MEASURING LOGISTICS COSTS –
Designing a generic model for assessing macro logistics costs in a global context with empirical evidence from the manufacturing and trading industries

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Applying for post-graduate studies and endeavoring a PhD was not an obvious choice for me when I started my studies at Turku School of Economics in 2005. When this possibility was first introduced to me while completing my master's thesis, the decision was pretty easy and I made it the same evening. Most people completing a doctoral dissertation experience a wide range of challenges during this process, which can sometimes become a lifelong project. I set myself the goal of completing it as efficiently as possible. Now, a little less than three years later, I can look back with the satisfaction of having done so. However, this would not have been possible without the support of several people.

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Kaartinkaupunki, Helsinki, July 25th, 2013
Karri Rantasila

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LIST OF ABBREVIATIONS

ABC	Activity-Based Costing
ANN	Artificial Neural Network (model)
ASEAN	Association of Southeast Asian Nations
ASLOG	Association Française pour la Logistique (French Logistics Association)
BSR	Baltic Sea Region
CFLP	China Federation of Logistics and Purchasing
CHF	Swiss Franc (currency)
CSCMP	Council of Supply Chain Management Professionals

CSIR	Council for Scientific and Industrial Research (South Africa)
ECB	European Central Bank
ELA	European Logistics Association
EUR	Euro (currency)
GDP	Gross Domestic Product
GLOCS	Generic Logistics Costs Structure
GMA	Grocery Manufacturers Association
IMF	International Monetary Fund
INR	Indian Rupee
ISIC	International Standard Industrial Classification of all Economic Activities
JPY	Japanese Yen (currency)
KOF	Swiss Economic Institute
KPI	Key Performance Indicator
KRW	South Korean Won
LCM	Logistics Cost Model
LPI	Logistics Performance Index
LPIO	Logistics Performance International Observatory
LSP	Logistics Service Provider
NAICS	North American Industry Classification System
NOK	Norwegian Krone (currency)
OECD	Organisation for Economic Co-operation and Development
RMB	Chinese Yuan (currency)
SEK	Swedish Krone (currency)
SCM	Supply Chain Management
TCA	Transaction Cost Approach
THB	Thai Baht (currency)
TF	Transportbrukernes Fellesorganisasjon (Federation of Norwegian Transport Users)
TOL 2002	Standard Industrial Classification 2002 in Finland
TÖI	Institute of Transport Economics of Norway
TSE	Turku School of Economics at the University of Turku
USD	US Dollar (currency)
VAT	Value Added Tax
ZAR	South African Rand (currency)

1 INTRODUCTION

1.1 Background of the study

Logistics research has taken major strides forward from the production line approach and routing studies of the 1970s to today's complex network configurations (Klaus 2009, 63). One thing, however, has remained unchanged: to be able to fulfill their customers' needs, companies must make decisions on e.g. how products are delivered and where raw materials are procured. At the same time, logistics has become a vital part of the economy and everyday life of people.

In the context of companies, the rational maximization of returns as a prerequisite for business prosperity was pointed out already in 1953 by Milton Friedman, who claimed that only those companies maximizing returns can survive (Friedman 1953, 22). Although some harsh criticism has been leveled at the limitations of rational choice theory and profit maximization (e.g. Boudon 1998, 825–827), we can safely assume that most entities try their best to minimize costs and hence improve their performance.

With significant cutbacks in manufacturing and labor costs, cutting logistics costs has become an increasingly important task for managers. Current economic developments and globalization mean that logistics costs can now amount to half the value of general commodities. Furthermore, technological developments have provided new opportunities to reduce logistics costs. (Dianwei 2006, 591) Empirical evidence has shown that there is a genuine opportunity to cut down logistics costs, as proven for example by the brewery company Carlsberg UK, which cut GBP 3.5m from its logistics costs in 18 months (Bourke 2010, 6).

The size of logistics costs is heavily dependent on the industry. According to Farahani, Asgari and Davarzani (2009, 59), logistics costs are higher in industries like the manufacturing of food, metals or chemicals. As depicted in Figure 1, it is possible that logistics costs as a substantial proportion of product prices may rise above the quartile of product prices in some industries. (Farahani et al. 2009, 59) The difference between industries is also confirmed by Finnish logistics cost datasets, which are comprehensively analyzed in chapter 7.

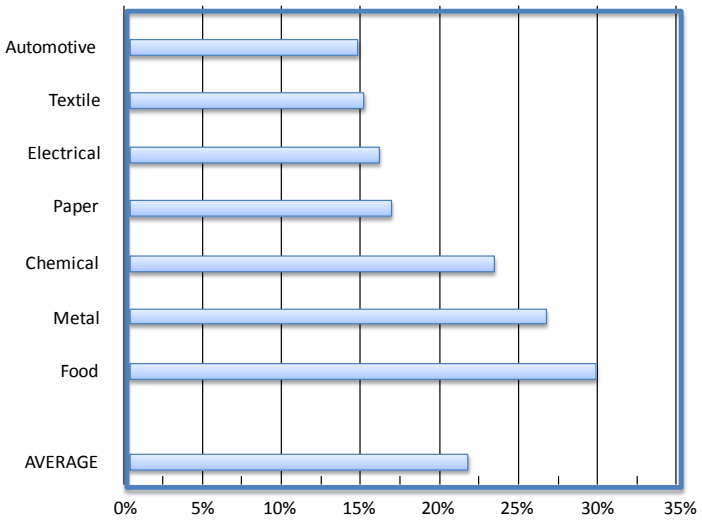


Figure 1 Logistics costs as a proportion of product prices in 2007 in selected industries (Farahani et al. 2009, 59)

Farahani et al. (2009, 57) claim that an essential obstacle to understanding integrated logistics is insufficient information on logistics costs. If managers are unable to receive transparent information on logistics costs at all stages of the material flow, they are also unable to improve the company's performance. Inaccurate information also complicates measurement of the impact of their decisions throughout the supply chain. (Farahani et al. 2009, 57)

Broadening the scope from the industrial point of view to macro (national and broader) level logistics costs, the world's logistics costs in 2002 totaled USD 6 732bn. This was over 5% more than the sum of USD 6 387bn from 2000. Compared to the Gross Domestic Product (GDP), for example in North America, logistics costs equaled 9.9% of GDP in 2002. (Bowersox, Rodrigues & Calantone 2005, 9–10) Based on these figures, it is clear that the level of logistics costs should be examined when considering potential cost savings.

The importance of lowering logistics costs has also been identified at national and global level. Logistics costs are an important factor that affects the competitiveness of nations (UN: Commercial Development of Regional Ports as Logistics Centres, 81), and at national level policy-making, infrastructure developments, and other investments (Farahani et. al 2009, 58). For example, in 2007 the Finnish Government included the goals of improving logistics competitiveness and reducing logistics costs in the Governmental Programme of Prime Minister Matti Vanhanen's second Cabinet. (Finnish Governmental Programme 2007, 38) Based on the Governmental Program's aims, the Ministry of Transport and Communication in Finland drafted the national logistics strategy, the goals of which include enhancing the competitiveness and attractiveness of Finland for companies. (Logistiikkafoorumi, 12)

The importance of logistics and trade for Finland's competitive edge was also identified (Paavola, Vehviläinen, Ojala, Antikainen, Iikkanen 2012, 5).

Several indicators have been developed for ranking countries globally, but none of them addresses macro logistics costs (Farahani et al. 2009, 60). These indicators include for example:

- The Global Competitiveness Index (GCI) developed by the World Economic Forum, which ranks countries' competitiveness in 12 categories including e.g. infrastructure and technology (Schwab 2011, 4–8).
- The KOF Index of Globalization published by the Swiss Economic Institute (KOF), which measures an overall index of globalization referring to actual economic flows, restrictions, information flows etc. (KOF Index of Globalization).
- The DHL Global Connectedness Index, which ranks countries according to the depth and breadth of their integration into the world economy (Ghemawat & Altman 2011, 16).

In the field of logistics, one widely utilized ranking is the Logistics Performance Index (LPI), published by the World Bank Group (see e.g. Gogoneata 2008 and Hollweg & Wong 2009). The World Bank has also recently initiated a project with the working title Logistics Performance International Observatory (LPIO). One goal of this project is to push logistics cost research towards more unified framework. (Arvis 2011, 13) This dissertation has a strong linkage to LPIO, which will utilize the findings of this dissertation.

Alongside global organizations, many countries and research institutions conduct macro level logistics studies, which treat issues like outsourcing and logistics costs. However, there is one major problem with the results of these studies: the definitions or research methodologies are not unified, which can make findings hard to compare.

If national logistics costs can be measured in a unified and reliable way, the findings provide a proper indicator for evaluating and monitoring logistics performance at national or even industrial level. The importance of measuring costs is rising fast as logistics activities accelerate and competition tightens. In recent years there have been some efforts to assess macro logistics costs, but there is still a long way to go before the logistics costs of nations or entities are comparable in the macro context.

1.2 Purpose of the study

The purpose of this study is to 1) *map the current state of national logistics costs research*, 2) *design a generic model for measuring macro logistics costs*,

and 3) *to apply the model to empirical data*. These aims could also be presented in the form of research questions (i.e. *what kind of studies have been conducted in the context of macro logistics costs, how to build a general model for measuring macro logistics costs, and what is the level of logistics costs for Finnish manufacturing and trading industries*). However, due to the complicated context and descriptive nature of this dissertation, overly narrow research questions would not serve the study of a new research field. Thus, this dissertation follows (in both structure and content) the purposes of the research, which are broader than mere research questions.

The issue of measuring macro logistics costs has not been comprehensively addressed in previous research, and even the concept of logistics costs is indistinct. The problem is acknowledged by several authors, including Farahani et al. (2009, 60), who states that despite the great importance of national logistics costs, the issue has not been properly treated in the literature (Farahani et al. 2009, 60). Also Dianwei and Brewer et al. agree that the definition of logistics cost is not currently unified (Dianwei & Brewer 2006, 592), nor is the true total logistics cost data available, except in case studies of individual firms or shipments (Brewer, Button & Hensher 2001, 510). Furthermore, Straube & Pfohl (2008) conclude that logistics cost components are not sufficiently standardized, either in the real world or on the scientific front. They also state that somewhat conspicuously, some logistics professionals cannot name all the relevant cost components at all. (Straube & Pfohl 2008, 48–49) Finally, Havenga (2010) asserts that because a more efficient logistics system is key to sustainable economic growth, it is a macroeconomic imperative to track key components of logistics costs (Havenga 2010, 476). Besides academia, other stakeholders have shown growing interest in macro logistics costs and other indicators. Examples of this are found in the LPI (Arvis et al. 2010, 28) and several individual reports and working papers (see Chapter 3.3). The issue of macro logistics costs is also on the agenda of the Organisation for Economic Co-operation and Development (OECD), which published a discussion paper (No. 201204) on macro logistics costs in 2012 (Rantasila and Ojala 2012, 3). Finally, as proved in this research, the interest of national actors (e.g. ministries) in the issue has seen a constant rise in recent years (see Chapter 3.4).

As there is no inventory of previously conducted logistics cost research available, the first task of this research is to systematically review all studies published in the past. The purpose of this review is to gather pivotal information on identified extant research (e.g. what has been done by whom, where, what methodologies have been applied, and what the results were). The outcome of this meta-analytical review should be an improved understanding of the current state of macro logistics cost research. Although the review

reveals some important aspects of this field, the outcome also serves another purpose, as it is intended to create a generic model for measuring and comparing logistics costs. The final purpose of the study is to apply the model developed using the data collected for Finland State of Logistics studies conducted in 2006, 2009, 2010, and 2012. As these datasets represent the largest logistics cost data in world, they are used here for empirical analysis. This part looks at the structure and level of logistics costs in Finnish manufacturing and trading industries. (Figure 2)

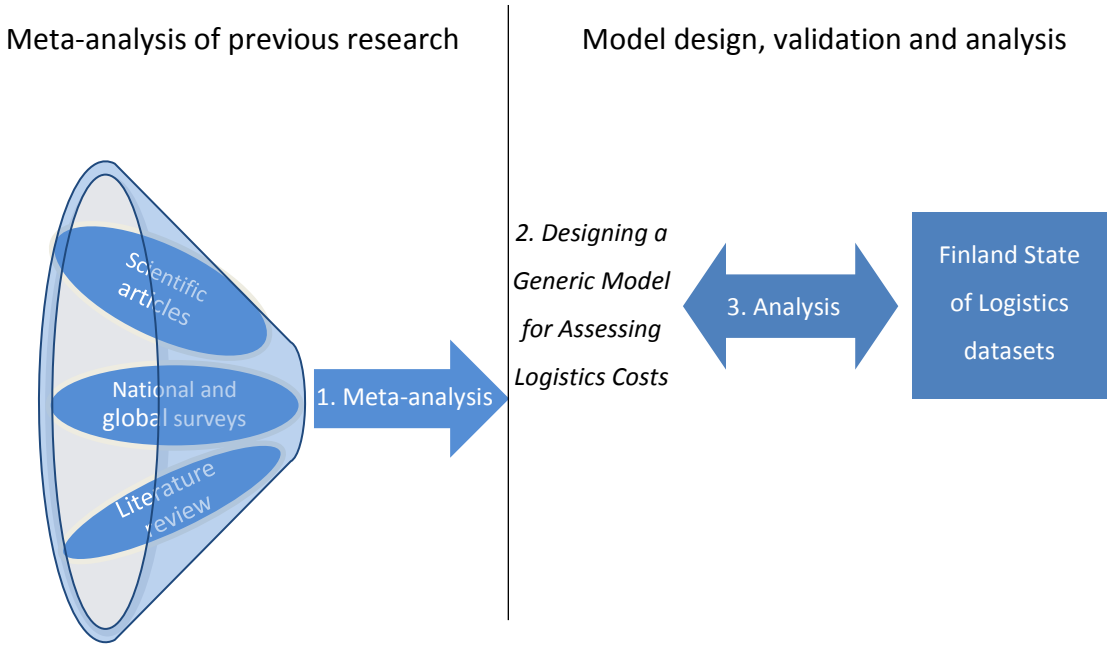


Figure 2 Purpose of the study

This study has strong links to previous logistics costs research, which offers a solid theoretical background for meta-analytical discussion that not only aims at creating a generic model for measuring and comparing the level and structure of macro logistics costs, but explores the field of logistics cost research in the macro context. Subsequently the developed model is applied to datasets of Finland State of Logistics surveys. This allows testing of the model with empirical data. Also the original cost data, collected during the review of identified extant research, is re-processed in a generic cost model to make output commensurable where feasible. In practice, this is done by applying an Excel-based tool, which makes currency and GDP conversions more convenient and accurate.

The empirical data in this study were collected for Finland State of Logistics surveys commissioned by the Ministry of Transport and Communication

in Finland and conducted by the Turku School of Economics (TSE). The number of respondents in the surveys were 2 255 (2006), 2 705 (2009), 1 813 (2010), and 2 732 (2012), which represents the largest dataset in the world. Since all of the surveys employed nearly similar questionnaires and datasets, the results are inter-comparable.

1.3 Research problem, structure and limitations of the study

Three main research problems emerged in this study. The first was to *map the current state of logistics cost research*. This falls into several sub-categories, each one contributing to the main problem from a slightly different perspective. They include: *coverage of the study* (e.g. country, area, global), *applied cost components* (e.g. transport, inventory carrying), *utilized methodology* (e.g. survey, modeling), and *results*. In addition to these, some additional aspects are presented in the summary tables.

The second main problem was to *create a generic model for measuring national logistics costs*. This is based on the outcome of the meta-analytical review of identified extant research, which is systematically analyzed for creating a generic logistics cost structure in the macro context. The outcome is then combined with some other theories like the Transaction Cost Approach (TCA).

The third problem was to *measure the level and structure of logistics costs in Finnish companies* in accordance with a generic cost structure, which also allows testing of the model. The datasets of Finland State of Logistics were employed at this stage.

The structure of this study is divided into five main parts: introduction, theory, methodology, empirical part and conclusions. Chapter 1 briefly introduces the subject of study, research problems, and pivotal concepts.

The theoretical part in chapters 2 and 3 presents the outcome of the review of identified extant logistics cost research, and summarizes the current state of research. Chapter 2 concentrates on clarifying the nature of logistics costs (including coverage of the study, applied cost components, utilized methodology, and results) in existing literature and other scientific articles. Chapter 3 concentrates on examining logistics costs in published studies, and is divided into several subchapters based on the methodology of the study (i.e. survey-based questionnaire, modeling, case study, and other methodology). The main goal of chapters 2 and 3 in addition to summarizing the current state of research is to provide a solid meta-analytical background for creating a generic logistics costs structure.

Chapter 4 introduces the research process from research design to data collection and re-presents methods implemented in the empirical section (chapters 5–7). The first chapter of the empirical part, chapter 5, concentrates on creating a generic logistics cost structure, while chapter 6 applies the generic structure to identified extant logistics cost research by retrieving the data from these studies and processing it through the model. The final empirical chapter, chapter 7, aims at analyzing the level and structure of logistics costs in Finnish manufacturing and trading companies in respect to the created generic cost structure. Conclusions are drawn in chapter 8 with summarization of the research.

The geographical limitations of this study are mainly related to analysis drawn in the empirical part. The data for this section were collected from Finnish companies, meaning that the results cannot be directly extrapolated to other areas or to a global context. Nonetheless, it makes sense to assume that the results would be quite similar in countries with a similar population (density, structure, etc.), market structure, and stage of development to those of Finland. The theoretical part aims particularly at including all previously conducted studies, thus the only limitations are posed by the language of publication. As the search was conducted in English, the prerequisite for inclusion was that the study contained at least an abstract in English. The search process is more comprehensively discussed in chapter 4. A further limitation as regards the theory section is that only studies that were considered reliable (in terms of the methodology, authors, etc.) were included for review.

1.4 Pivotal concepts

1.4.1 Logistics and supply chain management

Since adoption of the term *supply chain management* (SCM) in the early 1990s, there has been some confusion and disagreement over the term *logistics*. Various definitions have been offered for both. (Cooper, Lambert & Pagh 1997, 1–2; Lummus, Krumwiede & Vokurka 2001, 426) Still, it seems that despite the broad discussion in both academia and business, the definitions remain anything but constant. Evidence of this was provided in an article by the Finnish business newspaper *Kauppalehti* quoting a professor of industrial management, who defined logistics as "*Transportation and warehousing arranged in such a way that the company will not lose all its money*" (translation by the author) (Orrenmaa 2010, 17). Some more appropriate definitions are provided below.

