three logistics costs categories. The Chi-Square test is again used to confirm or reverse the results from the crosstabulation. Table 20 shows the results.

Table 20 The dependence between the level of outsourcing logistics information systems and the level of logistics costs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,026[a]	2	,599
Likelihood Ratio	1,022	2	,600
Linear-by-Linear Association	,895	1	,344
N of Valid Cases	357		

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 44,52.

The Sig.-level on the Pearson Chi-Square row in table 20 shows, that the risk level for the dependence between the variables to occur by a chance is nearly 60 percent. This uncertainty together with no dependencies to occur between the variables in crosstabulation, confirm that the level of outsourcing logistics information systems has no effect on the level of logistics costs.

5.3.4 The conclusions

In analysing the hypothesis no. 3 logistics functions were divided into three groups based on their nature. Each of these groups were then analysed with the level of logistics costs. The results from the crosstabulations and Pearson's Chi-Square tests almost unanimously showed that no dependencies between the variables exist. This proves the hypothesis no. 3 to be false. No relationship between the level of outsourcing and the level of logistics costs can be found among the respondents.

5.4 Reasons for outsourcing (H_4)

Chapter 2.4.3 presents reasons for outsourcing business functions (Kakabadse and Kakabadse 2005, 186). Also the results from Logistics Study 1996-1997 and Logistics Study 2001 considering reasons for outsourcing in Finnish companies were shown. Reasons for outsourcing business functions are considered to transform in the future to more strategic and not to so cost reduction related issues. Thus hypothesis no. 4 claims that the reasons for outsourcing logistics functions are becoming more strategic in

nature. Research question 15 asked what the respondents considered to be to most significant motivators to outsource logistics functions to external service providers. The results are illustrated in Figure 13.

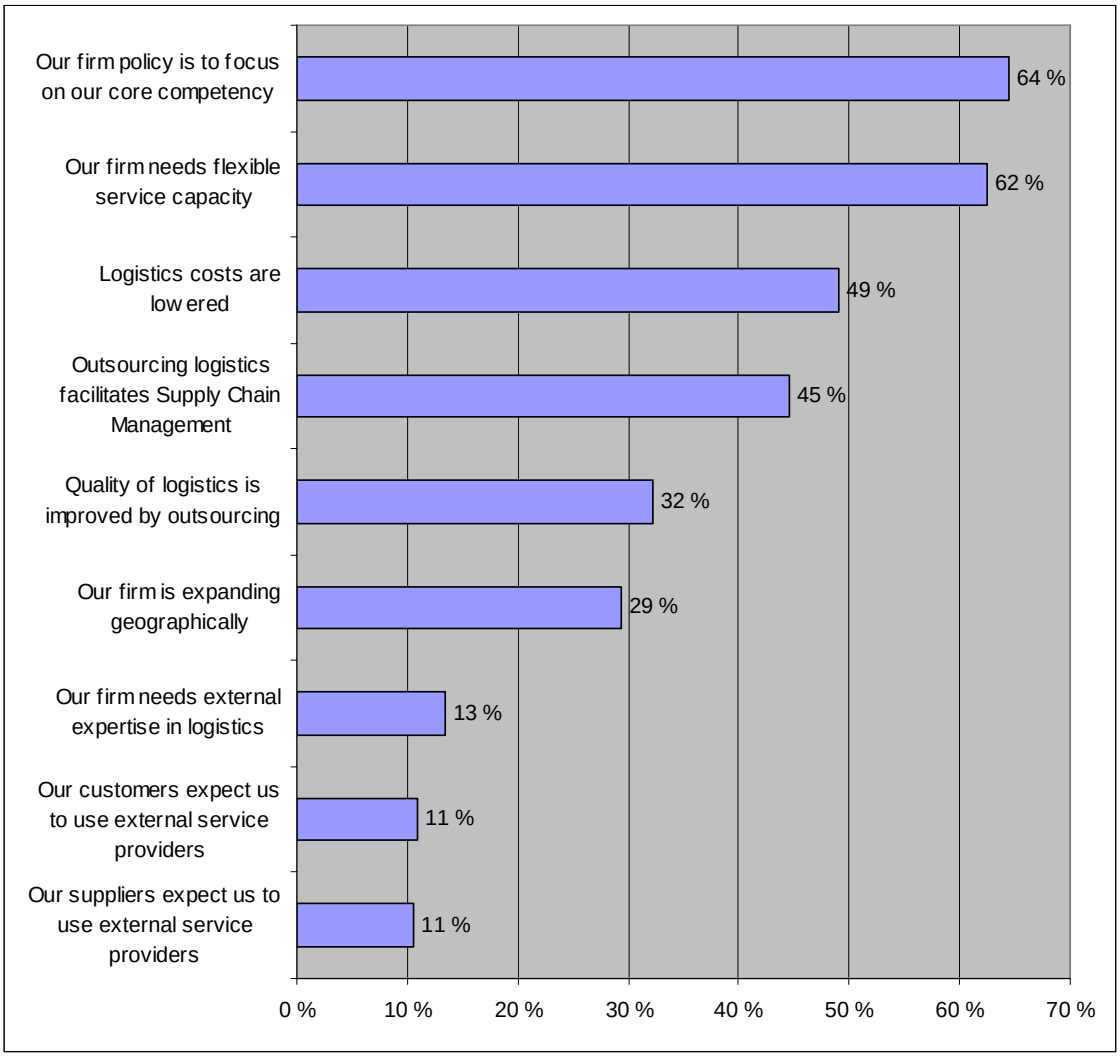

Figure 13 The reasons for outsourcing logistics functions to external service providers of Finnish wholesale companies (n = 357)

According to figure 13 the main reasons for outsourcing for Finnish wholesalers is the companies' aim to concentrate on their core competencies instead of doing everything themselves and acquiring flexible service capacity (over 60 percent of respondents both). 49 percent of companies responded lowering logistics costs being a significant reason to outsource logistics functions. Other significant reasons for outsourcing logistics functions are it's improvements in SCM and quality of logistics and the companies' need to expand geographically.