The first indication of a concept of logistics emerged in the military context. According to some research, the word *logistics* stems from the French word "logis", which refers to the facilities of organizing transportation, and supplying and housing army troops. Blanchard (1992, XV) also agrees with the military context, but believes that the term was usually conceived only as a downstream function. Since the early 1960s, the term has been employed in a business context referring to the physical organization of the company and the flow of materials in both down- and upstream functions, as well as organizing production. (Blanchard 1992, XV; Farahani et al. 2009, 1)

Although the term logistics has been used widely for many decades, the definition still seems to be blurred rather than well established. Ballou (2004, 4) proposed the following definition:

> *"Logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers' requirements."* (Ballou 2004, 4)

One of the most commonly used definitions of logistics, in both academia and business, is provided by the Council of Supply Chain Management Professionals (CSCMP). This non-profit organization, which promotes better logistics and supply chain management practices, defines logistics management as:

> *"That part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements."* (CSCMP definitions)

If the scope is broadened to the term of supply chain management, a distinction between these two terms is hard to make. Waters (2003, 23) has tried to tackle the problem by comparing the scope of logistics and SCM. He defines logistics management as an interactive process, optimizing material flows and the supply of production factors through the organization and its operations. In case this optimization is applied to all of the processes and functions from upstream suppliers to downstream end-customers, it is relevant to use the term SCM. (Waters 2003, 23) The definition of supply chain, provided after a comprehensive literature review by Mentzer, DeWitt, Keebler, Min, Nix, Smith and Zacharia (2001, 16–19), supports the conclusion

that the term supply chain is the next stage of terminological development in the field of logistics research. Their definition of supply chain is as follows:

> *"Supply chain management is defined as the systemic, strategic coordination of the traditional business functions and the tactics across these functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole."* (Mentzer, DeWitt, Keebler, Min, Nix, Smith & Zacharia 2001, 18)

From the above definitions, one can conclude that the line between logistics and SCM is inconsistent, although in practice they promote the same mission (Ballou 2004, 6). Some problems with conceptual definitions may also arise from national and linguistic contexts. For example, Töyli, Häkkinen, Ojala and Naula (2008) point out that in Finnish, the term "logistics" is widely used to cover both supply chain management and logistics (Töyli, Häkkinen, Ojala & Naula 2008, 60).

Based on the above it seems unnecessary to draw the line between these two terms in the context of this study, where the terminology plays a secondary role. To avoid misunderstanding, and for terminological simplicity, the term *logistics costs* is used from now on, excluding sub chapter 2.1.2.1 where micro (company) level supply chain costing tools are presented at a glance. Finally, the terms "micro" and "macro" are used to distinguish between studies, costing tools etc. conducted at focal company level and those dealing with logistics costs at macro level.

1.4.2 Cost measurement terminology

One terminological aspect that needs debating is related to cost measurement metrics. The Logistics Cost Survey 2006, conducted by Supply Chain Digest, collected the opinions on metrics of 247 respondents representing various industries. According to the report, the study was a self-selected poll, and the opportunity to take part was posted in several issues of the Supply Chain Digest newsletter and on their web site. Forty percent of the respondents used percent of sales as their primary metric of logistics costs, while 25% considered absolute costs their primary metric. The remaining respondents based their measurement on weight-based, sale unit-based or activity-based costing methods (Figure 3). (SCD – Logistics Cost Survey 2006)

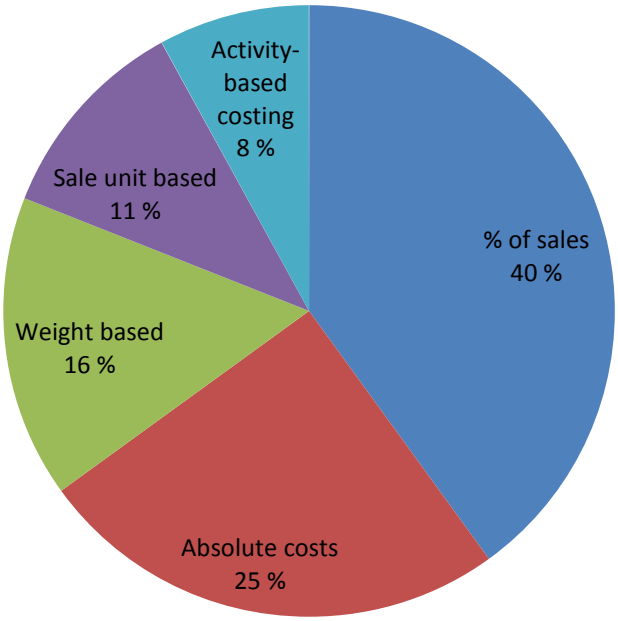


Figure 3 Primary metric for measuring logistics costs, n=247 (SCD – Logistics Cost Survey 2006)

The survey, however, emphasized more the metrics used by companies than those employed in the macro context. When assessing logistics costs at national level, there are three main metrics available (Rantasila & Ojala 2012, 9):

- % of sales or turnover,
- Absolute costs
- % of GDP

Some studies disclose the logistics costs as a percentage of sales or as a percentage of turnover. OECD defines the turnover as a total invoiced amount by the observation unit during the reference period (OECD Statistics 1). Sales, on the other hand, are defined as operating revenues less rebates, discount, returns and sales taxes on consumers (OECD Statistics 2). In general, these two definitions mean basically the same thing, with some minor differences concerning the inclusion or exclusion of value added tax (VAT). This is highly dependable on the statistical systems applied in the relevant country, which makes it both impossible and unnecessary to draw a strict line between these two in this study. The terms sales and turnover are used in the same meaning here, although it is granted that in some cases they may not be fully equivalent.

Many studies report logistics costs as a share of GDP. Without taking a stand on the GDP's explanatory competence, a definition should be provided. GDP measures the value of all final goods and services as well as the value of export generated in a certain area during the observation period. GDP can be combined in three different ways (e.g. by summing the final uses of goods and

services). (OECD Economics Department) This study quotes logistics costs as a percentage of GDP wherever possible in order to make the results for different countries more comparable.

Costs are presented as a part of GDP here because the term is more commonly used than other macro economical indicators (like Gross National Product or Purchase Power Parity), and because data from national statistics institutions are considered reliable. (Farahani et. al 2009, 71) Furthermore, Coyle, Langley, Bardi, Gibson and Novack agree that measuring costs in relation to GDP is a widely used barometer for gauging the rate of growth in economics (Coyle, Langley, Bardi, Gibson, Novack 2009, 43–44). Finally, in the context of measuring national logistics costs, it has been said that regional logistics costs are usually showed by GDP (Feng & Guijun 2008, 626; Li & Tang 2010, 61).

The question remains whether there is a difference between logistics costs quoted as a % of turnover or % of GDP. In general, it must be said that these are not wholly equivalent. The difference between them may relate, for example, to including the value of export, which may have an effect especially on questionnaire-based results. GDP excludes the exportation, but it can be assumed that companies include it in turnover when assessing their logistics costs as a percentage of it. The issue is not as relevant in statistics-based and case study approaches, which are based on mathematical modeling and may utilize national statistics data (e.g. GDP). However, given the magnitude and complexity of the problem of converting these metrics into commensurable form, this study quotes results primarily as a % of GDP, and where this is not possible as a % of turnover. This is acceptable here, given that very limited possibilities exist to convert them to the same form and the anticipated differences in results would be relatively minor.

Absolute costs are converted to Euro using the currency rates of the European Central Bank (ECB). Furthermore, presenting absolute costs as a % of GDP is more descriptive and comparative. For conversion, this study uses the GDP of the relevant country for the year the study was conducted. GDP data are downloaded from the OECD's Statistical Portal (OECD's Statistical Portal Main Economic Indicators database, International Monetary Fund, World Economic Outlook)

Since the study collects information from several different sources, some figures are given in local currencies. To quote these in commensurable currency, absolute costs are converted to Euro (EUR) using the currency rate on the last weekday of December of the year the study was published. Currency data are downloaded from the database of the ECB (European Central Bank, currency data).

The final terminological issue under discussion is how to make different industry allocations comparable with each other. Since different studies classify respondents on very irregular bases and with varying precision, the only option is to collect the cost data of these subgroups under the same industry classification. Given the global aspect of this study, one option would be to employ the international ISIC (International Standard Industrial Classification of all Economic Activities) classification, developed by the United Nations Statistics division. The aim is to gather different respondent groups under the ISIC top level of classification (industrial classification A-U). (United Nations Statistics Division) It then becomes possible to calculate weighted average values of logistics costs for each main industry group; even though this is theoretically possible, sufficient information (i.e. number of respondents per category and logistics costs per category) is nonetheless required to complete it. This was not the case in most of the reviewed studies, but the process is demonstrated in paragraph 5.2 with studies that had sufficient background data.

2 THE CONCEPT OF LOGISTICS COSTS IN PUBLISHED RESEARCH

At first sight it seems that many authors have tried, more or less on purpose, not to engage in the discussion on the concept of logistics costs. Considering that the term itself is widely used, this is somewhat paradoxical. This chapter presents the results of a comprehensive review of identified extant logistics costs research in the literature and scientific publications.

2.1 Complexity of assessing logistics costs

2.1.1 Factors behind the level of macro logistics costs and Logistics Performance Index

To understand the factors behind logistics costs, it is first necessary to become familiar with the functions of the logistics process. These functions, proposed by Sople (2007, 8–10), are: order processing, inventory management, warehousing, transportation, material handling and storage, logistical packaging, and information (Sople 2007, 8–10). Although these functions are not necessary the only ones generating logistics costs and no direct correlation between them is suggested; they simply facilitate our understanding of the nature of logistics costs. It should also be recognized that the level of costs depends on a number of different factors.

The maternity of logistics systems, and hence the weight of different factors, differs significantly from one country and industry to another. One indicator for assessing the logistics friendliness of specific country is the Logistics Performance Index (LPI), developed by The World Bank Group. This index measures the current logistics environment in six areas: customs, infrastructure, international shipments, logistics quality and competence, tracking & tracing, and timeliness (Figure 4). (Arvis, Mustra, Ojala, Shepherd & Saslavsky 2010, 28) The first version of LPI also collected data on a seventh component, domestic logistics costs, but it was found to be uncorrelated with other indicators and was dropped (Behar, Manners & Nelson 2011, 8; Hollweg & Wong 2009, 26).

Int. LPI Rank	Country	LPI	Customs	Infrastructure	International shipments	Logistics competence	Tracking & tracing	Timeliness
1	Germany	4.11	4.00	4.34	3.66	4.14	4.18	4.48
2	Singapore	4.09	4.02	4.22	3.86	4.12	4.15	4.23
3	Sweden	4.08	3.88	4.03	3.83	4.22	4.22	4.32
4	Netherlands	4.07	3.98	4.25	3.61	4.15	4.12	4.41
5	Luxembourg	3.98	4.04	4.06	3.67	3.67	3.92	4.58
6	Switzerland	3.97	3.73	4.17	3.32	4.32	4.27	4.20
7	Japan	3.97	3.79	4.19	3.55	4.00	4.13	4.26
8	United Kingdom	3.95	3.74	3.95	3.66	3.92	4.13	4.37
9	Belgium	3.94	3.83	4.01	3.31	4.13	4.22	4.29
10	Norway	3.93	3.86	4.22	3.35	3.85	4.10	4.35
11	Ireland	3.89	3.60	3.76	3.70	3.82	4.02	4.47
12	Finland	3.89	3.86	4.08	3.41	3.92	4.09	4.08
13	Hong Kong, China	3.88	3.83	4.00	3.67	3.83	3.94	4.04
14	Canada	3.87	3.71	4.03	3.24	3.99	4.01	4.41
15	United States	3.86	3.68	4.15	3.21	3.92	4.17	4.19
16	Denmark	3.85	3.58	3.99	3.46	3.83	3.94	4.38
17	France	3.84	3.63	4.00	3.30	3.87	4.01	4.37
18	Australia	3.84	3.68	3.78	3.78	3.77	3.87	4.16
19	Austria	3.76	3.49	3.68	3.78	3.70	3.83	4.08
20	Taiwan	3.71	3.35	3.62	3.64	3.65	4.04	3.95

Figure 4 Logistics Performance Index, top 20 performers in 2010 (World Bank LPI ranking)

Factors determining logistics performance are mainly the same ones that affect the level of logistics costs. Quality of infrastructure (transport corridors, telecommunication, IT etc.) is an important enabler of smooth logistics processes. Another important factor is the quality and competence of logistics service providers, which together with smooth border-crossing operations and international shipments ensure better performance and lower logistics costs. In general, logistics performance tends to be higher in countries that enjoy low corruption and high transparency of political operations like the legislative process. The reliability of processed logistics and timeliness are also factors that lower logistics costs. (Arvis et al. 2010, 14–22)

The relationship between LPI ranking and the level of logistics cost is clear. Countries with a low LPI score also suffer from high logistics costs. Especially the level of induced costs (cost of non-delivery or avoidance of non-delivery, storage, delivery) is significantly lower for countries with a high LPI score. Also the level of direct costs (freight and other shipment-related costs) decreases when the LPI score improves, especially at the lower scoring levels (Figure 5).

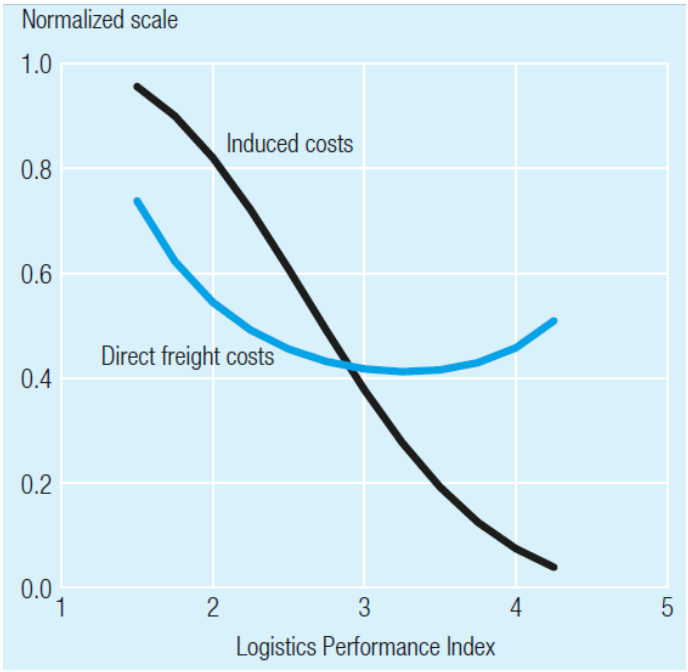
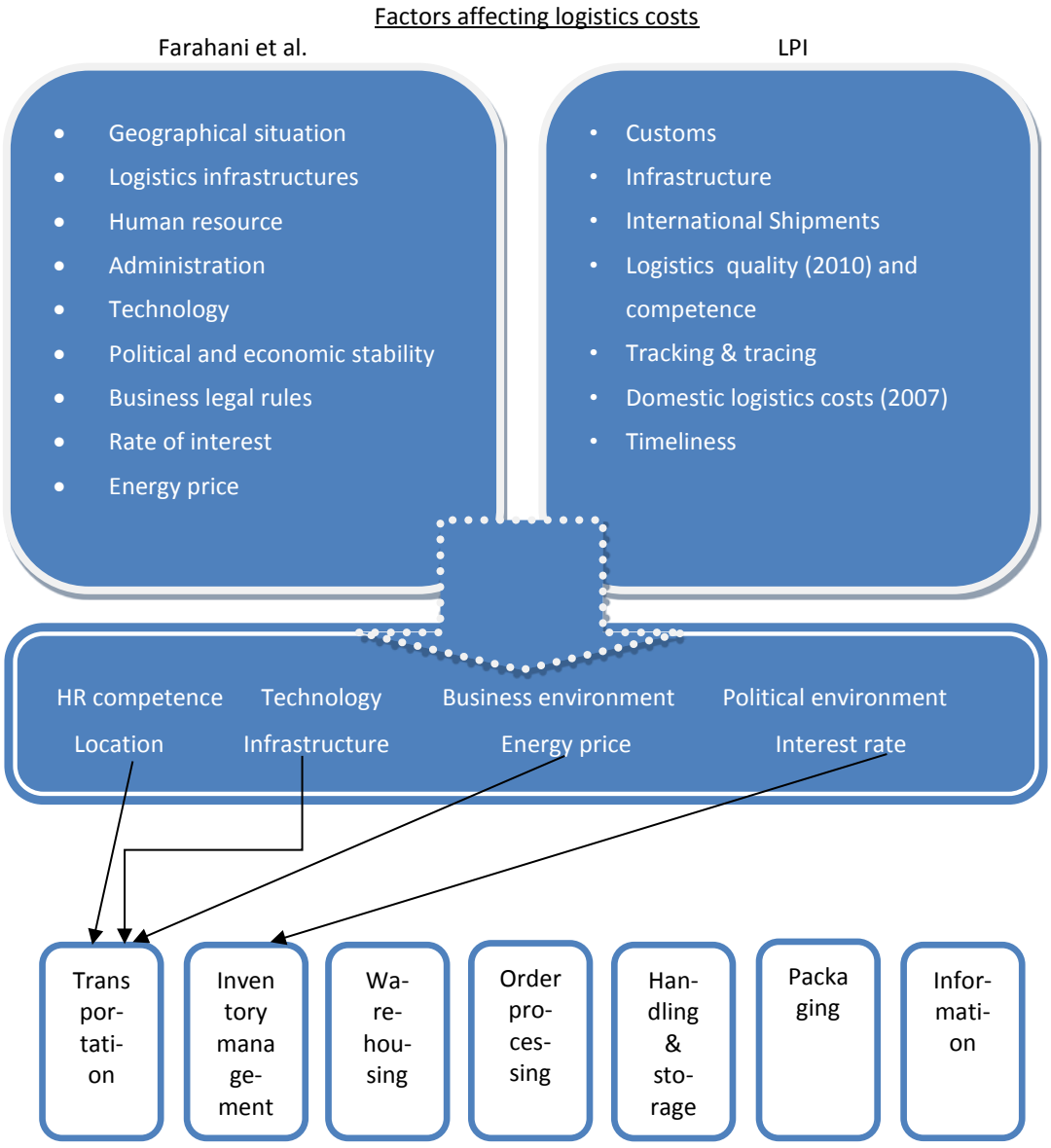


Figure 5 Connection between LPI and the level of logistics costs (Arvis et al. 2010, 26)

Some of the factors used to formulate LPI ranking are also identified by Farahani et al. (2009, 62–63) as factors affecting logistics costs; additional factors mentioned by them are interest rate level and energy price. One interesting finding regarding geographical situation (closeness of ports, economic hubs etc.) and logistics costs is that land-locked countries tend to suffer up to 50% higher logistics costs than those that have an oceanfront. Farahani et al. also proposes the term “business legal rules”, which covers custom operations, taxes and insurance costs and has a direct impact on logistics costs. (Farahani et al. 2009, 62–63)

In Figure 6, the above factors affecting the level of logistics costs identified by Arvis et al. (LPI) and Farahani et al. are combined under eight main groups. These are HR (human resources) competence, technology, business environment, political environment, location, infrastructure, energy price, and interest rate. Further, these groups can be divided between those affecting mainly a specific logistics function (identified by Sople) and those that have an effect on several. HR competence, technology, business environment, and political environment are the kind of factors that do not influence a specific function, while location, infrastructure, energy price, and interest rate can be mainly addressed to one particular function. Function-specific factors are illustrated with arrows (Figure 6).



Logistics functions creating costs (Sopple 2007)

Figure 6 Relationship between cost factors and individual cost components

The factors affecting logistics costs, and the relationship between these and logistics functions generating costs, are shown in the figure above. The arrows illustrate the relationship between them that directly affects the level of a specific logistics function. In fact, all the factors have an effect on all the logistics functions, at least indirectly, but those shown with arrows have a direct and the heaviest impact on the factor indicated.

2.1.2 Complexity of assessing logistics costs

Calculating logistics costs is a complex process even in micro level entities, and in the macro context there are only a few attempts to make such assessments. The issue is simply not properly addressed in academic debate. (Dianwei 2006, 592; Farahani et al. 2009, 60; Havenga 2010, 476; Straube & Pfohl 2008, 48–49; Wajszczuk & Wielicki 2004, 196)

The status quo is discussed in more detail by Farahani et al., who have identified the main factors causing the complexity of assessing logistics costs. First, logistics activities are very complex and include many different processes. Additional challenges are caused by the difficulties of acquiring transparent information about these processes. Furthermore, calculating the depreciation of all property and equipment involved in logistics activities increases the complexity. (Farahani et al. 2009, 60)

Besides these factors, micro level aspects like strategies and operational choices made by companies bring some additional complexity to measuring macro logistics costs. These choices by a company may create inhibitors to cost transparency, which may in turn lead to deficiencies in cost information, an overly narrow view of cost management, or differences in overhead cost allocation, for example. (Pohlen, Klammer & Cokins 2009, 22–23; 30)

One choice made by companies that has a significant effect on perceived logistics costs is whether the company has decided to outsource its logistics operations or produce these functions internally. Outsourcing of logistics functions is especially topical, as its popularity has increased steadily. Today, for example in Europe, up to 85% of domestic transportation is outsourced. For international transportation and warehousing the corresponding rate is around 81%. (Langley 2008, 13) From the viewpoint of measuring logistics costs, it is essential whether the costs of outsourcing are perceived as a part of logistics costs or not. Furthermore, if outsourcing contract bundles and several functions, the cost of an individual function may be hard to determine.

Alongside outsourcing, another essential question for measuring logistics costs is how focally company arranges its inbound and outbound logistics. This defines logistics functions the costs of which are covered by the company. One way to recognize a company’s part of the logistics costs is to scrutinize the terms of delivery (incoterms). For example, if a company purchases its raw material with ex works (EXW) incoterm and delivers products on a delivery duty paid (DDP) incoterm basis, it may seem to hit larger logistics costs than a company that has arranged its logistics vice versa. Figure 7 illustrates the connection between logistics arrangements and the probability of including logistics costs in measurements in terms of incoterms. Incoterms make especially international logistics costs difficult to compare.

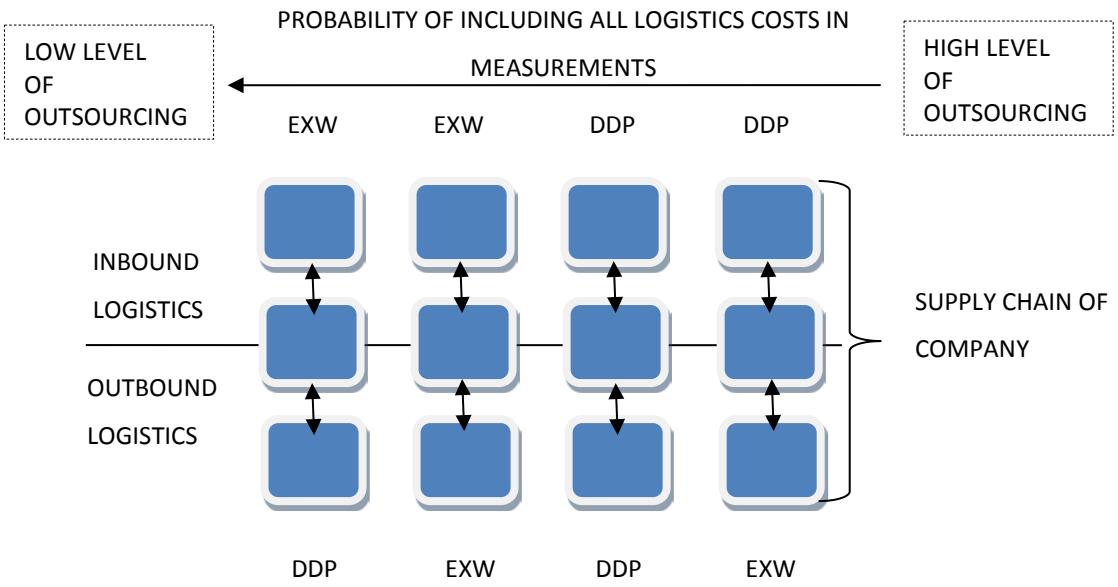


Figure 7 Impact of choosing the incoterms on logistics costs (partly adapted from Pohlen et. al 2009, 14–29)

The lower the level of outsourcing is, the higher the probability that all relevant logistics costs are included, as these are more probably perceived as the company's costs. The same logic applies to different combinations of incoterms, of which only utmost combinations are presented in the figure.

Although the problems of measuring logistics costs in the micro and macro contexts vary rather significantly, there is also a strong connection between the two. Given that a common definition of supply chain management in companies is missing and that the costing tools and methods used vary considerably (Pohlen et al. 2009, 12; 18–20), it can be assumed that this also has an effect on the results of macro level cost assessments, which employ interview- or questionnaire-based methods. To better understand the relationship between micro and macro level logistics costs assessments, the principles and tools for measuring logistics costs within companies are discussed briefly in chapter 2.1.2.1.

In macro level measurements, additional complexity is usually related to the availability and reliability of data. There are some distinctive problems with all methods applied to macro level assessments (breakdown of methods in this study: statistics-based studies, questionnaire-based surveys, and case studies). Generally, the statistics play a vital role, especially when estimating logistics costs from statistics data or in case studies. In the case of surveys, reliability is amplified with sample size, sampling techniques and clarity of the questionnaire form. These methods are examined in greater detail in chapter 2.1.2.2.

2.1.2.1 Measuring logistics costs in companies

The focal point of interest in this study is logistics costs in the macro context. Nonetheless, as discussed in the previous chapter, some commonly used methods of measuring logistics costs at micro level can justifiably be introduced. This facilitates especially the understanding of companies' view of logistics costs as a background for surveys. In addition, it is important also for logistics management to be able to utilize the cost analysis in order to understand the level of resources that logistics systems require (Abdallah 2004, 9).

Harrison and van Hoek (2002, 56) have identified some problems with traditional cost accounting methods. The first of these is that the true costs of different customer types, channels and markets are poorly understood with traditional accounting methods. The second one is that traditional accounting usually tends to aggregate costs at too high or too general a level. They also state that costing is functionally oriented at the expense of output, and the emphasis on full cost allocation to products ignores customer costs. (Harrison & van Hoek 2002, 56)

Zeng and Rossetti (2003, 790) have grouped costing techniques into two streams (optimization and analysis based techniques) and four groups based on literature review. The first of these streams deals with logistics cost optimization (optimization-based techniques); the second stream focuses on strategic aspects of logistics costs (analysis-based techniques). The optimization-based technique attempts to optimize the total logistics costs, including main cost elements like transportation and inventory holding costs. Analysis techniques can be further divided into three categories as depicted in Figure 8. (Zeng & Rossetti 2003, 790) The figure also illustrates the appropriate techniques for measuring logistics costs at micro (company) and macro (national) scale.

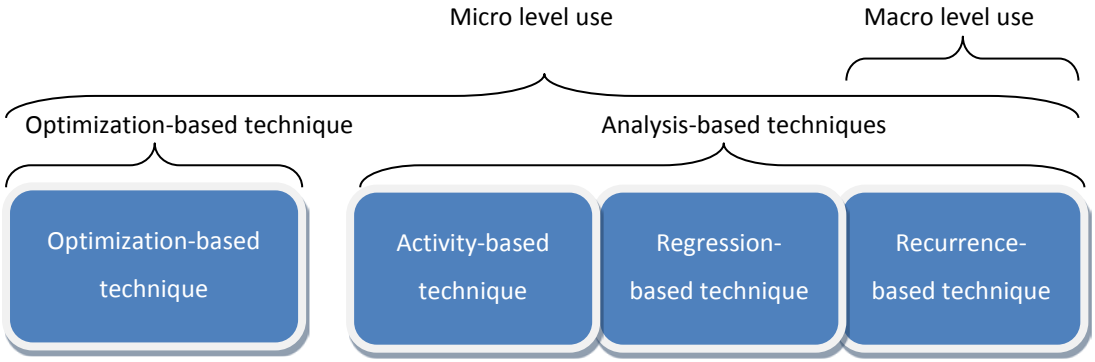


Figure 8 Grouping of logistics cost analysis methods (partly adapted from Zeng & Rossetti 2003, 789–790)

Activity-based costing (ABC) is a cost accounting approach that provides important financial information, which can also be utilized in analyses and the decision-making process related to logistics functions (Zeng & Rossetti 2003, 789). For example, Fang and Ng have delineated major logistics cost elements using the ABC method (Fang & Ng 2011, 273). Regression-based techniques are used to examine influences of certain variables and factors on measuring e.g. logistics costs. The rightmost technique in the figure is the recurrence based technique, which aims at identifying and classifying relevant cost factors. (Zeng & Rossetti 2003, 789–790)

The above techniques, used for assessing costs at micro level, do not directly provide the kind of information needed to assess costs at macro scale. It is, however, important to understand the basics of cost accounting techniques used by companies, as participants of surveys may employ this information in their answers.

The following tables (Table 1, Table 2, Table 3) present the most commonly used techniques and tools for micro level costing, classified according to which stage of the supply chain these are usually adapted in (Figure 9). Three stages of the supply chain are identified: i) intra-firm, ii) upstream/inbound, and iii) downstream/outbound.

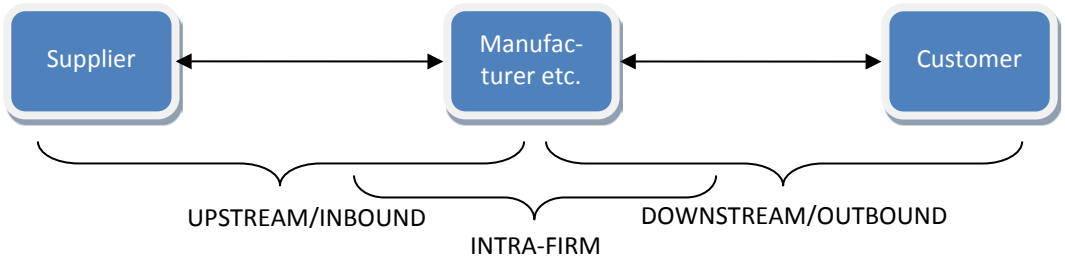


Figure 9 Grouping of supply chain costing tools

This grouping is not exhaustive and some of the tools might be used at different stages of the supply chain. Table 1 introduces the most commonly used costing tools in the intra-firm context, provides a brief description of each tool, and indicates some central management applications of the tool in question.

Table 1 Intra-firm logistics costing tools (Pohlen et al. 2009, 58–63)

Tool	Description	Management Applications
Activity-Based Costing (ABC)	Assigns direct and indirect costs to activities that consume resources. Then combines the costs in respect to used resources.	• Decision making, outsourcing and profitability analysis • Information of cost elements
Activity-Based Management (ABM)	Continuously improving end-user delivered value and profitability by focusing management	• Performance measure-ment • Cost reduction • Process engineering
Balanced Scorecard	Performance measurement in four perspectives: financial, customer, internal business process and innovation/learning	• Performance measure-ment • Evaluating customer service, suppliers, 3PL and financial performance etc.
Economic Value Added (EVA)	Assesses the profit generated by the firm by subtracting charge of capital from net operating profit	• Translates non-financial information into financial • Evaluates the created value
Kaizen Costing	Aims to reduce costs in the production stage	• Cost reduction of product currently in production
Standard Costing	Develops standard costs for activities that are tried to be met.	• Budget planning • Cost control • Simplifying activities

As presented in Table 1, intra-firm costing tools concentrate on measuring performance, primarily of a company's internal functions. Table 2 presents the costing tools focused on measuring costs in the upstream supply chain (inbound functions).

Table 2 Costing tools for upstream/inbound functions (Pohlen et al. 2009, 58–63)

Tool	Description	Management Applications
Cost Estimation	Focuses on determining expected costs of the product in respect to known factors	• Determining what products should be produced • Estimating costs of product
Cost-To-Serve (CTS)	Assigns non-production costs on a customer and cause basis to determine total cost	• Customer profitability estimation • Network optimization • Production scheduling • Inventory level decisions
Cost Transparency	Sharing in-house cost information with suppliers (extendible to downstream method by sharing information also with customers)	• Reducing costs through joint development • Trading ideas
Open Books Costing	Supplier provides “open book” information regarding cost structure to customer and in return customer helps supplier to reduce costs. (Not extendi-ble to downstream functions)	• Sourcing decisions, cost reduction • Evaluating performance of suppliers, 3PL, etc. downstream functions
Target Costing	Costing method for new products that determines customer requirements. It uses information from upstream to adjust downstream functions to meet upstream requirements. The method can be used also downstream.	• Cost reduction • Switching pressures to downstream functions
Value Chain Analysis	Analyzing activities from supplier in order to understand the activities and processes performed.	• Affecting activities and costs, outsourcing decisions • Identifying cost drivers • Reconfiguring supply chain and exploiting linkages and buyers
Total Cost of Ownership (TCO)	Determines the total cost of some acquisition by associating all the costs from sourcing to returns. This means that tools examine costs throughout the supply chain.	• Evaluating supply sources • Measuring total costs of some acquisition • Purchasing decisions

The opposite end of the supply chain consists of upstream functions. This can also be referred to as the outbound side of the supply chain. The tools related to assessing costs upstream are introduced in Table 3.

Table 3 Costing tools for downstream/outbound functions (Pohlen et al. 2009, 58–63)

Tool	Description	Management Applications
Cost Transparency	Sharing in-house cost information with suppliers (extendible to downstream method by sharing information also with customers)	• Reducing costs through joint development • Trading ideas
Customer Profitability Analysis (CPA)	Allocating revenues and costs to end side of supply chain to determine profitability.	• Determining customer or segment profitability • Re-allocating resources • Reducing costs • Network optimization • Production scheduling • Inventory level decisions
Inter-organizational Costing	Structural approach that aims to move cost pressures from upstream to supplier side.	• Improve functionality and quality through improved design, value engineering and cost reduction
Life Cycle Costing	Involves all of the costs associated with a system or product during its lifetime. The technique may be extended to the supply side.	• Reducing costs of upstream functions • Provides information of all stages of supply chain for decision making
Landed Costing	Captures costs of activities to move product to final destination. Includes freight, handling etc.	• Provides information for LSP selection • Network optimization and outsourcing decisions • Process re-engineering

As mentioned above, the grouping of tables is not absolute. Some of the tools can be implemented, at least with some minor changes, in different parts of the supply chain. These include especially TCO, Cost Transparency, Life-Cycle Costing or Inter-organizational Costing. Figure 10 positions all of the tools in

two classification dimensions (optimizing/analyzing – upstream/intra/down-stream) presented at this chapter.

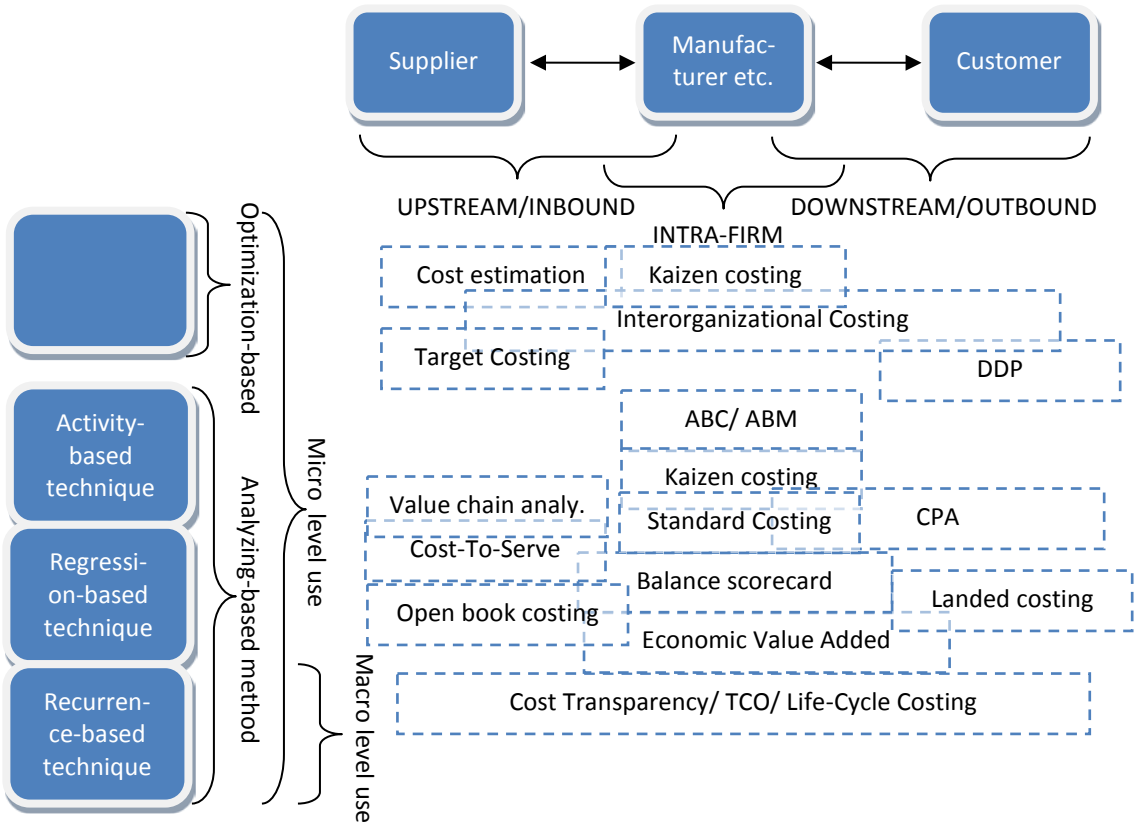


Figure 10 Classification of supply chain costing tools

Choosing the right tool depends on various factors. It is necessary to know what kind of information is needed and which activities should be considered as cost drivers. To illustrate one cost possible breakdown used by a real company, Figure 11 shows the logistics costs of PSA Peugeot Citroën in 2007.

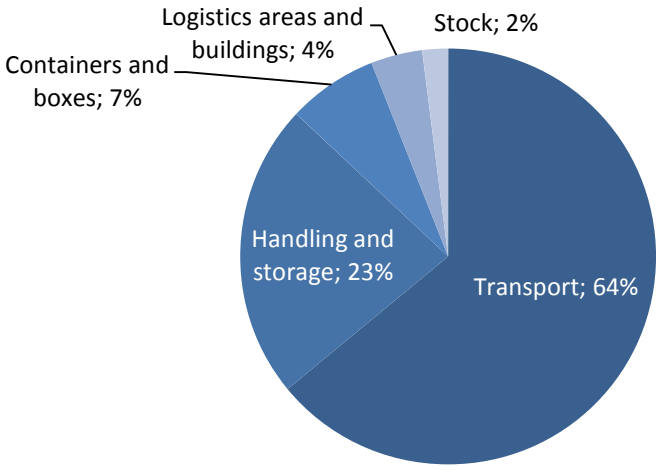


Figure 11 Logistics cost breakdown of PSA Peugeot Citroën as a % of total costs in 2008 (Wiklund 2008, 17)

As seen in Figure 11, transportation costs are the largest individual cost component for PSA Peugeot Citroën. Also handling and storage generate a significant portion of logistics costs, while other components are relatively small.

2.1.2.2 Methods of assessing logistics costs in the macro context

Some tools developed for measuring logistics costs at micro level are presented above. However, most of these cannot be directly adapted to assessing macro level logistics costs. As discussed previously, in this case no common methodology exists. Published macro level studies employ different kinds of methods and tools, depending on e.g. the availability of data and reliability of statistical sources (e.g. macroeconomic statistics).

Three methodological options for conducting a logistics cost study can be identified. The first is to collect empirical data directly from respondents, usually through questionnaires. Here these studies are referred to as surveys. The second alternative is to create a model by combining existing data from different statistical sources. Ojala (1992, 17) identifies three approaches of modeling: 1) econometric, 2) analytic and 3) simulation approach. Econometric models present the phenomena as a causal relationships network between internal and external variables. The analytic model employs mathematical manipulation to achieve a solution to the problem. Analytic models require that variables are quantifiable and can be represented with mathematical symbols. Simulation models seek to present the behavior of complex phenomena over extended periods based on real-world models. (Ojala 1992, 17–18) The third main group consists of studies employing the case-study method, which is also used in a considerable number of papers on supply chain management (Seuring 2008, 135).