The reasons for outsourcing logistics functions were surveyed among Finnish trade and industry companies also during years 1996-1997 and 2001. Logistics study 1996-

1997 (Ministry of Transportation and Communications Finland 1997) and Logistics study 2001 (Ministry of Transportation and Communications Finland 2001) had similar research questions on outsourcing which differ slightly from the research question and results of this study. Still some commonalities and change can be seen in the results. The results of Logistics study 1996-1997 show that the main reasons for outsourcing logistics functions were gaining flexibility (especially for distribution) and lowering fixed costs and direct labor costs. In 2001 the main reasons were reported to be gaining flexibility and lowering fixed costs. The meaning of creating higher service level for customer has grown from answer rate around 25 percent in 1997 to almost 35 percent in 2001. The biggest difference between the answers for this study and the studies from the turn of the millennium is the fact that concentrating on companies' core competence has become part of the company strategy and is the main reason for outsourcing logistics and other business functions. Although lowering logistics costs is an important reason for outsourcing, other more strategic reasons, for example outsourcing's effects on flexibility, supply chain management and quality are considered to be significant in making logistics more effective.

5.5 Company's production chain position's effect on logistics costs (H_5)

Hypothesis no.5 argues that companies with different positions in production chains have unequal logistics costs. To find out whether there is any relationship between production chain position and overall logistics costs, the 357 responding wholesalers have been divided in to four groups based on if they have any other positions in the production chain besides wholesaling. Logistics costs are grouped into three as already done in previous hypotheses. Table 21 features the cross tabulation chart on the relationship between production chain position and logistics costs.

Table 21 The relationship between production chain position and logistics costs

			logistics costs			Total
			low	medium	high	
company's position in the production chain	manufacturer-wholesaler	Count	8	12	14	34
		% within company's position in the production chain	23,5%	35,3%	41,2%	100,0%
	wholesaler	Count	85	82	66	233
		% within company's position in the production chain	36,5%	35,2%	28,3%	100,0%
	wholesaler-retailer	Count	20	14	31	65
		% within company's position in the production chain	30,8%	21,5%	47,7%	100,0%
	manufacturer-wholesaler -retailer	Count	6	8	11	25
		% within company's position in the production chain	24,0%	32,0%	44,0%	100,0%
Total		Count	119	116	122	357
		% within company's position in the production chain	33,3%	32,5%	34,2%	100,0%

Differences in logistics costs among the four groups of different kind of wholesalers are small. However some deviation can be seen in how the companies in the four different wholesaler groups are divided in terms of logistics costs. Companies who are only wholesalers with no other tasks in the production chain seem to have lower logistics costs than those with multiple tasks. 71,7 percent of pure wholesalers have low or medium logistics. The same percentages for manufacturer-wholesalers is 58,8 percent, for wholesaler-retailers 52,3 percent and for companies performing all the three task the percentage is 56. Although the responses from the companies with multiple tasks contain the logistics costs of manufacturing and retailing as well as the logistics costs of wholesaling, it can be said according to this crosstabulation that wholesalers are more effective in terms of logistics costs than the companies performing multiple consecutive tasks in production chain.

In order to prove the hypothesis, the Chi-Square test is also used to analyze the hypothesis. Table 22 contains the results from the test.

Table 22 The Chi-Square test on the dependence between production chain position and level of logistics costs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12,463[a]	6	,052
Likelihood Ratio	12,613	6	,050
Linear-by-Linear Association	1,677	1	,195
N of Valid Cases	357		

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 8,12.

Table 22 shows that the Sig.-level for Pearson Chi-Square equals 0,052. That means that there is only a five percent chance that the dependence between the production chain position and the level of logistics costs occurs by a chance. This proves hypothesis no. 5, which claims that a company's position in the production chain affects the overall logistics costs. In particular as a result from the crosstabulation it can be said that pure wholesalers with no other tasks in the production chain have lower logistics costs than companies with multiple tasks.

5.6 The relationship between facilities location and logistics costs (H_6)

Research question 26/26 asks the respondents to evaluate the operational preconditions of their company's localities from five different perspectives. Hypothesis no. 6a concerns the perspective of logistics efficiency and relates the level of the operational preconditions with logistics costs. 348 responses were given to question 26b. Only one company saw its operational preconditions on location very poor. The group of very poor was there fore excluded from the evaluation. Table 23 presents the cross tabulation of operational preconditions of localities from the perspective of logistics efficiency.

Table 23 The relationship between the location from the perspective of logistics efficiency and logistics costs

			logistics costs			Total
			low	medium	high	
Operational preconditions of localities from the perspective of logistics efficiency	poor	Count	2	3	8	13
		% within Operational preconditions of localities from the perspective of logistics efficiency	15,4%	23,1%	61,5%	100,0%
	not high nor poor	Count	26	18	16	60
		% within Operational preconditions of localities from the perspective of logistics efficiency	43,3%	30,0%	26,7%	100,0%
	high	Count	57	62	66	185
		% within Operational preconditions of localities from the perspective of logistics efficiency	30,8%	33,5%	35,7%	100,0%
	very high	Count	28	30	31	89
		% within Operational preconditions of localities from the perspective of logistics efficiency	31,5%	33,7%	34,8%	100,0%
Total		Count	113	113	121	347
		% within Operational preconditions of localities from the perspective of logistics efficiency	32,6%	32,6%	34,9%	100,0%

Table 23 shows no clear dependencies. Some indifference can be noted only when comparing the group of poor operational preconditions with the other groups. Over 60 percent of the companies in the group of poor operational preconditions have high logistics costs. As the preconditions get better the amount of companies with high logistics costs decreases. Although the big percentage in the first group can also be due to the fact that the group contains answers only from 13 companies and is substantially smaller than the other groups. In small groups individual answers have a big effect on the results. In the groups of not high or poor, high and very high operational preconditions the companies divide quite evenly to the different cost categories. Overall no clear relationship between the operational preconditions of firm's localities from the perspective of logistics efficiency and logistics cost can be found. Table 24 shows the Spearman's correlation coefficient for the dependence between the two variables.

Table 24 The dependence between the operational preconditions of localities from the perspective of logistics efficiency and the level of logistics costs

	Operational preconditions of localities from the perspective of logistics efficiency	
	Correlation coefficient	Significance level
Logistics costs	0,061	0,252

The dependence of the variables in this analysis is not significant, because the correlation coefficient is only 0,061 with significance level of 0,252. The significance level should not exceed 0,05 with this small correlation coefficient and so few respondents. This overrules hypothesis no. 6a.