Optional classifications of methods have also been presented in the context of macro logistics cost research. Hansen & Hovi (2008, I) name three research methods: 1) national accounting-based research, 2) opinion/questions-based surveys, and 3) studies based on estimating costs. (Hansen & Hovi 2008, I) The difference between estimation- and national accounting-based studies is thin, and in the present study both methods fall under statistics based studies. The structure of chapter 3 follows the classification between statistics-based studies, questionnaire-based surveys, and case/other studies.

Measuring macro level logistics costs is a multidimensional and complex issue. The first attempt to tackle this problem was made by Heskett, Glaskowsky and Nicholas in 1973. (Bowersox et al. 2003, 21; Farahani et al. 2009, 67) They projected the total logistics costs as a sum of four types of activities: transportation, inventory, warehousing, and order processing (Figure 12). This classification is still widely applied, and for example the CSCMP's Annual State of Logistics Reports employs the grouping developed by Heskett et al. (Bowersox et al. 2003, 21–22)

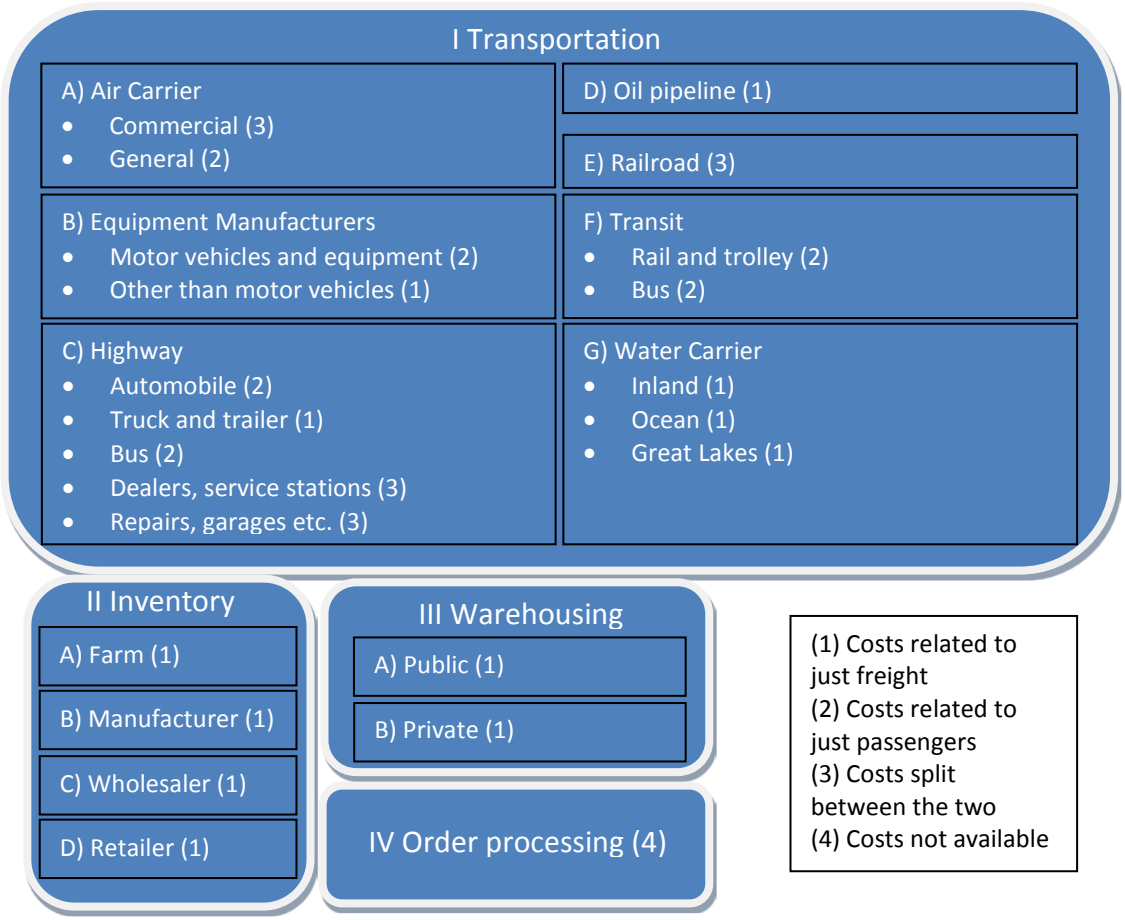


Figure 12 Logistics costs assessing the methodology proposed by Heskett et al. in 1973 (Bowersox, Calantone and Rodrigues 2003, 22)

The model developed by Heskett et al. was a stepping-stone to the evolution of macro logistics cost measurement research. Some examples of methodologies evolving from the taxonomy developed by Heskett et al. include Delaney's model, employed in the Annual State of Logistics Reports (see 3.1.2.1), and the estimation methodology developed by Bowersox et al. between 1992 and 2003. In *"Framing Global Logistics Requirements"* published in 1992, Bowersox presented an estimation of global logistics costs based on four pillars (Figure 13). These were total GDP, government sector product, industrial sector product, and total trade ratio. (Bowersox et al. 2003, 23–24)

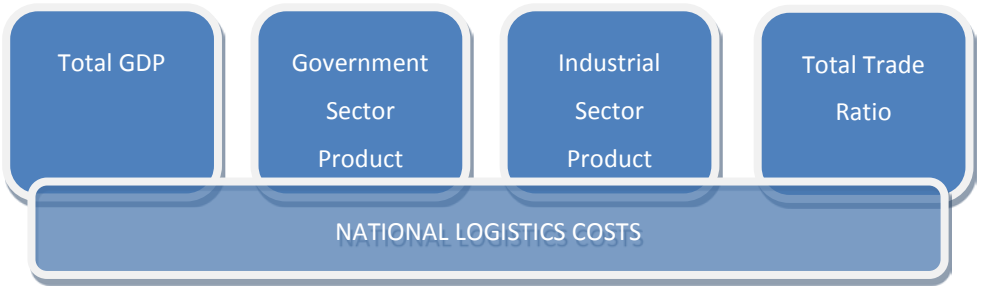


Figure 13 Logistics costs assessment methodology proposed by Bowersox et al. in 1992 (Bowersox et al. 2003, 23–24; Farahani et al. 2009, 68–69)

Total GDP and total trade ratio components are included in the model for measuring the size of individual economies. Total trade ratio was calculated by summing the imports and exports, then dividing the result by the GDP of the respective country. Governmental sector product and industrial sector product enable calculation of the expenditures of logistics activities of transportation, inventory, and warehousing. (Bowersox et al. 2003, 23–24; Farahani et al. 2009, 68–69)

In 1998 Bowersox and Calantone refined the methodology developed by Bowersox in 1992, and introduced the Artificial Neural Network (ANN) model, which is based on collections of mathematical models that emulate biological nervous systems (Bowersox et al. 2003, 25–27). The techniques based on the advantages of artificial intelligence were also proposed by Ojala already in 1992 as an approach to port planning (Ojala 1992, 17). The basic units of ANN are neurons, which basically have multiple inputs with different weights, and output units. Neurons are located in layers, of which this model has six (input, four hidden layers and an output layer). The model is illustrated in Figure 14.

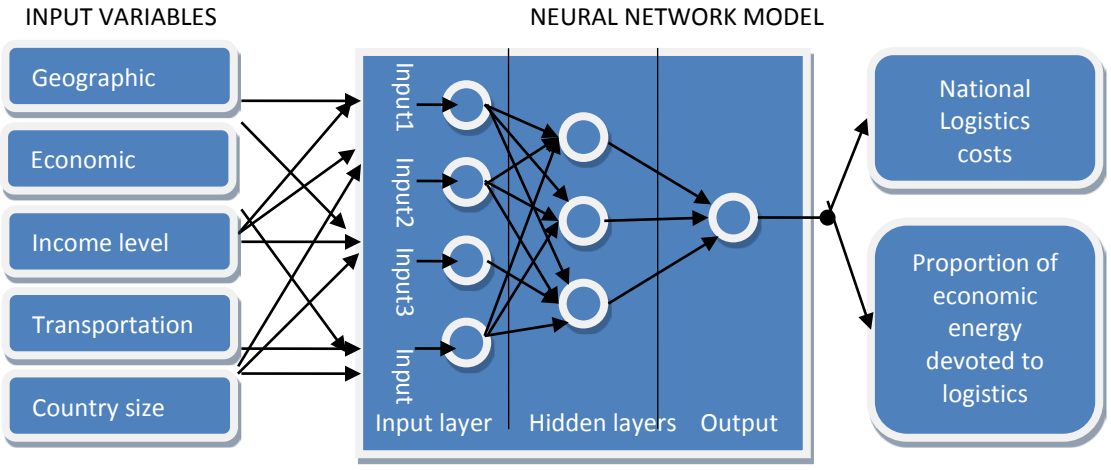


Figure 14 Example of logistics costs assessment using the Artificial Neural Network model (partly adapted from Bowersox et al. 2003, 25–27)

One of the challenges of the model is to find reliable input data. The input variables used by Bowersox et al. can be divided into five main categories: geographical region variables, economy variables, income level variables, transportation variables, and country size variables. These variables are forced through the Neural Network Model, which is adjusted in respect to previous research results, like CSCMP's Annual State of Logistics Study. The authors entitle this adjustment procedure training of the ANN. (Bowersox et al. 2003, 24–28; Farahani et al. 69–70)

Studies conducted by Bowersox et al. are among the very few that provide some estimates of global logistics costs. However, the logistics costs are only disclosed as total costs, and no cost component grouping is employed. The results of the study are presented in the chapter 2.2.2.

2.2 Structure of logistics costs

To be able to compare the level of logistics costs between entities, it is necessary to identify the main components of logistics costs. Unfortunately, there is no exhaustive definition or standard for these (Farahani et al. 2009, 60; Hansen & Hovi 2008, I). Hansen & Hovi made a serious effort to identify logistics cost components by reviewing previous research in 2008. The problem with this review is its relatively narrow source material, which was collected mainly from Scandinavia (Hansen & Hovi 2008, 25). Smith & Huber (2005, 14) have taken a different approach in their study, conducted among 1 068 Irish companies, as they surveyed the components included in supply chain costs. Of the respondents, 28.3% agreed that transport/freight/deliveries should be included.

Labor/salaries/wages were supported by 17% of respondents, while 16% agreed that materials should be included. A group of “other costs” would be included by 10.4%, storage by 8.5%, and inventory/stock by 6.6% of respondents. Also purchasing, production, administration, and carriage were identified by less than 5% of respondents respectively. (Smith & Huber 2005, 14)

Chapters 2.2.1 and 2.2.2 give an overview of the literature and journal articles regarding logistics cost research. A summary of the extensive literature and other research review is illustrated in tabular format at the end of the each sub-paragraph.

2.2.1 Literature review

Most of the textbooks discuss logistics costs from a cost accounting perspective (see more in chapter 2.1.2.1), which differs somewhat from the scope of this study. There are also a few textbooks dealing with the topic of macro logistics costs, but most of these seem to have adopted the approach of mostly quoting previous research (incl. books, articles, and studies). This chapter looks at some of the attempts at presenting logistics costs in textbooks to give the reader an overview of how they are considered in literature used for academic purposes. The total logistics cost concept and some other relevant attempts to measure logistics costs are presented as an example.

2.2.1.1 The total cost concept

The goal of logistics management should be to reduce the total costs of logistics activities as a whole. If the management is focused solely on one cost group, there is a risk that other costs may arise that has a negative impact on total costs. (Fröderberg 2006, 12) For example, Tavasszy, Ruijgrok and Thissen (2003) examined the relationship between changes in transportation costs and storage, handling and inventory costs to promote the total logistics cost concept (Tavasszy, Ruijgrok & Thissen 2003, 462).

The total logistics cost approach has also been applied in many practical problems. Gunn (2009) employed the total cost model when comparing the costs of alternative transport routes in Canada (Gunn 2009, 2–3). Ryerson and Hansen applied the approach in their research related to air passenger transport (Ryerson & Hansen 2009, 1).

Many of above studies refer to the total cost concept developed by Lambert, Grant, Stock and Ellram. Their approach identifies six main cost groups, which are more closely examined below. (Lambert, Grant, Stock & Ellram 2006, 11)

The first cost group is customer service level. The cost trade-off at this level is the cost of lost sales, which is one of the major costs in this group. Also the cost of returned goods is considered to fall under this cost group. (Lambert et al. 2006, 17) These costs may form a relatively large part of total logistics costs, but are not necessarily perceived as a part of total logistics costs.

Transport costs, in turn, are usually considered a large part of total logistics costs, because movement of materials and products is an essential logistics activity. The main factors affecting transport costs can be further divided into product-related (e.g. density and easiness of handling) and market-related (e.g. location of markets, available transport modes and seasonality) factors. (Lambert et al. 2006, 18–20; 200–201)

Warehousing and inventory-carrying costs are closely related to each other. Warehousing costs are generated by warehousing and storage activities, as well as costs of locating warehouses. Inventory carrying costs are triggered by four warehousing activities: capital or opportunity costs, inventory service costs, storage space costs, and inventory risk costs. (Fröderberg 2006, 14–15; Lambert et al. 2006, 21)

Lot quantity costs are due to procurement and production quantities that vary with changes in order or production size or frequency. These costs consist of setup costs (e.g. configuration time), capacity lost (e.g. during changeover), material handling, price differences in different quantities, and order costs (order placement and handling). (Lambert et al. 2006, 20)

The last group in the total cost concept is order processing and information systems costs that are related to such activities as order processing, communications and forecasting. These functions are extremely important and impose a major impact on other cost groups. (Lambert et al. 2006, 21) The cost groups are presented in Figure 15.

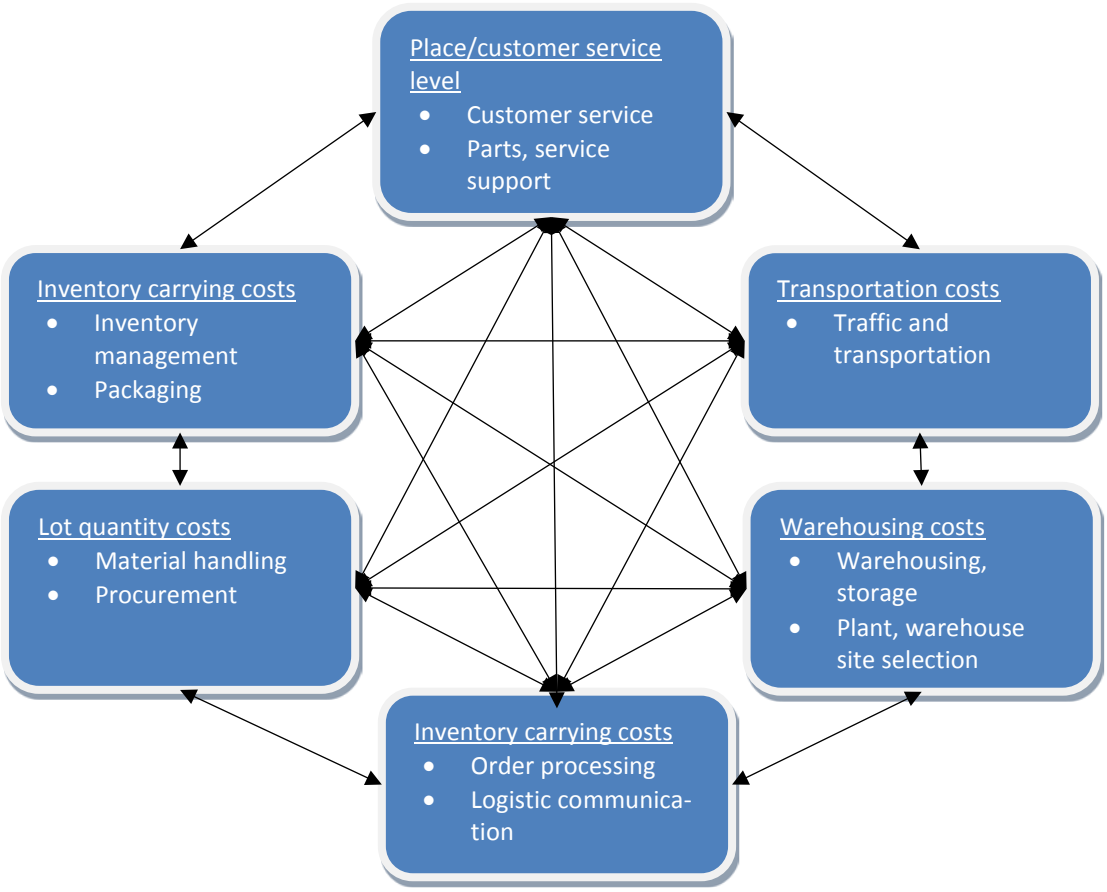


Figure 15 Logistics costs and connection between individual cost groups (Lambert et al. 2006, 11)

The arrows in Figure 15 illustrate the connections between cost groups. Due to these interdependencies, the total logistics costs approach should be applied in a company's decision-making at operational level to reduce its total logistics costs. In addition, identifying individual sub-costs facilitates measuring the performance of different functions and activities of the company.

2.2.1.2 Logistics costs in textbooks

Several different levels of logistics cost component breakdowns are proposed in the literature. Some works use only a three-level breakdown, while others may divide logistics costs between very narrow components. For example, Sople has a three-level breakdown of transportation, storage, and inventory (Sople 2007, 8).

In the *Handbook of Logistics and Distribution Management*, authors Rushton, Croucher and Baker introduce two classifications. The first is based on categorization, in which the cost components are allocated into four subgroups. These are

transportation, inventory carrying, storage/warehousing and administration costs. This classification was also used e.g. by Herbert W Davis & Company in 2005 and ELA (European Logistics Association) in 2004. (Rushton, Croucher & Baker 2006, 10–13) One of the earliest attempts to classify national logistics costs was made by Dimitrov in 1991. The book "*National Logistics Systems*" refers to the results of several early national logistics cost studies (Figure 16) including e.g. from the U.S. (1984), Sweden (1983), and France (1981). (Dimitrov 1991, 12) Based on reviewed studies, also Dimitrov proposes four components of logistics costs: transportation costs, trade costs, communication costs, and inventory carrying costs (Dimitrov 1991, 26–27)

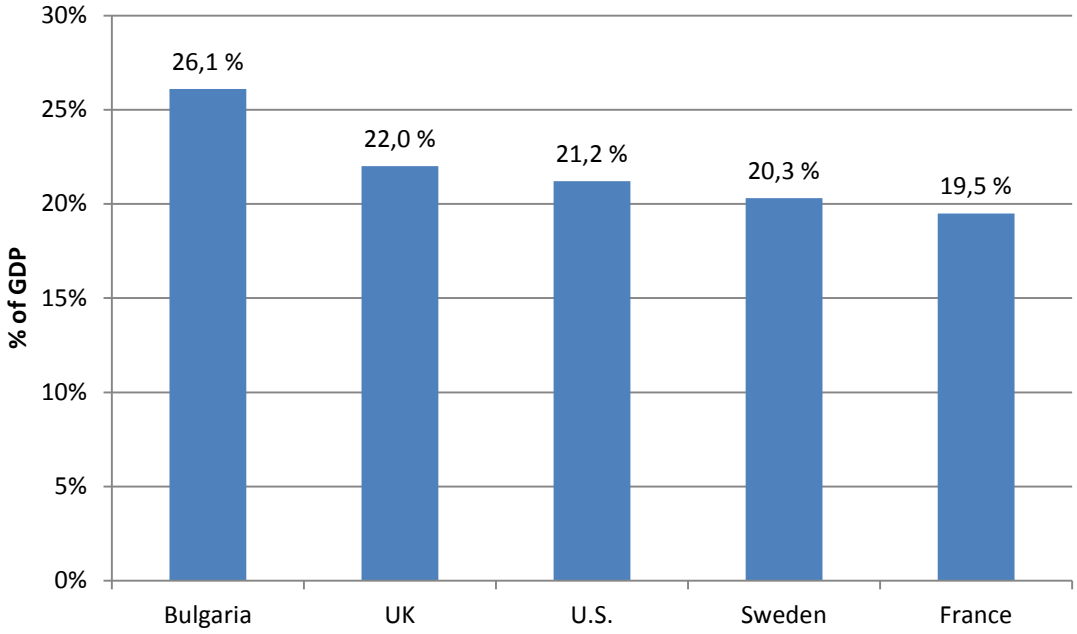


Figure 16 Logistics costs as a % of GDP in selected countries in the early 1990s (Dimitrov 1991, 12)

The *Handbook of Logistics and Distribution Management* by Rushton et al. also proposes a five-level breakdown (this has since been used in an industry cost audit carried out in the UK by Dialog Consultants Ltd). The fifth level of costs added to classification of Davis et al. is overall logistics costs. (Rushton et al. 2006, 10–13) Christopher also identifies some similar cost elements in a study of the principles of logistics costing. He pays a lot of attention to the true costs of inventory and identifies, among other things, pilferage costs. (Christopher 2005, 101–102) Depending on the industry and other variables, pilferage may account for a rather large share of logistics costs. The cost of pilferage is also identified by Rushton et al. as a part of inventory holding costs (Rushton et al. 2006, 204). An earlier edition of the *Handbook of Logistics and Distribution Management* (2001) also provided the figures of logistics costs in several countries (Figure 17). (Rushton, Oxley & Croucher 2001, 11)

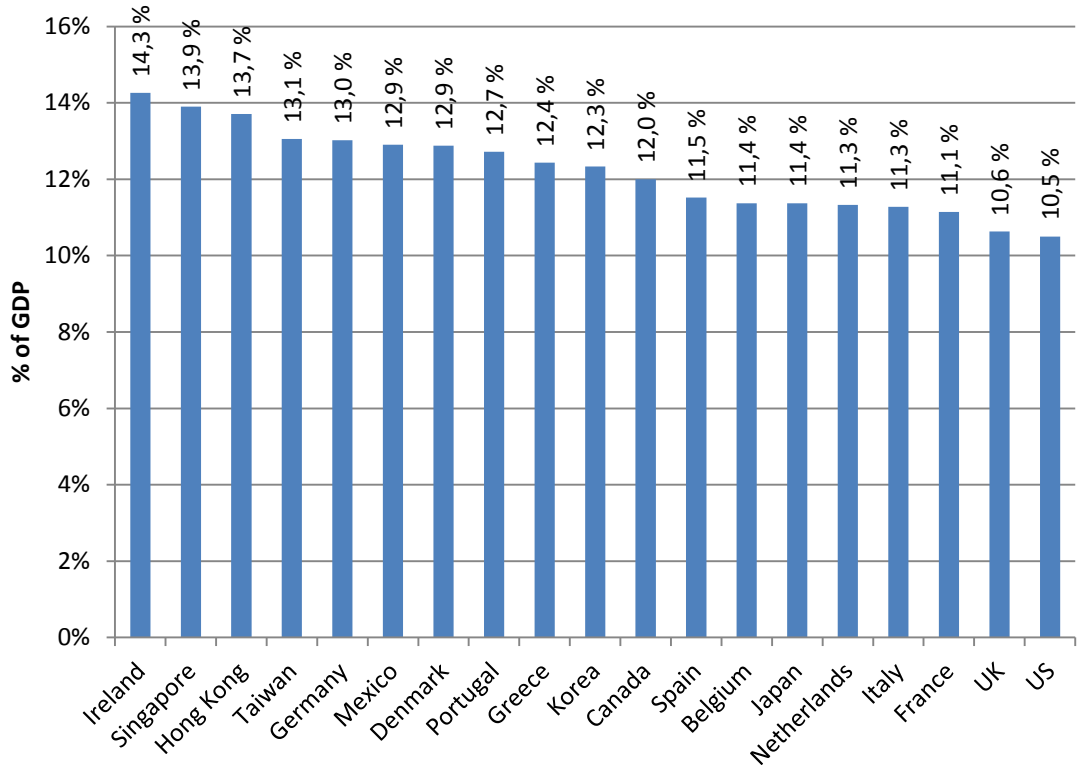


Figure 17 Logistics costs as a % of GDP in selected countries in 1998 (Rushton et al. 2001, 11)

Ayers (2006, 63) divides logistics costs into five components. An interesting difference between the cost grouping of Ayers and that of other authors is that purchased materials and associated labor are considered an individual cost group. The four other groups identified by Ayers are transportation, warehousing, inventory, and packaging. (Ayers 2006, 63)

Some examples of a more detailed cost breakdown are presented by Bidgoli (seven-level breakdown) and Kivinen and Lukka (12-level breakdown). Bigdoli recognizes order costs, transport costs, costs of deterioration and damage during transit, capital costs of goods during transit, capital costs of inventory, warehousing costs, and stock-out costs (Bidgoli 2010, 214). Kivinen and Lukka conducted a questionnaire-based study regarding the services required in a logistics management system. Based on these services, the authors created a cost structure that includes a total of 12 processes as follows (Kivinen & Lukka 2002, 25–56):

- Warehousing
- Manufacturing
- Transportation
- Customer service
- Procurement

- Quality control
- Reverse logistics
- Recycling logistics
- Logistics technology
- Packaging
- Consultancy
- Value-added services

Some of these cost concepts are in line with other studies, but a few groups, like manufacturing and quality control, are processes involved primarily elsewhere in logistics functions. Certainly all of these groups include logistics costs, but the contribution of logistics activities to total costs is probably relatively small in certain groups.

The reviewed textbooks also have different approaches to classifying logistics costs. For example, Coyle, Bardi and Langley (1988, 29) use the origin of cost. Their classification is based on three main groups (plant logistics costs, transportation costs, and warehouse costs), that are further divided into subgroups (Figure 18). (Coyle, Bardi & Langley 1988, 29)

Figure 18 Costs of the logistics system by Coyle et al. (1988, 29)

There are certainly some advantages to precise classification, but what makes the model in Figure 18 interesting is the fixed cost subgroup, which departs from an otherwise strict grouping.

One of the rare textbooks that provides also logistics cost data based on an empirical survey is the one by Straube and Pfohl from 2008. In *Trends and Strategies in Logistics*, data for the study were gathered from 897 German-based and 155 EU-based respondents. The authors identify six cost components. (Straube & Pfohl 2008, 46–49) As this textbook also provides some empirical logistics cost data, it is discussed more comprehensively later.

2.2.1.3 Summary of logistics costs in literature

Table 4 summarizes the findings of the review of literature. The main purpose of the table is to indicate the grouping of cost components used by each source. As the results quoted in the literature are not based on empirical data but on earlier studies, these figures are not included.

Table 4 Summary of logistics costs components based on the literature review

Publication (Year of publication)	Bidgoli (2010)	Sople (2007)	Ayers (2006)	Lambert (2006)	Rushton (2006)	Kivinen (2004)	Coyle (1998)	Dimitrov (1991)	SUM
Transportation costs	✔	✔	✔	✔	✔	✔	✔	✔	8
Inventory carrying costs	✔	✔	✔	✔	✔		✔	✔	7
Warehousing costs	✔	✔	✔	✔	✔	✔	✔		7
Packaging costs			✔		✔	✔	✔		4
Administration costs					✔		✔		2
Customer service				✔		✔			2
Order processing/information	✔			✔					2
Associated labor			✔						1
Capital costs of goods in transit	✔								1
Communication								✔	1
Consultancy						✔			1
Cost of damage during transit	✔								1
Fixed costs							✔		1
Logistics technology						✔			1
Lot quantity				✔					1
Manufacturing						✔			1
Procurement						✔			1
Purchased materials			✔						1
Quality control						✔			1
Recycling logistics						✔			1
Reverse logistics						✔			1
Stock-out costs	✔								1
Trade costs								✔	1
Value-added services						✔			1

As seen in the table above, some cost components (i.e. transport, warehousing, inventory carrying) appear in most of the publications. The following chapters, which deal with articles and studies, also look at the level of logistics costs. Chapter 2.2.2 discusses the concept of logistics costs based on a review of scientific articles.

2.2.2 Cost assessment in scientific articles

Compared to textbooks scientific articles provide more information on the level of logistics costs. Although many articles concentrate more on specific issues like measuring costs in a certain industry, the concept of logistics costs is often discussed. The review of academic publications below gives a broad overview of the cost components commonly used in research papers.

2.2.2.1 Banomyong & Supatn 2011

In their article *Developing a supply chain performance tool for SMEs in Thailand*, authors Banomyong and Supatn develop a supply chain assessment tool, which among other things measures costs. The authors identify nine cost dimensions: customer service, forecasting, procurement, inventory holding, information processing, value of damaged goods, transportation, warehousing, and returned goods. (Banomyong & Supatn 2011, 21–24)

The results for a sample of 43 Thai SMEs are quoted as costs per sale. The exact cost figures are not provided, but the sample companies are divided into inferior, similar, and superior performers. The average costs for each class are: customer service 0.5–5%, procurement 0.5–5%, information processing <0.5%, transportation 1–10%, warehousing 0.5–5%, forecasting < 0.5%, inventory holding 0.5–5%, value of damaged goods 0.1–3%, and returned goods 0.5–3% per sale respectively. Also “best practice” and “top Thai company” are illustrated in Figure 19. (Banomyong & Supatn 2011, 26)

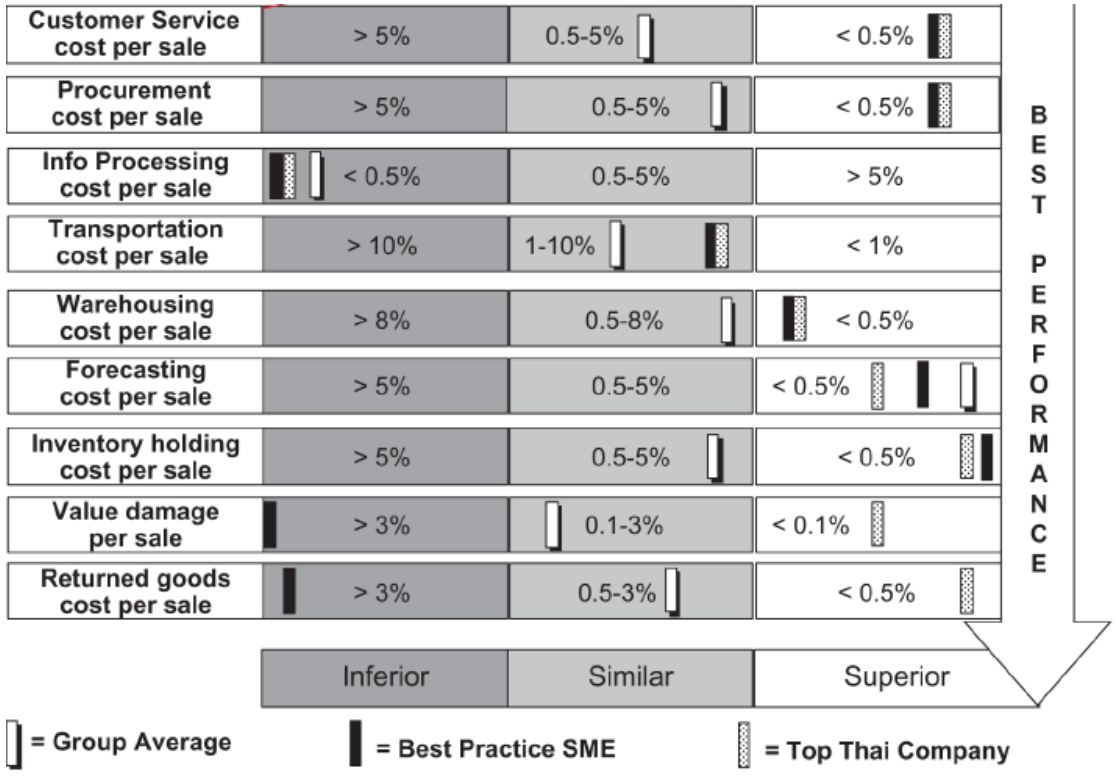


Figure 19 Logistics costs of SMEs in Thailand (Banomyong & Supatn 2011, 26)

The main contribution of Figure 19 is to provide some estimation of the approximate levels of costs. It also illustrates the differences of logistics costs between top performers and average companies.

2.2.2.2 Creazza, Dallari & Melacini 2010

Creazza, Dallari and Melacini (2010) look at the configurations of logistics networks, and as part of the study also derive overall logistics costs using simulation (Creazza, Dallari & Melacini 2010, 154). Four categories of logistics costs are identified: transportation, handling, inventory carrying, and order processing (Creazza, Dallari and Melacini 2010, 157).

Transportation costs consist of LCL (less than container load) rates and FCL (full container load) rates. Handling costs include all costs related to material handling, while order-processing costs are equivalent to costs caused by administrative operations. The inventory carrying cost component has three sub-items: safety stock cost, cycle stock cost, and in-transit inventory cost, which together form the category of inventory carrying costs. (Creazza et al. 2010, 157)

2.2.2.3 Choi & Lee 2009

Choi and Lee refer to the China Federation of Logistics and Purchasing (CFLP), according to which the national logistics costs of China were RMB 4,500bn in 2007 (Choi & Lee 2009, 83–87). Figure 20 illustrates the level and components of logistics over the last two decades. The cost components of the CFLP's study are more comprehensively presented in Chapter 3.1.2.3.

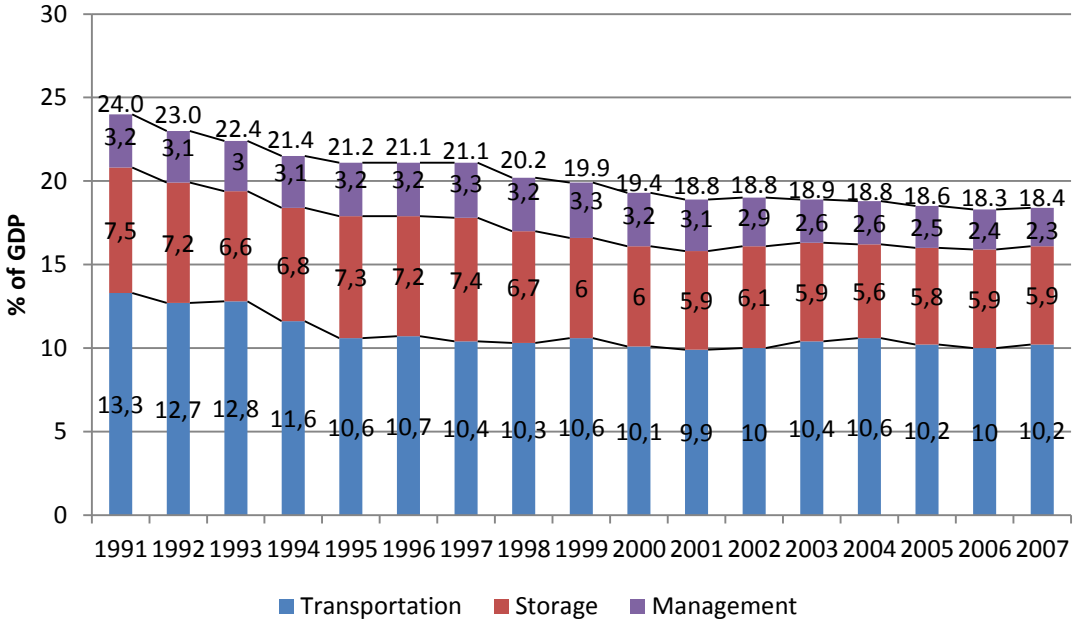


Figure 20 Logistics costs in China 1991–2007 as a % of GDP (Choi & Lee 2009, 87)

As shown above, transport costs contribute the greatest share of total logistics costs. According to the authors, domestic transportation is dominated by road transport, which represents 63.2% of total transportation costs. The second biggest cost component is storage costs, totaling 32.9% of all logistics costs. This also indicates the significance of storage activities in China. As the figure indicates, China has succeeded in reducing the amount of total logistics costs in recent decades.

2.2.2.4 Jensen 2007

According to Jensen (2007), the actions causing logistics costs are related to transportation, warehousing, administration, order processing, IT management, documentation and planning. Based on these actions, logistics costs are classified into six main components (Jensen 2007, 2–3):

- Transportation costs (incl. material handling)
- Warehousing costs (costs for premises and material handling in the warehouse)
- Costs of capital tied in inventory
- Administration costs
- Transport packaging costs
- Indirect logistics costs (e.g. obsolescence, damages etc.)

Jensen states that there are no relevant studies regarding logistics costs in Sweden (in 2007). The nearest similar study is Finland State of Logistics 2006, the results of which, according to Jensen, can be used to describe the logistics environment in Sweden as well. (Jensen 2007, 4)

2.2.2.5 Dianwei 2006

Dianwei unveils the concept and level of national logistics costs in his paper *The Research on Logistics Cost Accounting and Management in China*, presented in the International Conference on Management of Logistics and Supply Chain in 2006. According to the paper, present logistics costs (as a % of GDP) at the time of writing were 18.6% in China, 10% in Germany, 6.5% in Japan, and 8.7% in the U.S. As these figures are acquired from other studies that are discussed later in this dissertation, only the definition and components of logistics costs in China proposed by the author are discussed at this point. (Dianwei 2006, 591)

According to Dianwei, logistics costs generally include fixed asset investments (e.g. logistics equipment), stocking, transportation, overhead and labor expenses of logistics management, as well as information transferring costs. Based on these, six components of logistics costs are defined (Dianwei 2006, 592):

- Costs of logistics procession design, restructure and option
- Substance consumption (e.g. fixed assets wear and tear)
- Permission losses in stocking and transportation
- Other costs of organizing logistics activities
- Wages, bonus, and allowance
- Manufacturing expenses of commodities, stocking, packing, transportation, loading/unloading, fuel, and semi-manufactured goods

Dianwei seems to take a slightly different approach to cost classification than other authors. Instead of assigning costs to each logistics function, costs are classified per expenses.