Hypothesis no. 6b concerns another perspective for operational preconditions of localities in Finland. This perspective is traffic infrastructure. The analysis is aimed to find out whether the level traffic infrastructure has an effect on transportation costs. In terms of operational preconditions companies were again divided into five different categories, of which the category of very poor operational preconditions was eliminated because of only one company belonging to it. Transportation costs are divided to low, medium and high level of transportation costs. The class boundaries of the cost categories are designed to divide the respondents to the cost categories evenly. Table 25 presents the relationship between the operational preconditions of localities in from the perspective of traffic infrastructure and transportation costs.

Table 25 The relationship between the operational preconditions of localities from the perspective of traffic infrastructure and transportation costs

			transportation costs			Total
			low	medium	high	
Operational preconditions of localities from the perspective of traffic infrastructure	poor	Count	5	2	7	14
		% within Operational preconditions of localities from the perspective of traffic infrastructure	35,7%	14,3%	50,0%	100,0%
	not high nor poor	Count	24	34	21	79
		% within Operational preconditions of localities from the perspective of traffic infrastructure	30,4%	43,0%	26,6%	100,0%
	high	Count	64	54	59	177
		% within Operational preconditions of localities from the perspective of traffic infrastructure	36,2%	30,5%	33,3%	100,0%
	very high	Count	36	21	20	77
		% within Operational preconditions of localities from the perspective of traffic infrastructure	46,8%	27,3%	26,0%	100,0%
Total		Count	129	111	107	347
		% within Operational preconditions of localities from the perspective of traffic infrastructure	37,2%	32,0%	30,8%	100,0%

Again the respondents are divided in each operational precondition –group quite evenly to the different transportation cost categories, except the companies with poor operational preconditions. This exception can be explained by the small number of respondents in the group. However the table shows that 46,8 percent of companies with very high operational preconditions have low transportation cost. In other operational precondition –groups this percentage is somewhat lower, around 30 to 36 percent. This would implicate that companies with very high level of traffic infrastructure at hand have lower transportation costs. The Spearman's correlation coefficient is also used to analyze the claim given in the hypothesis. Table 26 illustrates the results from the analysis.

Table 26 The dependence between the operational preconditions of localities from the perspective of traffic infrastructure and transportation costs

	Operational prec. of localities from the persp. of traffic infrastructure	
	Correlation coefficient	Significance level
Transportation costs	-0,05	0,347

The table shows that the correlation coefficient for the dependence between the variables is near zero, which proves that no dependence occurs between these variables among the respondents. Hypothesis no. 6b about the relationship between the operational preconditions of localities from the perspective of traffic infrastructure and transportation costs can thus be checked to be untrue.

5.7 The effect of keeping track of logistics costs on logistics costs (H_7)

Research question 23a concerns with keeping track on company's logistics costs. Hypothesis no. 7 concerns the effect of the level of keeping track of company's logistics costs on the overall logistics costs. 350 responses were given to the question of 'We carefully keep track of our company's logistics costs'. The responses were given on a five point scale from total disagreement to total agreement. Table 27 illustrates the cross tabulated results.

Table 27 The relationship between keeping track of firm's logistics costs and the overall logistics costs

			Logistics costs			Total
			low	medium	high	
We carefully keep track of our firm's logistics costs	I completely disagree	Count	6	3	6	15
		% within We carefully keep track of our firm's logistics costs	40,0%	20,0%	40,0%	100,0%
	I somewhat disagree	Count	13	20	20	53
		% within We carefully keep track of our firm's logistics costs	24,5%	37,7%	37,7%	100,0%
	I do not agree nor disagree	Count	13	18	17	48
		% within We carefully keep track of our firm's logistics costs	27,1%	37,5%	35,4%	100,0%
	I somewhat agree	Count	46	31	50	127
		% within We carefully keep track of our firm's logistics costs	36,2%	24,4%	39,4%	100,0%
	I completely agree	Count	36	42	29	107
		% within We carefully keep track of our firm's logistics costs	33,6%	39,3%	27,1%	100,0%
Total		Count	114	114	122	350
		% within We carefully keep track of our firm's logistics costs	32,6%	32,6%	34,9%	100,0%

The answers on each row of the table divide quite evenly but some indifferences which could confirm the hypothesis can be seen. The percentages on column of high logistics costs decrease as the level of keeping track of logistics costs increases. Also some minor increases in low logistics costs column can be seen as the level of keeping track of logistics costs increases.

Another method that can be used to evaluate the dependencies between the two variables of logistics costs and keeping track of firm's logistics costs is the Chi-Square test. The Chi-Square test can be used on all scales from nominal scale to ratio scale. Correlation analysis is not applicable in this analysis, because the answers to research question 23/26a are on nominal scale. Table 28 shows the Chi-Square tests results on the relationship between the level of keeping track of firm's logistics costs and logistics costs.

Table 28 The results of the Chi-Square tests on the relationship between the level of keeping track of firm's logistics costs and the level of logistics costs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10,723[a]	8	,218
Likelihood Ratio	11,167	8	,192
Linear-by-Linear Association	1,624	1	,203
N of Valid Cases	350		

a. 2 cells (13,3%) have expected count less than 5. The minimum expected count is 4,89.

In this analysis we are interested in the Pearson Chi-Square row of the table. The number that shows whether the hypothesis is correct is the Sig.-value. In this case the Sig.-value shows that there is a 22 percent risk that the dependency occurs by a chance. As a summary of these two different analyzing methods, no relationship between the level of keeping track of firm's logistics costs and logistics costs occurs.

5.8 The relationship between co-operating in logistic performance indicators following and logistics costs (H_8)

Research question 23b concerns with following the logistics performance indicators in co-operation with both suppliers and customers. Hypothesis no. 8 tries to reveal whether this co-operation has any effect on logistics costs. The same five-answer-scale on performance indicators following co-operation was used as in hypothesis no.7 and the same logistics costs classification is also used. The cross tabulation contains 344 answers and is presented in table 29.