2.2.2.6 ANN model by Bowersox et al. 2005

Chapter 2.1.2.2 briefly explains the ANN model developed by Bowersox et al. with the relevant methodology. This study is the only identified source of global logistics costs in extant research. The results are presented in actual costs and as a part of GDP in 24 selected countries, located on all five continents. According the study, global logistics expenditures in 2002 were approximately EUR 6 090bn (USD 6 387bn) or 13.7% of global accumulated GDP. In 2000, global logistics expenditures accounted for 13.4% of global GDP, which means that logistics costs have increased faster than the global economy has grown. The authors also provide results in relation to geographical region (Figure 21). (Bowersox et al. 2005, 9)

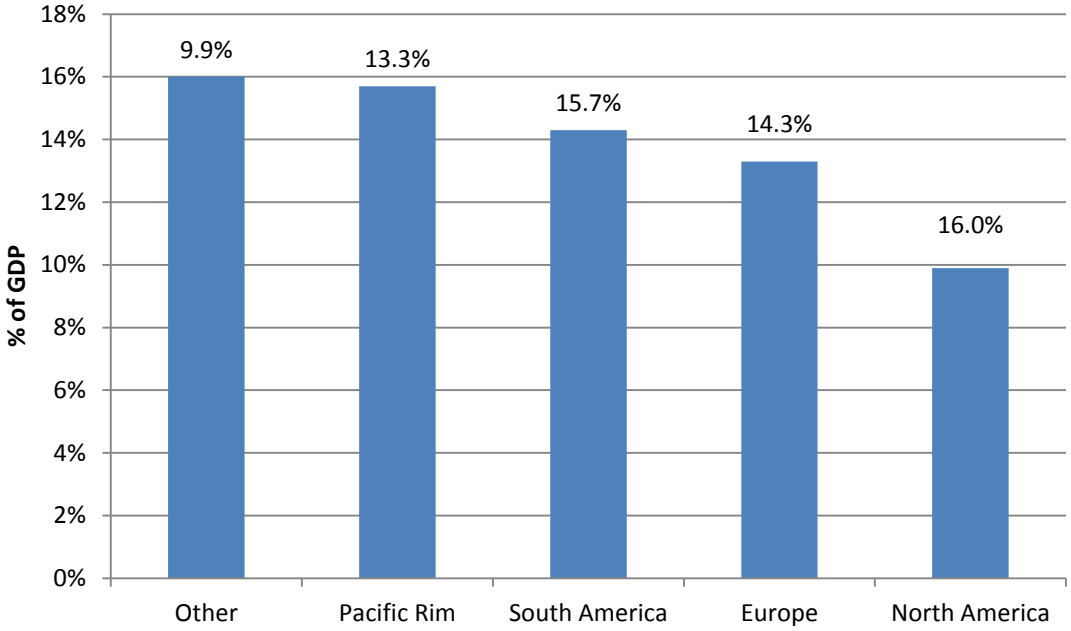


Figure 21 Logistics costs in different continents as a % of GDP (Bowersox et al. 2005, 9)

Although the study by Bowersox et al. is well conducted, it does not provide information on different cost components. Still, the study is the only real attempt to assess global logistics costs.

2.2.2.7 Zeng & Rossetti 2003

Zeng and Rossetti have studied a potential framework for evaluating logistics costs in global outsourcing processes. Building the model begins with identification of the components of logistics costs that are significant to the process in question. To be able to do this, the authors have defined six main cost

components and described individual costs included in these categories (Table 5). (Zeng & Rossetti 2003, 785–793)

Table 5 Components of logistics costs by Zeng and Rossetti (2003, 793)

Logistics cost category	Sub-components
Transportation	• Freight charge • Consolidation (cost of small shipments) • Transfer fee (changing transport mode) • Pickup and delivery
Inventory holding	• Holding during transfer • Safety stock
Administration	• Order processing • Communication • Other overhead costs
Customs	• Custom clearance • Brokerage fee • Allocation fee (customs bill)
Risk and damage	• Damage, loss, delay • Insurance
Handling and packaging	• Terminal handling (fee charged by transportation company) • Material handling (salaries and facility cost) • In/out handling • Disposal charge • Packaging materials • Storage (warehouse rent)

The classification of logistics costs created by Zeng and Rossetti is rather specific, which in most cases is useful when creating comparable data. It should nonetheless be noted that the more specific the model is, the more likely some necessary information will be missing. There is also a risk that some costs will be calculated twice when the line between sub-groups is ambiguous. A balance has to be found between strict and loose classification in respect of available data, research structure (e.g. statistics based vs. survey based) and the purpose of the research. It should also be noted that the very same cost components are usually included in other components in harsher classifications.

2.2.2.8 Hansen & Hovi

As mentioned above, Hansen and Hovi have reviewed several logistics cost studies mainly in Scandinavia. Most of the reviewed studies are introduced in this study in their own subchapters with the most recent data. The authors also

introduce some earlier studies, the results of which are briefly presented here since primary sources were not available.

Kalstad (1984) studied the costs of transportation and communications in different industries. The goal was to examine the effects of these cost groups on Norwegian industries and individual companies. The total costs of transportation and communications were calculated by summing the costs of outsourced transportation, internal transportation and communication. Data were gathered from the national accounting system and the results presented as a % of GDP. In 1981 this share was 13.7–15%. (Hansen & Hovi 2008, 2)

A more interesting study reviewed by Hansen and Hovi is *Transport og konkurranseevne, Effektivisering av Norges internasjonale godstransporter* (author's translation: Transport and competitiveness, the efficiency of Norway's international freight transport), which was initiated by the Norwegian Government in 1988. This initiative aimed to examine the costs related to foreign trade, and to propose actions to reduce these costs. For this purpose, the study places export-related logistics costs into different groups as illustrated in Table 6. (Hansen & Hovi 2008, 2–3)

Table 6 Logistics costs per cost component as a % of total export value in Norway in 1988 (Hansen & Hovi 2008, 3)

Cost component	Percent of total export value
Transportation costs	9.2%
Warehousing costs	5.4%
Cost of capital tied during transportation	0.5%
Insurance	0.4%
Packaging (sea cont. freight only)	0.9%
	16.4%

The first cost component is transportation and forwarding costs, based on 1986 data. Warehousing costs consist of on capital tied in inventory and stock-keeping costs (handling, salaries etc.). The third cost component is more or less related to the second component and is referred to as the cost of capital tied in inventory during transportation. The fourth and fifth cost groups are insurance and sea container packaging costs. (Hansen & Hovi 2008, 2–3)

Bjørnland and Lægreid (2001) studied long-term logistics costs based on previous research and statistics. They presented results as a percentage of all logistics costs in 1997. The results were as follows: warehousing (17.6%), packaging (14.5%), insurance during transport (3.8%), cost of capital tied in inventory during transportation (6.2%), and transportation costs excluding internal transport (57.9%). (Hansen & Hovi 2008, 4)

2.2.2.9 Summary of logistics costs in scientific articles

Table 7 summarizes the pivotal aspects of logistics cost research in scientific articles. The breakdown of logistics costs in each article is provided with the applied method of measurement, and the level of costs is given where available.

Table 7 Summary of logistics cost components in scientific articles

Publication (Year of publication)	Banomyong 2011	Creazza 2010	Choi 2009	Jensen 2007	Dianwei 2006	Bowersox 2005	Zeng 2003	Bjørnland 2001	NOU 1988	SUM
Cost components										
Transportation costs	✔	✔	✔	✔			✔	✔	✔	7
Warehousing costs	✔		✔	✔			✔		✔	5
Inventory carrying costs	✔	✔		✔			✔			4
Administration costs			✔	✔			✔			3
Risk and Damage								✔	✔	3
Insurance								✔	✔	2
Packaging costs	✔						✔			2
Tied capital costs (transport)								✔	✔	2
Cost of commodities space movement					✔					1
Customer service	✔									1
Customs							✔			1
Design, restructure and option costs					✔					1
Forecasting	✔									1
Handling		✔								1
Indirect logistics costs				✔						1
Information processing	✔									1
Order processing		✔								1
Other costs					✔					1
Permission losses					✔					1
Procurement	✔									1
Substance consumption					✔					1
Returned goods	✔									1
Wages, bonus, allowance					✔					1
Logistics costs and scale of measurement										
% of sales / turnover	✔			✔						
% of GDP					✔	13.8				
Actual costs (bn EUR)		✔				6090	✔		✔	
Other								✔	✔	

As shown in the table, the breakdown of logistics costs also varies within some scientific articles, but transport and inventory carrying costs are included in many papers. Only one article (Bowersox et al.) gives any figures of logistics costs based on empirical data. A combined table of all cost components in the literature and scientific articles is given in the appendices (see Appendix 8.29).

2.3 Approaches to identifying logistics costs

One of the goals of this research was to *design a generic model for measuring macro logistics costs*. In general, cost components directly related to the physical flow of goods are often perceived as a part of total logistics costs. In this study these are referred to as direct costs of logistics. Logistics processes also generate costs for functions (e.g. administration functions) that are not used solely by logistics activities. Identifying and estimating these is considerably more difficult than for direct costs. This chapter proposes and discusses some approaches that facilitate the identification of different logistics cost components.

2.3.1 Fourfold table of logistics costs

Even though the appropriate method of determining cost varies depending on the industry, there are some established general techniques of identifying costs (Bhattacharyya 2005, 34). Presenting the costs in a fourfold table according to certain dimensions is one way to categorize different units. In this context, this approach involves dividing logistics costs into smaller subsets. Two dimensions of costs are employed in the model to categorize logistics costs (Figure 22). The first of these counterparts is the classification between direct and indirect logistics costs (see also 3.2.1.5). The other is alternative costs (overhead costs) and activity-related costs. This approach has been adapted, for example, in Finland State of Logistics surveys and the 2007 study State of Logistics in the Baltic Sea Region. (Harrison & van Hoek 2002, 56; Naula, Ojala, Solakivi, Takalokastari, Rantanen, Kalske, Engblom, Häkkinen, Essén, Töyli and Stenholm 2006, 17; Ojala et al. 2007, 36; Solakivi, Ojala, Töyli, Lorentz, Hälinen, Rantasila & Naula 2009, 20–21; Ojala, Solakivi, Hälinen, Lorentz & Hoffmann 2007, 36; Harrison & van Hoek 2002, 56)

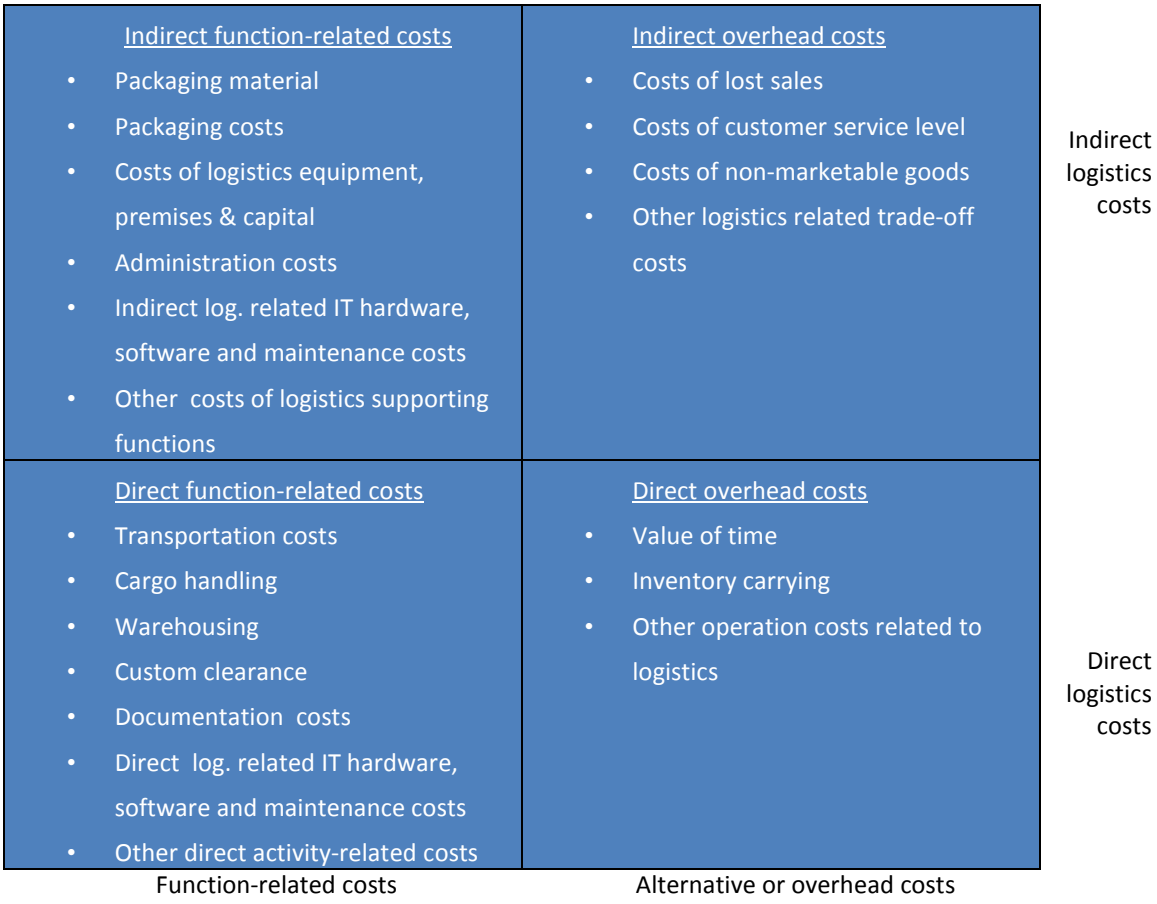


Figure 22 Logistics costs positioning in the fourfold table (partly adapted from Ojala et al. 2009, 24)

Figure 22 shows logistics costs divided into four subsets. Direct logistics costs are a group of costs that are associated with some specific logistic activity, or can be directly attached to a specific one. These costs are usually related to the most tangible logistics activities like transportation and warehousing. The costs generated by these activities can be easily traced back to the cost object. (Harrison & van Hoek 2002, 60; Pohlen et al. 2009, 64–65)

The counterpart to direct logistics costs is indirect logistics costs. These are expenditures that cannot be directly related to a particular logistic activity, but are necessary for supporting execution logistics activities. It is also difficult to link indirect costs with specific logistics activities, as the cost object is commonly used by several activities. Indirect costs cover all costs that cannot be tied to a specific activity. (Harrison & van Hoek 2002, 60; Pohlen et al. 2009, 64–65)

Direct and indirect costs can be further divided according to related function and alternative or overhead costs. Alternative or overhead costs are a group of costs that are necessary for doing business, even though these are not directly related to a specific (logistics) function. In general, all costs other than those that

can be directly linked to materials or labor are lumped into this category. (Hansen & Mowen 2010, 35) The group of function-related costs, on the other hand, consists of costs incurred because of a certain (logistics) activity.

Combining these two counter-dimensions, it is possible to identify four different cost groups labeled as:

- Direct function-related costs
- Direct overhead costs
- Indirect function-related costs
- Indirect overhead costs

Direct function-related costs are usually the kind of costs caused by tangible logistics functions that are easily identified and traced back to a certain activity. The costs belonging to this group include e.g. transportation costs, and warehousing costs that are commonly perceived as logistics costs. These are directly linked to a certain activity like transporting goods from factory to wholesaler. However, it is important to draw the line between warehousing costs, which are direct and function-related costs, and inventory carrying costs that occur when capital is tied to the inventory itself. The nature of inventory carrying costs is overhead.

Direct overhead costs are overhead or alternative costs that arise from operations that are compulsory for a company in order for it to offer its products to customers. These costs can be directly linked to logistics functions like value of time or inventory carrying costs, but still cannot be allocated to a sole logistic activity (e.g. single truck load).

Indirect overhead costs are costs that arise when logistics activities are not working as planned. One could say that the costs in this group are only incurred in the case of failure of logistics functions. In this case, the risk is fulfilled due to e.g. lost sales or non-marketable goods. Even if the risk does not materialize, avoiding it still creates costs.

Finally, indirect function-related costs are expenditures that are not directly linked to a sole logistics function but to an activity. It is impossible, for example, to allocate the cost of packaging material or of a new forklift to a specific transported product. However, these supporting functions are essential for fluent logistics activities. The model of logistics costs described above is further elaborated by applying the transaction cost approach (TCA).

2.3.2 Applying the Transaction Cost Approach

Transaction costs occur when carrying out any exchange of commodities or services including transactions taking place within the entity or between companies. In general, the concept of transaction cost is understood as the costs

of transacting under uncertainty and managing the risk of dependence and spillover in the inter-firm context (Visser 2007, 216). In the context of supply chain management, Williamson emphasizes the encompassing character of available transaction cost literature (Williamson 2008, 14). Transactions costs can be divided between three main groups; information costs, negotiation costs and enforcement costs. (Hobbs 1996, 17; Williamson 1981, 552–553)

It is also possible to further classify transaction costs in three different elements based on the stage in which they occur. The pre-transaction element includes costs like need identification, source verification, adding and educating the supplier, and adding new competence. The transaction element includes costs like price, order placement, transportation, tariffs, billing/payment, and inspection costs. Logistics costs falling into this element are e.g. transport, inventory holding, handling and packaging. The post-transaction element includes costs like defective finished goods, repair/replacement, loss of goodwill and reputation. An example of logistics cost in this category could be purchasing costs. (Kumar 2010, 147)

TCA is based on four key factors affecting the costs of an entity. These are uncertainty (or informational asymmetry), bounded rationality, opportunism, and asset specificity. Uncertainty refers to changes in the business environment that are beyond the control of the relevant parties and cannot be foreseen. Information asymmetry results when the parties of a transaction possess incoherent information. Bounded rationality means the inability of parties to make rational decisions even if they want to. It is closely related to asymmetric information and opportunism, of which the latter refers to situations where the entity or individual seeks ways to exploit a situation to its/their own advantage. The last factor of TCA is asset specificity, which arises when assets (human or physical resources) have become specific to a particular transaction. This can be related e.g. to situations with a low number of suppliers on the market, which makes it difficult or impossible to bargain or change supplier. (Hobbs 1996, 17–18; Ojala 1995, 27–28)

Together with production costs, transaction costs comprise the total costs of entity. TCA can be employed in several different contexts, and for example Ojala has used it to classify logistics costs (Ojala 1995, 38–40). Figure 23 depicts the process of applying TCA to classify logistics, and incorporates the fourfold table of logistics costs into the TCA framework.

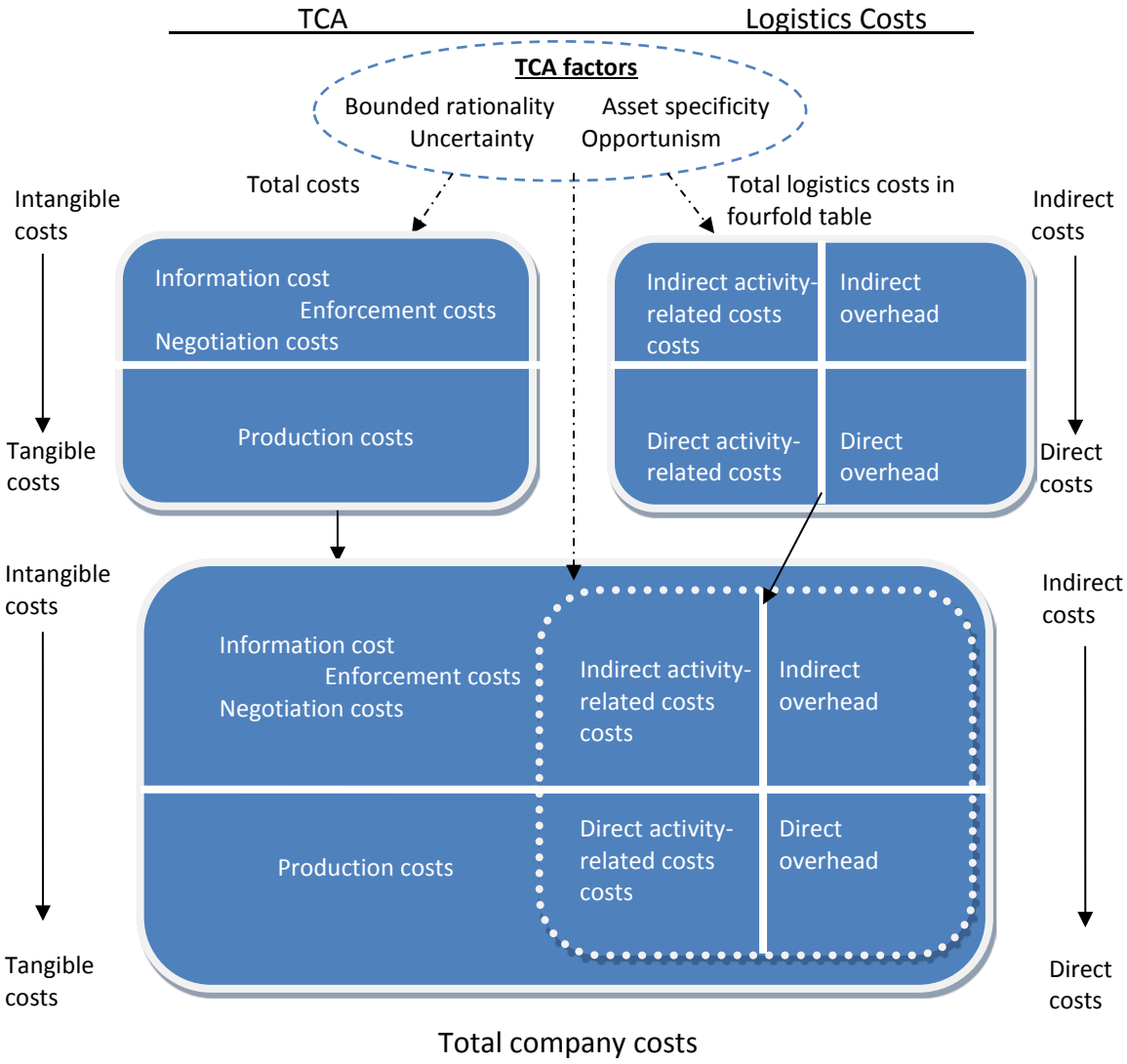


Figure 23 Adapting TCA to logistics costs (partly adapted from Ojala 1995, 38–40), block sizes are illustrative only.