Table 29 The relationship between following logistic performance indicators together with suppliers and customers and logistics costs

			Logistics costs			
			low	medium	high	Total
Our firm follows logistic performance indicators together with our suppliers and customers	I completely disagree	Count	22	27	25	74
		% within Our firm follows logistic performance indicators together with our suppliers and customers	29,7%	36,5%	33,8%	100,0%
	I somewhat disagree	Count	28	25	34	87
		% within Our firm follows logistic performance indicators together with our suppliers and customers	32,2%	28,7%	39,1%	100,0%
	I do not agree nor disagree	Count	26	28	31	85
		% within Our firm follows logistic performance indicators together with our suppliers and customers	30,6%	32,9%	36,5%	100,0%
	I somewhat agree	Count	28	26	23	77
		% within Our firm follows logistic performance indicators together with our suppliers and customers	36,4%	33,8%	29,9%	100,0%
	I completely agree	Count	6	8	7	21
		% within Our firm follows logistic performance indicators together with our suppliers and customers	28,6%	38,1%	33,3%	100,0%
Total		Count	110	114	120	344
		% within Our firm follows logistic performance indicators together with our suppliers and customers	32,0%	33,1%	34,9%	100,0%

Based on the cross tabulation in table 29 there seems not to be any relationship between following logistics performance indicators together with suppliers and customer and logistics costs. The respondents divide evenly in the table and no indifferences can be noted. The Chi-Square test is completed to confirm the results of the cross tabulation. Table 30 presents the results from the analysis.

Table 30 The results of the Chi-Square tests on the relationship between the level of following logistics performance indicators together with suppliers and customers and the level of logistics costs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,729[a]	8	,950
Likelihood Ratio	2,737	8	,950
Linear-by-Linear Association	,400	1	,527
N of Valid Cases	344		

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 6,72.

The significance level of Pearson Chi-Square on table 30 shows that the risk of dependence occurring between the variables by a chance is 95 percent. This result added to the results from the crosstabulation proves that no depencence occurs between the level of following logistics performance indicators together with suppliers and customers and the level of logistics costs among the respondents. Hypothesis no. 8 is thus proved to be false.

5.9 The effect of company's internal logistics competence on logistics costs (H_9)

Research question 21 deals with logistics competence inside the supply chain and among competitors. Hypothesis no. 9 deals with the logistics competence inside the respondent companies. In order to diminish some of the subjectivity from the responses, the logistics competence among competitors is also included in the analysis. The respondents are divided in to four groups, based on how they see their own competence and the competence of their competitors. Figure 9 in chapter 4.2.2 illustrates to four groups that are named satisfied, slow starters, advanced and pioneers. The cross tabulation in table 31 tries to find out whether these groups of companies have any indifferencies in the level of logistics costs.

Table 31 The relationship between logistics competence and logistics costs

			Logistics costs			
			low	medium	high	Total
Logistics competence	Satisfied	Count	52	48	47	147
		% within Logistics competence	35,4%	32,7%	32,0%	100,0%
	Slow starters	Count	9	8	14	31
		% within Logistics competence	29,0%	25,8%	45,2%	100,0%
	Advanced	Count	21	28	28	77
		% within Logistics competence	27,3%	36,4%	36,4%	100,0%
	Pioneers	Count	37	32	33	102
		% within Logistics competence	36,3%	31,4%	32,4%	100,0%
Total		Count	119	116	122	357
		% within Logistics competence	33,3%	32,5%	34,2%	100,0%

The respondents divide quite evenly to logistics costs –categories, but some minor indifferencies can be seen. Companies belonging to the group of 'satisfied' in terms of logistics competence divide evenly to the cost categories and the frequency in low costs is bigger than among those companies that are slow starters. Slow starters have the biggest frequency in high logistics costs and that number seems to fall on the way to better competence to groups advanced and pioneers. The Chi-Square tests are completed to confirm or over these notions from the crosstabulation. Table 32 shows the results.

Table 32 The dependence between logistics competence and logistics costs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,802[a]	6	,704
Likelihood Ratio	3,778	6	,707
Linear-by-Linear Association	,021	1	,885
N of Valid Cases	357		

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 10,07.

Table 32 shows that there is 70 percent risk that any dependencies that might be seen in the cross tabulation occurred by a chance. This would imply that there is no dependence between logistics competence and logistics costs at least among the

respondent wholesalers. The study is thought small and maybe in bigger studies dependence between these two variables can found. However in this case hypothesis no. 9 is proved to be false.

5.10 The effect of logistics service providers' logistics competence on logistics costs (H_{10})

The analysis of hypothesis no. 10 is based on research question 21/26d. The analysis tries to find out whether the logistics competence of logistics service providers has effect on the respondent wholesalers' logistics costs. The level of logistics competence among the service providers is based on the evaluations of the respondents given in the research question mentioned above. Logistics costs are again divided in to low, medium and high costs. The classification has been presented in chapter 4.3.1. Table 33 presents the results of the crosstabulation.

Table 33 The relationship between the logistics service providers' logistis competence and the logistics costs of the respondent companies

			Logistics costs			Total
			low	medium	high	
Logistics competence of your logistics providers	somewhat low	Count	1	3	9	13
		% within Logistics competence of your logistics providers	7,7%	23,1%	69,2%	100,0%
	not high nor low	Count	14	19	16	49
		% within Logistics competence of your logistics providers	28,6%	38,8%	32,7%	100,0%
	somewhat high	Count	74	62	74	210
		% within Logistics competence of your logistics providers	35,2%	29,5%	35,2%	100,0%
	very high	Count	19	24	16	59
		% within Logistics competence of your logistics providers	32,2%	40,7%	27,1%	100,0%
Total		Count	108	108	115	331
		% within Logistics competence of your logistics providers	32,6%	32,6%	34,7%	100,0%

The only clear result from the cross tabulation in table 33, is that among those respondents who consider their logistics service provider's competence to be somewhat low, the logistics costs are mostly high (nearly 70 percent). On other levels of

competence the respondents are divided more evenly to the cost groups. Some minor fall can be noted in the column of high logistics costs as the competence level of the service providers raises. The Spearman's correlation coefficient on these two variables in presented in table 34.

Table 34 The dependence between the logistics service providers' logistics competence and logistics costs

	Logistics competence of your logistics service providers	
	Correlation coefficient	Significance level
Logistics costs	–0,136*	0,013

*= Correlation is nearly significant

The correlation coefficient of -0,136 between the two variables is nearly significant, because the significance level is only 0,013. With this many responses (N=331) the correlation coefficient of around 0,1 is adequate. The two analyses presented prove that the logistics competence of logistics service providers affects logistics costs on the wholesale companies. As the competence level rises, the overall logistics costs decrease, but only very slightly. Hypothesis no. 10 is thus true.