As illustrated in Figure 23, TCA facilitates the understanding of logistics costs as part of a company's total costs. On the one hand, both total costs and logistics costs (upper boxes) are affected by TCA factors (inside the circular dashed box). On the other hand, logistics costs are an inseparable part of a company's total costs that can be classified by applying TCA (lower box). Two aspects of commonalities between logistics costs and TCA, the tangibility and directness of costs, are illustrated in the figure. The feasibility of TCA to systematize logistics costs is one example of how well-established economic theories can be applied to recent problems even in other disciplines. In this study, TCA is applied to facilitate the taxonomy of different logistics costs components. The next chapter describes the outcome of the comprehensive review of macro level logistics costs in identified extant research.

3 MACRO LOGISTICS COST STUDIES

This chapter looks at previous studies in terms of the research methods used. Three main categories are identified as follows:

- Statistics-based studies
- Surveys
- Case studies and other studies

The first two are further divided into two subcategories based on geographical coverage. These are multi-country and single-country studies. The order of individual studies in the subchapters follows the year of publication from the latest to the oldest.

In the primary classification, statistics-based studies employ statistical data, models and methods to derive the level of logistics costs. Statistics may include e.g. national accounting statistics. The distinctive difference between case studies (which also may use statistics) and statistics-based studies is that the latter use a well-established and verified model. Surveys use questionnaires to collect data on logistics costs from respondents. One significant difference between this approach and statistics-based studies is from the supply chain point of view; while statistics-based studies usually approach the issue from the supply side of the chain, surveys are usually conducted among stakeholders on the demand side. Finally, case and other studies include studies conducted with a case study methodology and studies that cannot be categorized into statistics-based studies or surveys. Case studies are usually employed where sufficient statistics are not available and it is not possible to conduct a survey. Other studies include not just mixed methods, but also studies that do not disclose the employed methods clearly enough. Studies in this category were not used for building the generic model, but are introduced at a glance.

In addition to utilized methods, it is possible to categorize studies based on levels of observation. These are micro (specified entity like a company) and macro, which is further divided into single-country and multi-country studies. This dissertation only concentrates on macro level studies for two reasons: First, the scope of study cannot be expanded too broadly, and access to valid micro level data is challenging. Second, as discussed in the chapter 2.1.2.1, the methods of measuring costs at micro level vary significantly from those used in macro level studies.

In accordance with the classification above, this chapter comprises three main sections covering statistics-based studies, surveys, and case and other studies

respectively. Statistics-based studies and surveys are further divided into single- and multi-country studies (Figure 24).

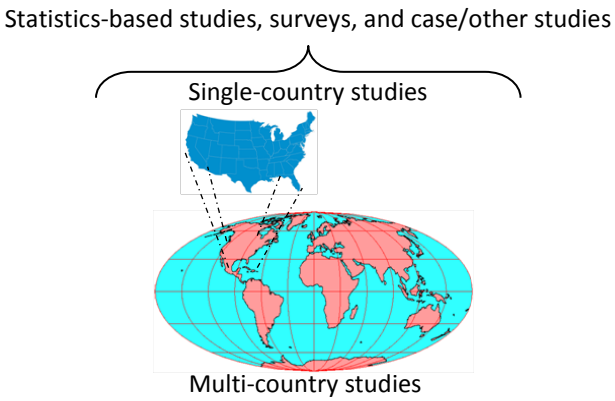


Figure 24 Categorization of logistics studies

The goal of this chapter is to provide a comprehensive picture of identified extant macro logistics cost research. The outcome forms the basis for designing a generic logistics costs model.

3.1 Statistics-based studies

This subchapter presents the logistics cost studies employing statistics based methods. Studies are divided into multi-country and single country studies.

3.1.1 Multi-country studies

3.1.1.1 Canada/United States logistics analyses and state of logistics report 2008

In 2005, Industry Canada launched a project dedicated to creating an assessment toolkit for logistics costs. The toolkit defines three components of costs and classifies cost activity categories and related components. Logistics costs related publications of the project include: *Industry Canada – Logistics Cost and Agility Assessment Tool, SCM and KPI Analysis – A Canada / United States Perspective* and *State of Logistics: The Canadian Report 2008*. (State of Logistics: The Canadian Report 2008, 2; Industry Canada – Logistics Cost and Agility Assessment Tool, 2)

The methodology used in the reports is based on an economic model developed in-house and originally designed in 2006. These models and analyses draw

upon datasets collected by Statistics Canada and the Bureau of Economic Analysis (U.S.), and there is also a direct linkage between data collected for CSCMP's Annual reports (see 3.1.2.1) and Canadian reports. (State of Logistics: The Canadian Report 2008, 2; SCM and KPI Analysis – A Canada / United States Perspective 2006, 24)

The reports apply a three-level breakdown of logistics costs that classifies costs as internal, outsourced, and inventory carrying (Industry Canada – Logistics Cost and Agility Assessment Tool, 4–5). This method of grouping is somewhat ambiguous and differs from activity-based grouping, which is employed in many other studies. Figure 25 illustrates the methodology.

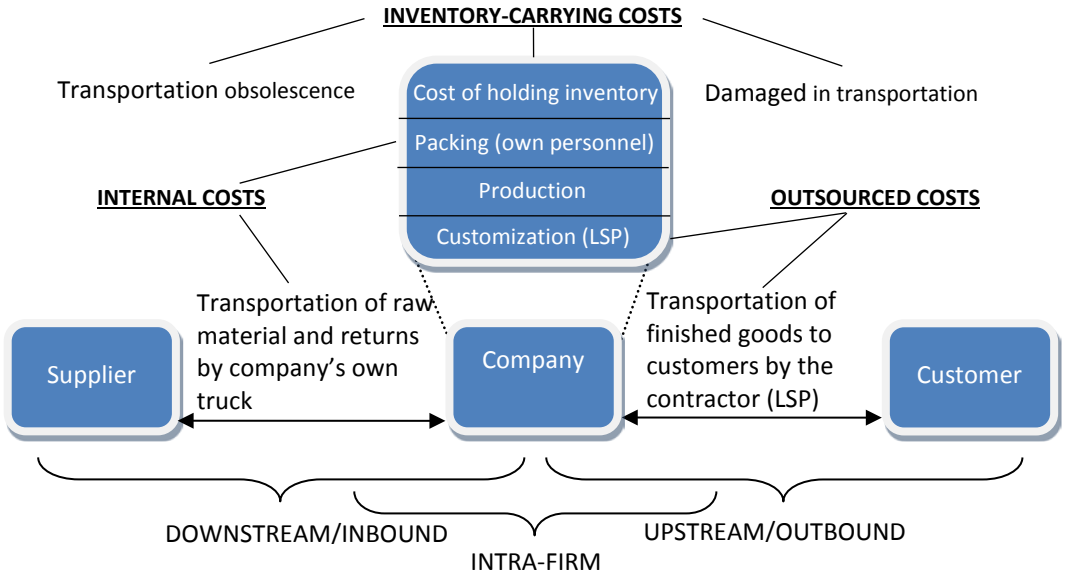


Figure 25 Grouping of logistics costs in Canada, 2008

The first of the cost groups, internal costs, covers logistics costs that occur internally within the firm (excluding outsourced activities and production processes). Internal costs were compiled by first determining the occupational types (21 occupations) related to internal logistics costs activities. Next, the types were assigned to one of the four main logistics activities (Distribution Center - DC, Office Work - OW, Truck Transportation - TT and Other Transportation - OT). The authors then identified the number of persons working in industrial subsectors. There were 60 subsectors in manufacturing and 30 in wholesale, as well as in retail. Finally the authors needed to find the logistics' supplier equivalent to the four main logistics activities and calculate the wage bill of activities after occupations were linked to them. The ratio of total costs to the wage bill was then allocated to 120 subsectors in total. After allocation, the costs of other internal costs components were estimated based on salaries (Figure 26). (SCM

and KPI Analysis – A Canada / United States Retail Perspective 2006, 25; State of Logistics: The Canadian Report 2008, 3; Industry Canada – Logistics Cost and Agility Assessment Tool, 8–9)

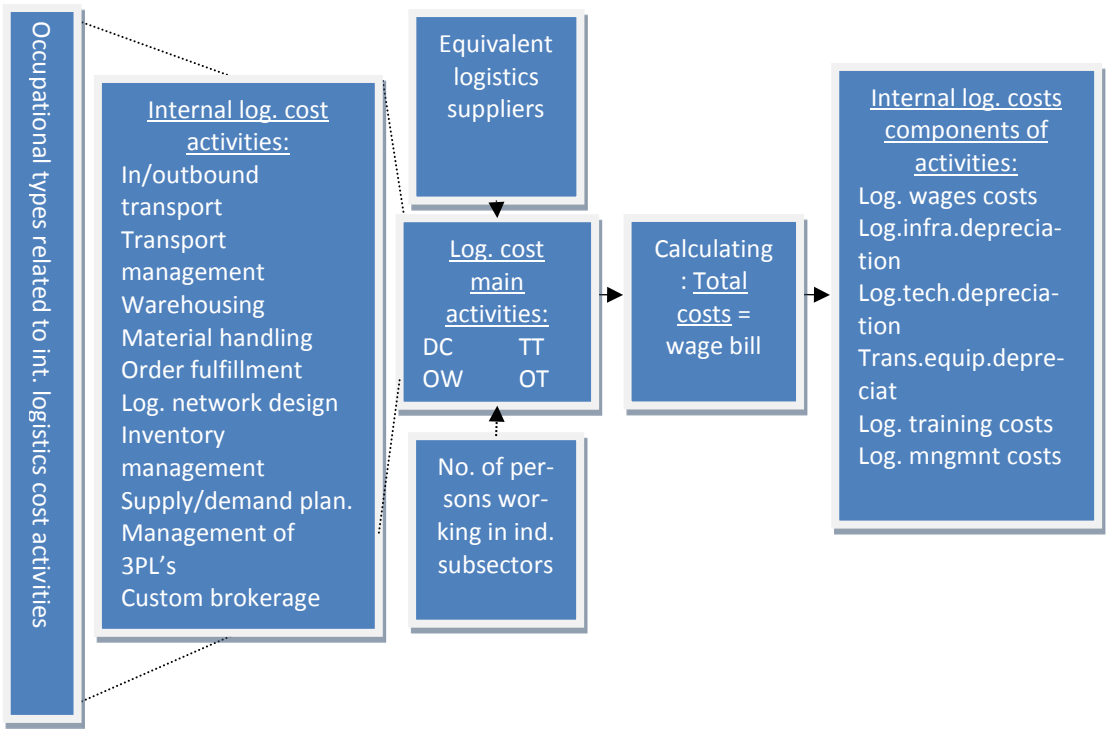


Figure 26 Calculating internal logistics costs in Canadian studies (partly adapted from SCM and KPI Analysis – A Canada / United States Retail Perspective 2006, 25; Industry Canada – Logistics Cost and Agility Assessment Tool, 9–11)

The second cost component, outsourced costs, indicates the value of activities outsourced to LSPs. The data for calculating outsourced activities was adapted from statistics indicating how much each industry requires a production of each other industry to produce its own output. (SCM and KPI Analysis – A Canada / United States Retail Perspective 2006, 25–26; State of Logistics: The Canadian Report 2008, 3)

The last cost component was inventory-carrying costs, which covers opportunity costs (cost of holding inventory), shrinkage (damage etc.) and obsolescence in all stages from inbound to outbound logistics. The inventory-carrying cost rate applied in this study was 20%. (State of Logistics: The Canadian Report 2008, 3; SCM and KPI Analysis – A Canada / United States Retail Perspective 2006, 26–27) For example in a Swedish study, presented later on, the corresponding rate is 25%.

Canadian studies reported results in three different ways including 1) as a % of GDP, 2) as a % of sales or 3) as a share of gross margin. Most of the results are only illustrated by charts, without adding the actual figures in charts or appendices. Therefore, only the latest results of the 2008 study are presented in Figure 27.

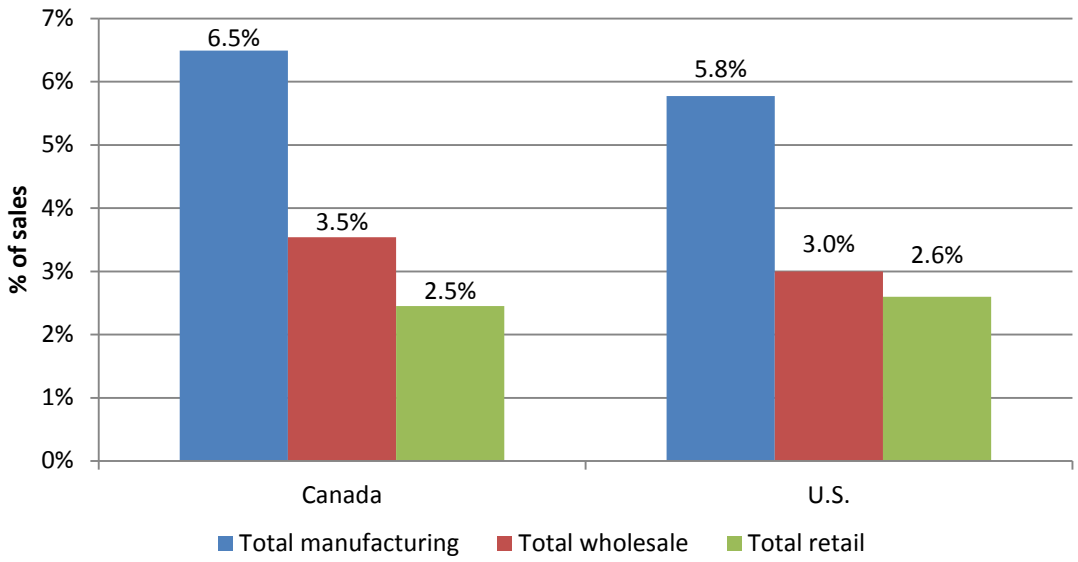


Figure 27 Logistics costs as a % of sales in Canada and U.S. in 2008 (State of Logistics: The Canadian Report 2008, 13)

As shown in Figure 27, U.S. based companies enjoy slightly lower logistics costs in all industries compared to Canadian ones. Between 2005 and 2007, total logistics costs increased by 3% for the Canadian economy. The growth was fastest among the retail industry, where costs increased almost by 22%. This was due to growing inventory levels, which led to a rise in inventory-carrying costs. On the other hand, the rise in costs was only around 1% in the manufacturing and wholesale sectors. Compared to the U.S, Canada suffered 12% higher total logistics costs in manufacturing, 18% higher costs in wholesaling and 30% higher costs in the retail industry. (State of Logistics: The Canadian Report 2008; 2–3) Figure 28 shows the Canadian and U.S. results in respect of cost components.

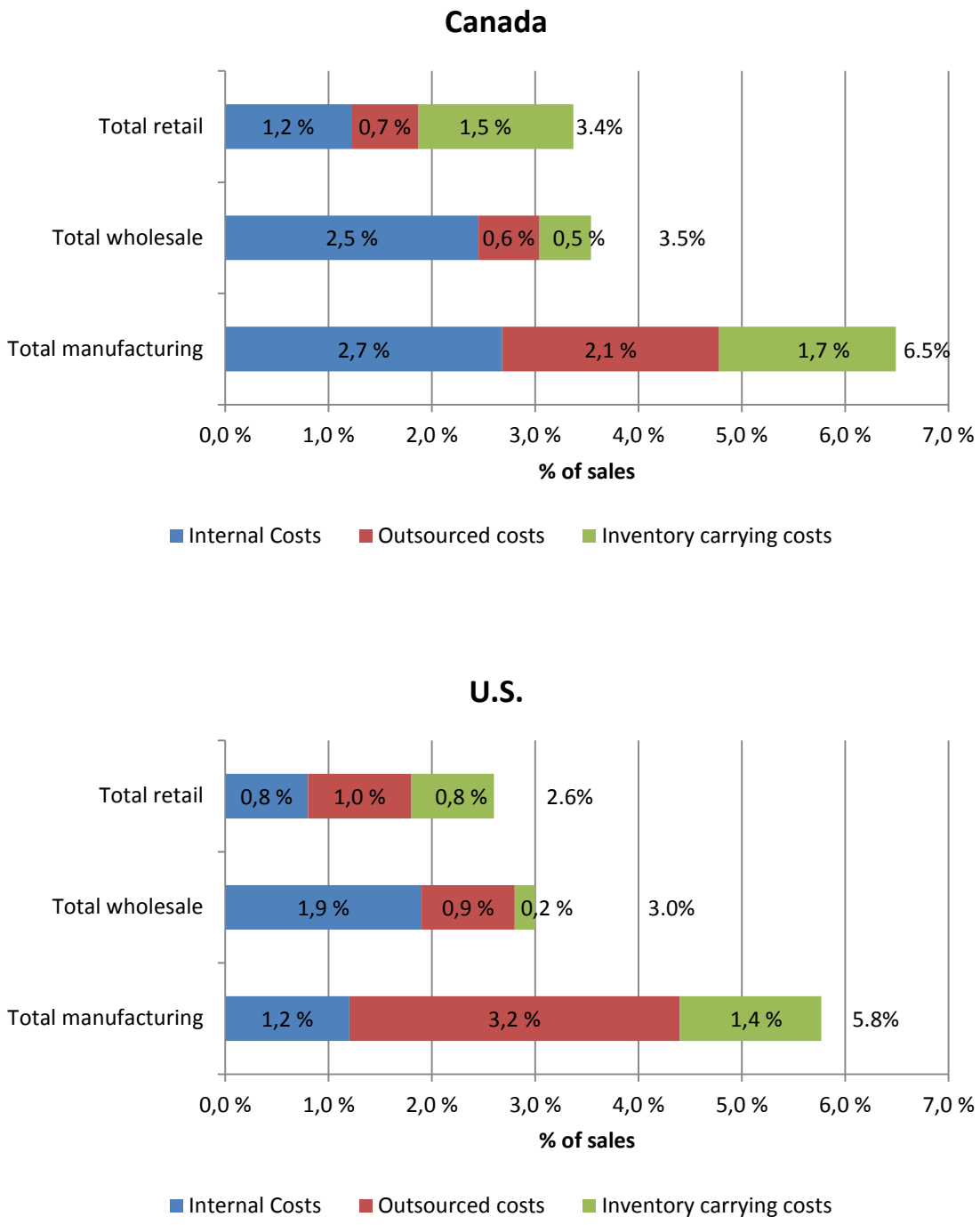


Figure 28 Logistics costs per cost component as a % of sales in Canada and the U.S. in 2008 (State of Logistics: The Canadian Report 2008, 13)

As shown in Figure 28, outsourced costs in the U.S. are higher in every industry than in Canada. Since companies are usually able to lower their total costs by outsourcing activities, this may partly explain the lower total costs in the U.S.