6 DISCUSSION

This chapter contains discussion over the results of the analyses made in chapter 5. Each hypothesis is discussed separately and some reasons for the occurred results are implied. As a conclusion of this chapter a general discussion of the results of all the hypotheses is included here and some implications from similar researches from other researchers are presented.

6.1 Information technology's effect on logistics costs

Hypothesis no.1 deals with using information technology in supply chains. According to Williams et al. (2002, 703–706) the adoption of information technology in to supply chains results in cost savings. The use of electronic supply chains enables swift change and evaluation of logistics service providers and other partners.

The cross tabulations in chapters 5.1.1 and 5.1.2 show that when the level of technology is high, some reductions in logistics costs occur. The analysis of the hypothesis shows significant or nearly significant negative correlation between the variables of using information technology and logistics costs. This means that when a company's level of information technology rises to high level, logistics costs decrease. The analyses done here back up the argument made by Williams et al. (2002, 703–706) and confirm hypothesis no. 1.

6.2 Electronic business and it's effects on order lead times

A study of Finnish industrial companies (TT 2000, 13) revealed that almost 70 percent of the respondents stated that entering and utilizing electronic business has shortened their lead times. Hypothesis no. 2 examined this claim among Finnish wholesalers.

The crosstabulation between the level of utilizing electronic business and order lead times shows that when electronic business is utilized on high level, order lead times are short (three days or less). The correlation between these variables is signicant and negative, which strenghens the result of the cross tabulation.

Another explanation for short lead times in companies utilizing electronic business is the fact, that in many companies were the use of electronic business and information technology is high, the products can be delivered electronically. Electronic delivery shortens lead times. However, based on the analysis and prior research, hypothesis no. 2 can be stated true.

6.3 Outsourcing's effect on logistics costs

Hypothesis no. 3 deals with the level of outsourcing in a company and the level of logistics costs. Many researches (Boyson et al. 1999, 73; Lieb et al. 1993; Andersson 1995, 155) imply that outsourcing logistics functions brings cost savings and other improvements to companies.

In analyzing this hypothesis the outsourced logistics functions are divided in to three based on their nature and each of these groups are individually tested in cross tabulation together with logistics costs. In the analysis of all these groups: core functions, complementary functions and information systems no clear dependencies between the level of outsourcing and the level of logistics costs were found. There was a high risk level for dependencies to occur between the variables by change in each logistics function group.

Based in the analysis among the participants of this research, the level of outsourcing has no effect on logistics. However many researchers have found out that outsourcing actually lowers logistics costs. The differencies between the results can arise from the fact that in this research the overall level of outsourcing, except core functions, among the respondent companies was low. Also the fact that previous studies were done among industry companies rather than trade companies might effect the results.

6.4 Reasons to outsource logistics functions

The reasons for outsourcing business functions have been considered to have changed over the last decade. In the past cost reduction was the main reason to outsource. Nowadays the reasons are more strategic. Companies want concentrate on their core competencies and create higher value to customers. (Kakabadse & Kakabadse 2005, 186; Skjoett-Larsen 2000, 112)

Hypothesis no. 4 contains the argument that reasons for outsourcing are more strategic nowadays. The results from Logistics study 1996–1997 and Logistics study 2001 are compared with results of the survey in this research. In the both previous Logistics studies lowering fixed costs and gaining flexibility were the main reasons to outsource logistics functions. The survey for this research shows that in 2006 the main reasons for Finnish wholesalers to outsource logistics functions was to be able to concentrate on core competencies instead doing everything themselves and to gain flexible service capacity. Lowering logistics costs was the third most important reason, but overall cost reduction has become less important reason to outsource. This proves that hypothesis no. 4 is true.

6.5 Production chain position's effect on logistics costs

Hypothesis no. 5 claims that the position company has in the supply chain effects logistics costs. According Rosenbloom and Warshaw (1989, 31–33) and Childs and Batista (1997, 448) wholesalers are still used in supply chains as intermediaries, because they can perform services and functions in the supply chain with lower costs than other supply chain members.

According to the crosstabulation in table 19 (see page 69), wholesalers with no other supply chain position have lower logistics costs than companies with multiple supply chain tasks, like manufacturer-wholesalers. The Pearson Chi-square test for the dependencies between chain position and logistics costs shows that there is a 95 percent change that the dependencies occuring between the variables are true. Thus hypothesis no. 5 is true.

6.6 Location's effect on logistics and transportation costs

Hypothesis no. 6a and 6b both have to do with location. Allen (1991, 64) states that location decisions are made based on cost, availability to utilities and the level of traffic infrastructure. Infrastructure and cost of utilities affect logistics efficiency.

In analysing hypothesis no. 6a the operational preconditions of localities from the perspective of logistics efficiency (evaluated by the respondent companies themselves) and logistics costs are compared using cross tabulation. The results from the cross tabulation show no clear dependencies between the variables. The correlation test in table 22 (see page 75) proves the results.

In analysing hypothesis no. 6b the operational preconditions of localities from the perspective of traffic infrastructure and transportation costs are compared using cross tabulation. The results from the cross tabulation show no clear dependencies between the variables. The correlation test in table 24 (see page 77) proves the results.

When the results for these two hypotheses are combined, it can be stated that among wholesalers in Finland location does not affect logistics costs. This is probably a concequency of the fact that the level of traffic infrastructure in Finland is high and utilities like water, electricity and sewer are easy to access.

6.7 The effect of keeping track of logistics costs on logistics costs

A systematic way of following costs as a whole by using for example total cost analysis is a way to achieve cost savings (Lambert & Burduroglu 2000, 6). Hypothesis no. 7 claims that this systematic tracking of logistics costs reduces them.

The cross tabulation of the variables of keeping track of logistics costs and logistics shows no clear dependencies between the variables. However some minor decrease in high logistics column can be seen as the level of keeping track of logistics increases. The Chi-Square test indicates that this risk percentage for this dependency to occur by a change is 22. As the dependence is so weak and there is over 20 percent change that does not actually occur, it can be stated that among these Finnish wholesalers keeping systematically track of company's logistics costs does not reduce logistics costs. Hypothesis no. 7 is false.

6.8 Following logistics performance indicators in co-operation with suppliers and customers and it's effect on logistics costs

Extensive measurement of logistics performance indicators is viewed as a critical competence for a company. It is used to assess the functional performance and is crucial to improving logistics processes. (World Class Logistics 1995, 218)

Hypothesis no. 8 claims that keeping track of logistics performance measures together with suppliers and customers lowers logistics costs. The crosstabulation of the variables of the hypothesis together with Chi-Square test results shows no dependencies between the two variables. This overrules hypothesis no. 8.

The reason for no dependencies to occur in this analysis could be the fact that among the respondents the level of keeping track of logistics performance measures was overall quite low. The frequency of companies at the category of "I completely agree" was only 21. The sample is way too low in order to be able to make any clear assumptions of how they are divided on the logistics costs scale.

6.9 Company's internal logistics competence and it's effect on logistics costs

When it comes to implementing new technology to a company, it requires advanced logistics knowledge from the company's personnel. Through an efficient implementation of these new technologies logistics performance can though be improved. (Larson & Kulchitsky 1999, 90)

Hypothesis no. 9 claims that the level of logistics competence inside the company affects logistics costs. The crosstabulation of the variables of the hypothesis shows some minor dependencies between the variables. However the Chi-Square test indicates that there is a 70 percent risk that these dependencies occur by a chance. Among these Finnish wholesalers there is no link between the level of inside company competence and logistics costs. This might be explained by the fact that the competence was evaluated by the companies themselves and how they see themselves in comparison to their competition.

6.10 Logistics service provider's logistics competence and it's effect on logistics costs

Hypothesis no. 10 claims that the level of logistics competence of the logistics service provider affects logistics costs. This is based on theory that TPL providers can operate with lower unit costs. Providing logistics services is the main business function for the service provider and it has a lot of competence. (Cheung et al. 2006, 750; Coyle et al. 1996, 577)

The cross tabulation of the variables of hypothesis no. 10 shows some minor dependencies between the variables. Logistics cost decrease slowly as the competence level of the service provider increases. Correlation coefficient of these variables is nearly significant. Hypothesis no. 10 is thus true.

6.11 General discussion over the results of the analysis

The research hypotheses were tested in chapter five. The combined results of the hypothesis testing are presented in table 35 and are discussed more deeply in this chapter.

Table 35 The results of the hypothesis testing

Hypotheses	result of the testing
Hypothesis no. 1: Using information technology in supply chains reduces logistics costs.	TRUE
Hypothesis no. 2: Utilizing electronic business cuts order lead times.	TRUE
Hypothesis no. 3: The level of outsourcing in a company has an effect on the level of logistics costs.	FALSE
Hypothesis no. 4: The reasons for outsourcing logistics functions are becoming more strategic in nature.	TRUE
Hypothesis no. 5: The position in the supply chain affects logistics costs.	TRUE
Hypothesis no. 6a: The location from the perspective of logistics efficiency affects logistics costs.	FALSE
Hypothesis no. 6b: The location from the perspective of traffic infrastructure affects transportation costs.	FALSE
Hypothesis no. 7: Keeping track of company's logistics costs systematically reduces the logistics costs.	FALSE
Hypothesis no. 8: Keeping track of logistics performance measures together with suppliers and customers lowers logistics costs.	FALSE
Hypothesis no. 9: The level of logistics competence inside the company affects the costs of logistics.	FALSE
Hypothesis no. 10: The level of logistics competence of the logistics service provider affects the costs of logistics.	TRUE

The use of information technology among Finnish wholesalers seems not to be that developed. These results are probably due to the fact that most wholesalers are small independent companies, who have not got the need or required resources to acquire complex IT solutions. Overall in Finland, it is the large companies who have the ability and knowledge to procure and use IT solutions like ERP and EDI. When the level of information technology is high enough, mostly among large companies, it has some effect on logistics costs. In Logistics Survey 2006 (Ministry of Transport and Communications Finland 2006, 52) similar were found. 70 percent of large companies, from industry and trade, use ERP in controlling logistics information. However suppliers rarely (less than 40 percent of respondents) have access to inventory level data of their customers. In trade visibility in supply chains is even rarer.

Outsourcing logistics functions has become a way for companies to concentrate on their core competencies, rather than doing everything themselves. Lowering costs is not the main reason for outsourcing anymore. Althought the relationship between outsourcing and lower logistics costs is not that clear, more strategic benefits are born from outsourcing. For example increased flexibility improves customer satisfaction. The hypothesis testing showed that wholesalers have lower logistics costs than companies with multiple tasks. This proves the claim that concentrating on core competencies does lower costs. This result also fortifies the wholesalers' roles in supply chains. Aarnio (2007, 102) has studied the outsourcing's effect logistics costs among Finnish industry and construction companies. That research also states that outsourcing has no clear

effect in lowering logistics costs. However outsourcing is used to increase the value of the outsourced function.

The location does not seem to have any effects on logistics costs among Finnish wholesalers. Although distances in Finland are long, the traffic and other infrastructure are on high level in the whole country. Most wholesalers are small and use delivery and postal services to deliver their products. Some changes to transportation rates can be negotiated, but overall they are quite the same for all wholesalers. Ojala, Solakivi, Hälinen, Lorentz and Hoffmann (2007, 87–96) have studied the operational preconditions of manufacturing, trading and logistics service companies at the Baltic Sea region. Most of the respondents of that study find their overall operational environment at their current location to be good. The biggest shortcomings have to do with traffic infrastructure at St. Petersburg region in Russia and Pomerania region in Poland.

Keeping track of logistics costs and other performance measures internally and with partners is not common among Finnish wholesalers. Again this is probably due to the fact that most Finnish wholesalers are small, and do not have the knowledge or resources the track performance measures intensively. Hovever bigger wholesalers and other large companies, who have the knowledge and resources, probably benefit greatly from careful track keeping. According to Logistics Survey 2006 (Ministry of Transport and Communications Finland 2006, 50) the most useful measure for companies is the complete deliveries –measure. The ability to make use of the different measures improves as the companies get bigger and more international.

One reason to outsource logistics functions in this research was to require external expertise in logistics. The level of logistics competence of the logistics service provider seems to have an impact on logistics costs. Competence together with quantity lowers logistics costs. On the other hand the level of logistics competence of the wholesalers does not seem to have any impact on logistics costs. This is probably due to the fact that logistics competence among most Finnish wholesalers is low, because of their size. Also a lot competence is required by outsourcing logistics functions. According to Logistics Survey 2006 (Ministry of Transport and Communications Finland 2006, 58) the logistics competence of companies is higher in large companies than in small companies. Companies operating only in Finland have the lowest level of competence. According to Ojala et al. (2008, 59) the most important logistics development needs of manufacturing and trading companies at the Baltic Sea region are developing information systems, improving customer service and cutting logistics costs. Regional indifferencies occur in the results (Ojala et al. 2008, 64–65).

7 CONCLUSIONS

The main research problem in this study was to find how logistics is implemented inside the Finnish wholesale trade. The level of usage and knowledge about the different aspects of logistics varies greatly. When it comes to the level information technology, both internal and external usages of different technologies are low. Mail, phone, fax, e-mail and web pages are still the most commonly used technologies in controlling orders and deliveries. This is probably due to the fact that most Finnish wholesalers are small companies and communications, like purchasing orders are still done using telephones and e-mail.

Objectives for information technology in supply chain management (Simchi-Levi et. al 2003, 267) are not reached by most Finnish wholesalers. Information visibility is weak and collaboration between supply chain partners does not incur among most wholesalers. Most Finnish wholesalers are still at the intrafirm and interfirm information systems –stages of Zacharia's information systems supply chain model (2000, 293) and only the biggest have reached the supply chain information systems – stage.

The level of oursourcing logistics functions to logistics service providers by wholesalers varies between different types of logistics functions. The level of outsourcing logistics corefunctions (transportation, reverse logistics and freight forwarding) is high for 45 percent of the respondent companies and most companies have outsourced some of these functions. Logistics complementary functions (sales order handling, invoicing, warehousing, inventory management and product customization/finalization) are not outsourced at all by 52 percent of respondents and logistics information systems are not outsourced at all by 62 percent of surveyed wholesalers.

Keeping track of logistics performance indicators is another important topic of logistics knowledge. When it comes to internal tracking, for instance following logistics costs, two thirds of the respondents keep track of their costs. On the other hand external tracking together with suppliers and customers is less common. Over 70 percent of respondent do not really follow their logistics performance indicators together with partners. Companies follow those performance measures they consider to be important. However supply chain wide tracking is rare. The measurement is activity-based rather than process-based. The respondents were also asked themselves to evaluate their logistics competence. Logistics competence among Finnish wholesalers is low. Wholesalers outsource most their logistics core functions and in small companies there is no logistics knowledge inside the company. It can also be noted that logistics competence among Finnish wholesalers is very much branch oriented. Most of the respondents (70 percent) evaluated their competence to be at the same level as their

competitors. Companies acquire competence when they need it in competing with other companies of the branch. Overall logistics knowledge and competence are still on their way to Finnish companies. It is only in recent years that companies have realized the importance of the logistics function for the company's performance.

The research hypotheses tested in this research tried to establish what aspects of logistics are the tools for reducing costs and in that way improve the performance of the wholesalers. Based in this research utilizing information technology, concentrating in wholesaling and logistics competence among logistics service providers have a clear effect in lowering logistics costs. The other aspects of logistics included in the hypotheses are poorly implemented in to Finnish wholesale companies, which is due to their size. Their effect on logistics costs can not there be evaluated in a proper manner. Logistics costs are divided in to many sub-categories based on their nature. For wholesalers, especially the small ones, understanding of all these different cost categories is difficult and they do not always know what costs should be included in logistics costs.

Wholesalers perform their tasks with lower costs than companies with multiple tasks, like manufacturers who do their own wholesaling. The theory on the tasks of wholesalers (Chapter 3.2) presents multiple marketing tasks that wholesalers perform. Manufacturers and other channel members want also to concentrate on their core competencies and want to "outsource" these marketing tasks to wholesalers, who specialize in these marketing tasks, like bulk breaking and customer support. They perform better doing the tasks and provide increased customer satisfaction. This combined with lower costs proves that wholesalers are needed in supply chains.

8 SUMMARY

The aim of this research is to reveal the state of logistics and the level and knowledge of different aspects of logistics in Finnish wholesale companies. Survey data from Logistics Survey 2006 by Turku School of Economics is used in this research. The aspects of logistics used in the survey are logistics costs, logistics performance measures, logistics information systems, logistics competence, logistics operating environment and outsourcing of logistics activities.

The main research question is how logistics and the different aspects of it are implemented among Finnish wholesale companies. In addition the tasks and roles of wholesalers in supply chain and business in general determined. The analysis part of the research tries to find out what are aspects of logistics sholud be developed in order to reduce logistics costs using hypothesis testing as the analyzing method.

The research presents the main elements of logistics and supply chain management. Logistics costs are divided in to direct and indirect logistics costs. Logistics performance measures help companies the measure their activities. The development of information technology has been fast in recent years and the use of more demanding technologies like RFID and ERP is becoming more general in all companies, not just wholesaling companies. The outsourcing of logistics functions has become a part of the strategy for wholesalers. The required knowledge and flexibility is gained by outsourcing functions to logistics service providers. Wholesale companies are divided in to different groups based on their product and service mix. Wholesaling is carried out for example by merchant wholesalers, manufacturers' sales branches, agents and retail chains.

Hypothetic-deductive research method is used in this research. Hypotheses are created based on the theory presented in the research. The hypotheses are tested with the help of the survey data using cross tabulation, correlation coefficients and the Chi-Square test as analyzing tools. The correlations between the different variables are so close to zero, that inside this group of companies no big changes in logistics costs were found by developing the different aspects of logistics. However the results show that when the aspects of logistics are implemented well in companies, some minor decrease can be seen on logistics costs. Many aspects of logistics are still difficult and expensive to implement for Finnish, especially small wholesale companies. Thus their effects on logistics costs are difficult to recognize and the effects are often marginal.

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APPENDIX 1 STANDARD INDUSTRIAL CLASSIFICATION 2002

51	***Wholesale trade and commission trade, except of motor vehicles and motorcycles***
511	**Wholesale on a fee or contract basis**
5111	Agents involved in the sale of agricultural raw materials, live animals, textile raw materials and semi-finished goods
51110	Agents involved in the sale of agricultural raw materials, live animals, textile raw materials and semi-finished goods
5112	Agents involved in the sale of fuels, ores, metals and industrial chemicals
51120	Agents involved in the sale of fuels, ores, metals and industrial chemicals
5113	Agents involved in the sale of timber and building materials
51130	Agents involved in the sale of timber and building materials
5114	Agents involved in the sale of machinery, industrial equipment, ships and aircraft
51140	Agents involved in the sale of machinery, industrial equipment, ships and aircraft
5115	Agents involved in the sale of furniture, household goods, hardware and ironmongery
51150	Agents involved in the sale of furniture, household goods, hardware and ironmongery
5116	Agents involved in the sale of textiles, clothing, footwear and leather goods
51160	Agents involved in the sale of textiles, clothing, footwear and leather goods
5117	Agents involved in the sale of food, beverages and tobacco
51170	Agents involved in the sale of food, beverages and tobacco
5118	Agents specializing in the sale of particular products or ranges of products n.e.c.
51181	Agents involved in the sale of paper and paper products
51189	Agents specializing in the sale of particular products or ranges of products n.e.c.
5119	Agents involved in the sale of a variety of goods
51190	Agents involved in the sale of a variety of goods

512-519 Wholesale trade

512 Wholesale of agricultural raw materials and live animals

5121 Wholesale of grain, seeds and animal feeds

51210 Wholesale of grain, seeds and animal feeds

5122 Wholesale of flowers and plants

51220 Wholesale of flowers and plants

5123 Wholesale of live animals

51230 Wholesale of live animals

5124 Wholesale of hides, skins and leather

51240 Wholesale of hides, skins and leather

5125 Wholesale of unmanufactured tobacco

51250 Wholesale of unmanufactured tobacco

513 Wholesale of food, beverages and tobacco

5131 Wholesale of fruit and vegetables

51310 Wholesale of root crops, vegetables and fruit

5132 Wholesale of meat and meat products

51320 Wholesale of meat and meat products

5133 Wholesale of dairy produce, eggs and edible oils and fats

51331 Wholesale of dairy produce, eggs and edible oils and fats

51332 Wholesale of eggs

5134 Wholesale of alcoholic and other beverages

51340 Wholesale of alcoholic and other beverages

5135 Wholesale of tobacco products

51350 Wholesale of tobacco products

5136 Wholesale of sugar and chocolate and sugar confectionery

51361 Wholesale of sugar and chocolate and sugar confectionery

51362 Wholesale of bakery products

5137 Wholesale of coffee, tea, cocoa and spices

51370 Wholesale of coffee, tea, cocoa and spices

5138 Wholesale of other food, including fish, crustaceans and molluscs

51381 Wholesale of fish

51382 Wholesale of health food

51383 Wholesale of pet food

51389 Wholesale of food n.e.c.

5139 Non-specialized wholesale of food, beverages and tobacco

51390	Non-specialized wholesale of food, beverages and tobacco
514	**Wholesale of household goods**
5141	Wholesale of textiles
51411	Wholesale of fabrics and yarns
51412	Wholesale of textiles
5142	Wholesale of clothing and footwear
51421	Wholesale of clothing and footwear
51422	Wholesale of footwear
5143	Wholesale of electrical household appliances and radio and television goods
51431	Wholesale of electrical household appliances
51432	Wholesale of radio and television goods
5144	Wholesale of china and glassware, wallpaper and cleaning materials
51441	Wholesale of household articles
51442	Wholesale of wallpaper
51443	Wholesale of household cleaning materials
5145	Wholesale of perfume and cosmetics
51450	Wholesale of perfume and cosmetics
5146	Wholesale of pharmaceutical goods
51461	Wholesale of drugs
51462	Wholesale of diagnostic instruments and medical and orthopaedic equipment
5147-5148	Wholesale of other household goods
51471	Wholesale of furniture and carpets
51472	Wholesale of floor coverings
51473	Wholesale of stationary and other office supplies
51474	Wholesale of books
51475	Wholesale of photographic equipment and supplies
51476	Wholesale of optical goods
51477	Wholesale of watches, clocks and jewellery
51478	Wholesale of sports goods
51481	Wholesale of musical instruments and supplies
51482	Wholesale of boats and boating accessories
51483	Wholesale of toys and games
51489	Wholesale of other household goods n.e.c.

515	**Wholesale of non-agricultural intermediate products, waste and scrap**
5151	Wholesale of solid, liquid and gaseous fuels and related products
51511	Wholesale of liquid fuels
51512	Wholesale of natural gas
51519	Wholesale of other fuels
5152	Wholesale of metals and metal ores
51520	Wholesale of metals and metal ores
5153	Wholesale of wood, construction materials and sanitary equipment
51531	Wholesale of roundwood
51532	Wholesale of wood products
51533	Wholesale of metal and mineral products
51534	Wholesale of bathroom furniture and supplies
51539	Non-specialized wholesale of construction materials
5154	Wholesale of hardware, plumbing and heating equipment and supplies
51541	Wholesale of tools and materials
51542	Wholesale of plumbing and heating equipment and supplies
51549	Non-specialized wholesale of tools and of plumbing and heating equipment and supplies
5155	Wholesale of chemical products
51550	Wholesale of chemical products
5156	Wholesale of other intermediate products
51560	Wholesale of other intermediate products
5157	Wholesale of waste and scrap
51570	Wholesale of waste and scrap
518	**Wholesale of machinery, equipment and supplies**
5181	Wholesale of machine tools
51810	Wholesale of machine tools
5182	Wholesale of mining, construction and civil engineering machinery
51820	Wholesale of mining, construction and civil engineering machinery
5183	Wholesale of machinery for the textile industry and of sewing and knitting machines
51830	Wholesale of machinery for the textile industry and of sewing and knitting machines
5184	Wholesale of computers, computer peripheral equipment and software
51840	Wholesale of computers, computer peripheral equipment and software

5185	Wholesale of other office machinery and equipment
51851	Wholesale of office machinery
51852	Wholesale of office furniture
5186	Wholesale of other electronic parts and equipment
51861	Wholesale of electrical equipment and supplies
51862	Wholesale of telecommunication equipment and electronic components
5187	Wholesale of other machinery for use in industry, trade and navigation
51871	Wholesale of machinery for use in industry
51879	Wholesale of machinery and equipment n.e.c.
5188	Wholesale of agricultural machinery and accessories and implements, including tractors
51880	Wholesale of agricultural machinery and accessories and implements, including tractors
519	**Other wholesale**
5190	Other wholesale
51901	Non-specialized wholesale
51909	Wholesale n.e.c.