3.1.1.2 Top 100 in European transport and logistics services

Klaus and Kille have measured the total logistics costs of the European business logistics system. The authors estimate that the total annual expenditure on logistics services in the European economy was EUR 930bn in 2010. This includes all freight transportation, storage, transshipment, order picking, all inventory maintenance expenditures, order processing, planning, management and administration expenditures, covering both, in-house and outsourced logistics services. The two partly overlapping methods applied by the authors are introduced in following paragraph. (Klaus & Kille 2007, 42–43; Kille & Schwemmer 2011, 1)

The first approach is related to volumes, distances, and freight types. These are relatively well documented in Europe. The data of freight tonnages transported by road are used to extrapolate all up- and downstream functions. Based on these measurements of the road transport sector in Germany, it is possible to evaluate the size of the whole European road transport and total logistics market, with some adjustments to the German analysis to include national differences. The adjustment was based on three factors representing the stages of logistical development: labor costs, geographical condition in the country, and aggregate correction factor, which notes the positive or negative percentage by which the theoretical extrapolation of the transportation costs should be adjusted in the country's case. The logistics development factor is represented as GDP per population. Labor cost is presented as the average labor cost per month, and geographical condition by the weighted average distance by road/rail. By doing the same kind of extrapolation for all transportation modes, it is possible to evaluate the total revenues in European freight transport. To produce a preliminary estimate of total expenditures, the authors have projected the expenditures to cost breakdown of the Davis Logistics Database 2005 (see also 3.2.1.1). After this extrapolation the total logistics expenditures can be generated for several European countries (Figure 29). (Klaus & Kille 2007, 45–56)

The other approach is to utilize a national economy's data of value-creating activities. Based on several individual case studies and reliable statistical data, it should be possible, according to the authors, to calculate logistics costs for each country. The attributes of case studies are not discussed further by the authors. However, the results based on the second approach do not significantly differ from those with first approach (for example in 2005, the total logistics expenditures were EUR 803.4bn with the second approach, and EUR 799.6bn with the first).

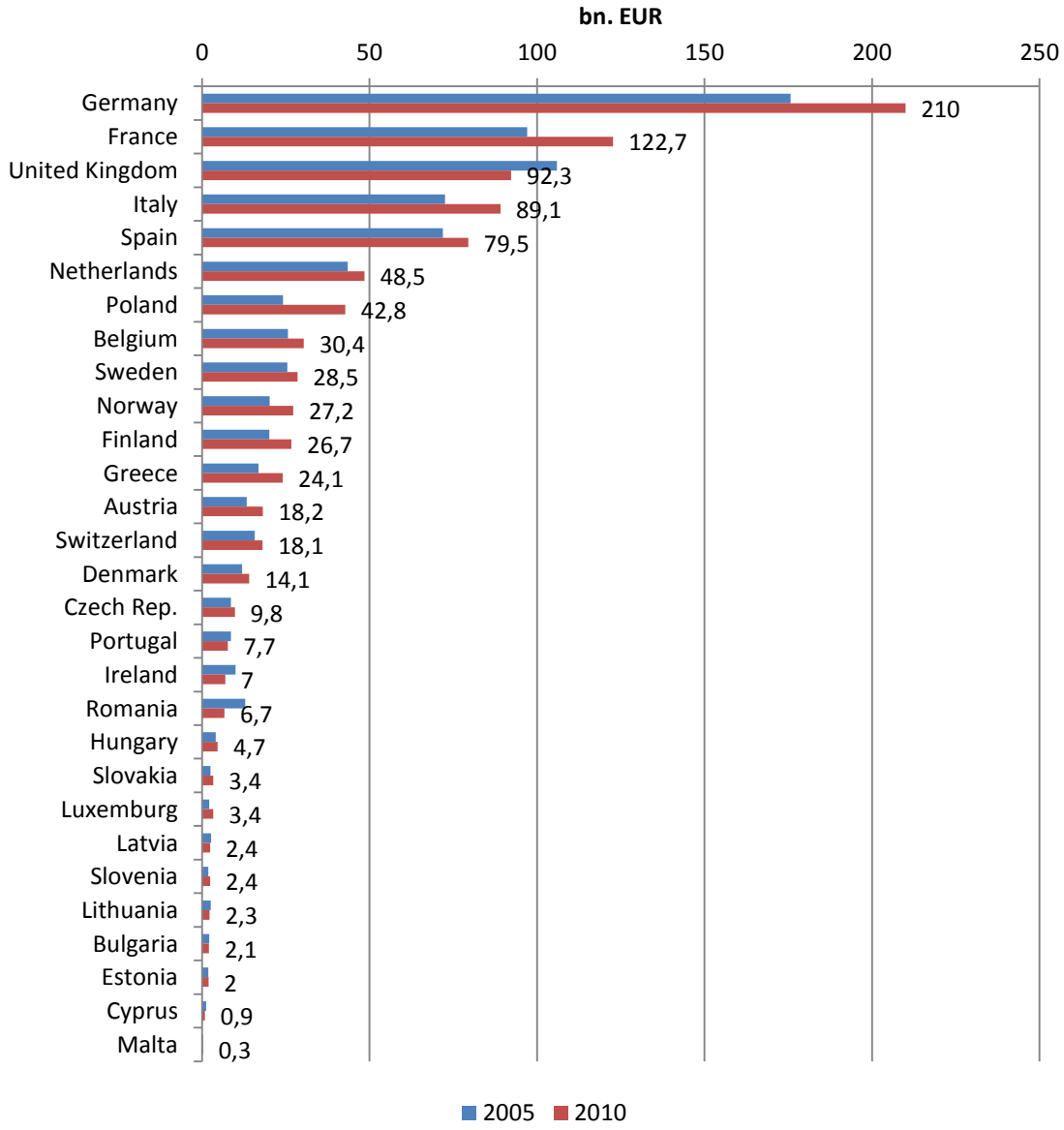


Figure 29 Volume of the logistics market in European countries in 2005 and 2010, bn Euro (Klaus & Kille 2007, 45–56; Klaus et al. 2011, 1)

The level of logistics expenditures has been on the increase in most countries. However, several countries including the UK, Portugal, Ireland, Romania, and Lithuania had smaller logistics expenditures in 2010 than in 2005. Without taking a stand as to whether it explains the differences or not, it should be mentioned that general economic conditions may have had an impact on national statistics, which may reflect on these calculations as well. The logistics costs per cost component are illustrated in Figure 30.

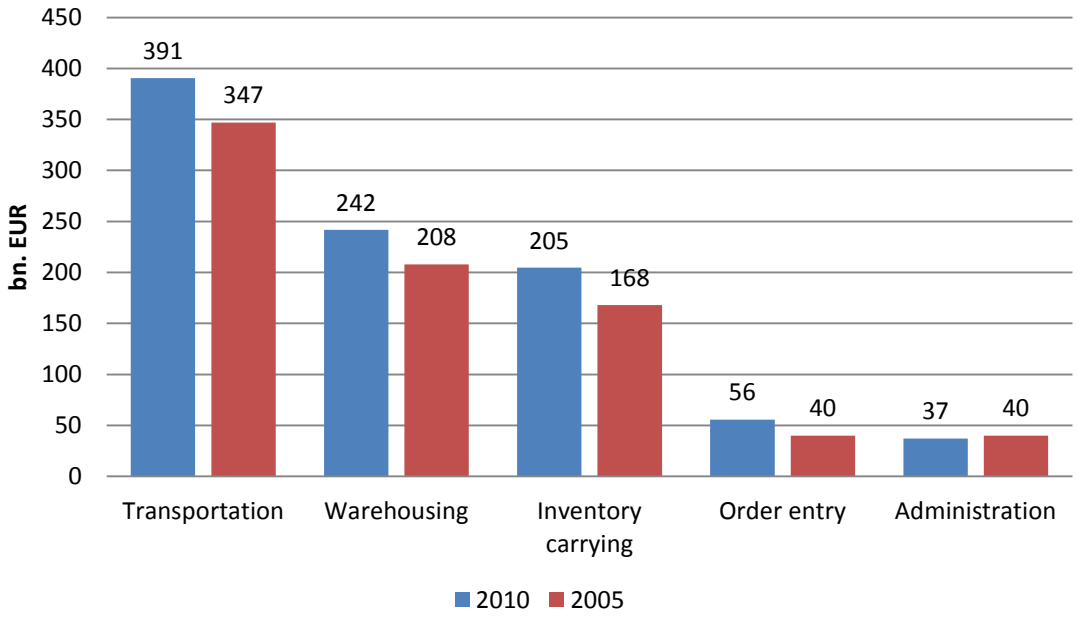


Figure 30 Logistics costs per component in Europe in 2010 and 2005, bn EUR (Klaus & Kille 2007, 63; Klaus et al. 2011, 3)

Considering the cost components, the results of the Top 100 in European Transport and Logistics Services are in line with other studies. Transportation costs are the largest individual cost component, followed by warehousing and inventory-carrying costs (in the 2011 edition this is labeled capital cost). The share of other groups (order entry and administration) is relatively small compared to these three.

3.1.2 Single-country studies

3.1.2.1 CSCMP's annual State of Logistics Report (USA)

CSCMP publishes an Annual State of Logistics Report defining the current state of business logistics costs and giving an outlook on business logistics in the U.S. The study is conducted on a yearly basis with constant methodology, making the results comparable with previous ones.

State of Logistics Reports present logistics costs in respect of four main cost components. This is based on methodology originally introduced by Bowersox and Calantone in 2003 and adapted into the State of Logistics Report that same year. Since then, one change has been made to the cost components. The original methodology employed three main logistics cost components, which meant that shipper-related costs were included in transportation costs. At a later stage, shipper-related costs were presented as top level costs. This is only a technicality and has no effect on the results. The methodology is called CASS after the

company Cass Information System Inc., which established it. The cost components and methodology are presented in the table below.

Table 8 Cost components in CSCMP's reports and CASS methodology (partly adapted from Farahani 2009, 78; Wilson 2009, 2; Wilson 2011, 11)

Main cost components	Sub components	CASS data source
Inventory-Carrying Costs	• Interest • Taxes, obsolescence, depreciation, insurance • Warehousing	• Annualized Commercial Paper Rate • Alford-Bangs production formula • Expenditure on public warehousing census
Transportation Costs	• Truck-Intercity • Truck-Local • Railroads • Waterways • Oil Pipelines • Air • Forwarders	• * • * • * • * • * • * • *
Shipper-Related Costs		• *
Logistics Administration Costs		• 4 % of total logistics costs

*** Based on Eno estimates, which are derived on the basis of truck vehicle miles**

Inventory-carrying costs include all costs associated with holding the goods in storage. These fall into four main groups: capital costs for inventory investments (interest charges), inventory service costs (taxes, insurance etc.), storage space costs (warehousing) and inventory risk costs (obsolescence, damage etc.). (Farahani et al. 2009, 75–76)

Transportation costs include charges of transporting goods in all modes. These estimations are based on data provided in the annual *Transportation in America* report published by the Eno Transportation Foundation. The report provides extensive data on movements of people and goods along highways, railroads and waterways, on public transportation and by air in the U.S. Based on this data the expenditures of seven subgroups are calculated. The same statistics are used to calculate shipper-related costs. (Farahani 2009, 76–77)

Logistics administration costs include the costs of indirect management and supporting staff, as well as IT expenses. Administration costs are set at 4% of the sum of three other main cost groups (transportation, inventory-carrying and shipper-related costs). This same methodology has been employed since the first data series was published in 1973. (Farahani 2009, 77)

In 2010, the logistics costs increased from 7.8% of GDP (USD 1 100bn) in 2009 to 8.3% of GDP (USD 1 211bn). This is mainly due to a rise in transport and inventory-carrying costs. Figure 31 illustrates the development of absolute

costs compared to costs as a percentage of GDP. (CSCMP's 20th Annual State of Logistics Report 2009, 1; Wilson 2011, 12–13)

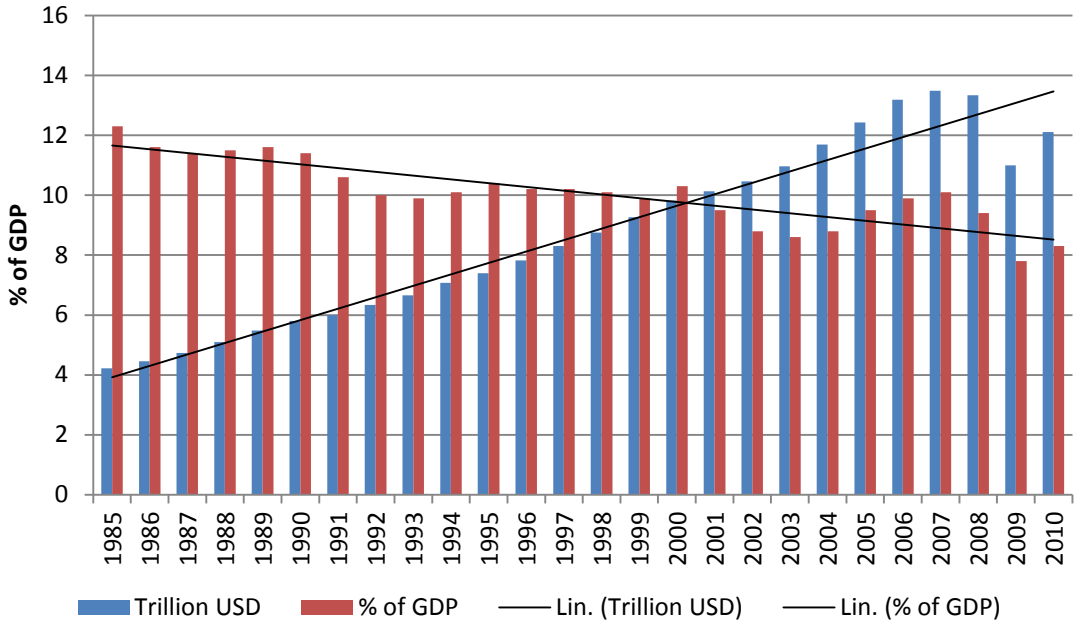


Figure 31 Logistics costs in the U.S. between 1985 and 2008 as a % of GDP and as absolute costs, tn USD (CSCMP's 19th Annual State of Logistics Report 2008, 30; Wilson 2011, 12–13)

We can conclude that although the absolute value has increased, the level of logistics costs has fallen almost steadily as a % of GDP. This indicates that the economy has grown faster than logistics costs, which is a positive development at least from a logistics point of view.

Transportation costs (incl. shipper related costs) rose by 10.5% and accounted for 5.2% of GDP. The transportation costs rose in all modes of transport, of which trucking costs accounted for approximately 78%. The second largest cost component, inventory-carrying costs, rose by 10.3% and accounted for 2.7% of GDP, as inventories were up and interest rates dipped lower. Also the level of other costs increased slightly. (Wilson 2011, 11) The development of logistics costs per main cost component as absolute costs is illustrated in Figure 32.

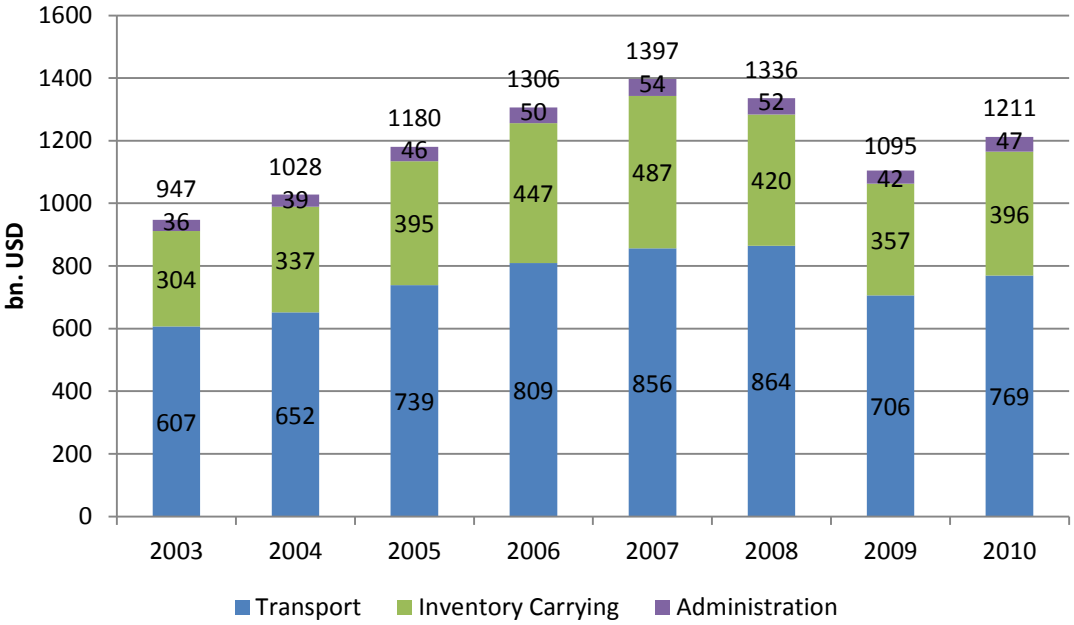


Figure 32 Development of logistics costs per cost component in the U.S. between 2005 and 2010, bn USD (data source: CSCMP's 19th Annual State of Logistics Report 2008, 30; Wilson 2009, 2; Wilson 2011, 11)

According to Figure 32, all the costs rose after 2 consecutive years of decline. The situation seems to be normalizing following the global recession that started in 2008.

3.1.2.2 State of Logistics Surveys for South Africa

The Annual State of Logistics Survey for South Africa has been published annually since 2004 by the Council for Scientific and Industrial Research (CSIR). The seventh edition was published in 2010, following the same structure employed in earlier versions. In the case of logistics costs, the studies have adopted a more formal and quantitative approach. Since the first study in 2004, all editions have consequentially employed the same modeling technique as a tool of assessing national logistics costs. The model starts from where total logistics costs are computed using product-specific data on transportation mode, transported and stored tonnage, transportation distances and costs, transit times, and opportunity cost of time during transport. (State of Logistics Survey for South Africa 2004, 4–9) This model is called the Logistics Cost Model, and employs a bottom-up approach to compute logistics costs by aggregating primary input elements (amount of commodities produced) and the costs of performing additional activities (transport, storage and handling). (State of Logistics Survey for South Africa 2007, 14–15; State of Logistics Survey for South Africa 2010, 9)

The model has undergone many improvements in recent years. Furthermore, the results have been adjusted to match revised-country specific data like GDP. (State of Logistics Survey for South Africa 2008, 6–10)

The logistics costs for South Africa in 2010 were 13.5% of GDP (ZAR 323bn). Costs decreased from 2007 and 2008, when total logistics costs were 15.9% (2007) and 14.7% (2008) of GDP.Figure 33 depicts the level of each cost component from 2003. (State of Logistics Survey for South Africa 2010, 18–19)

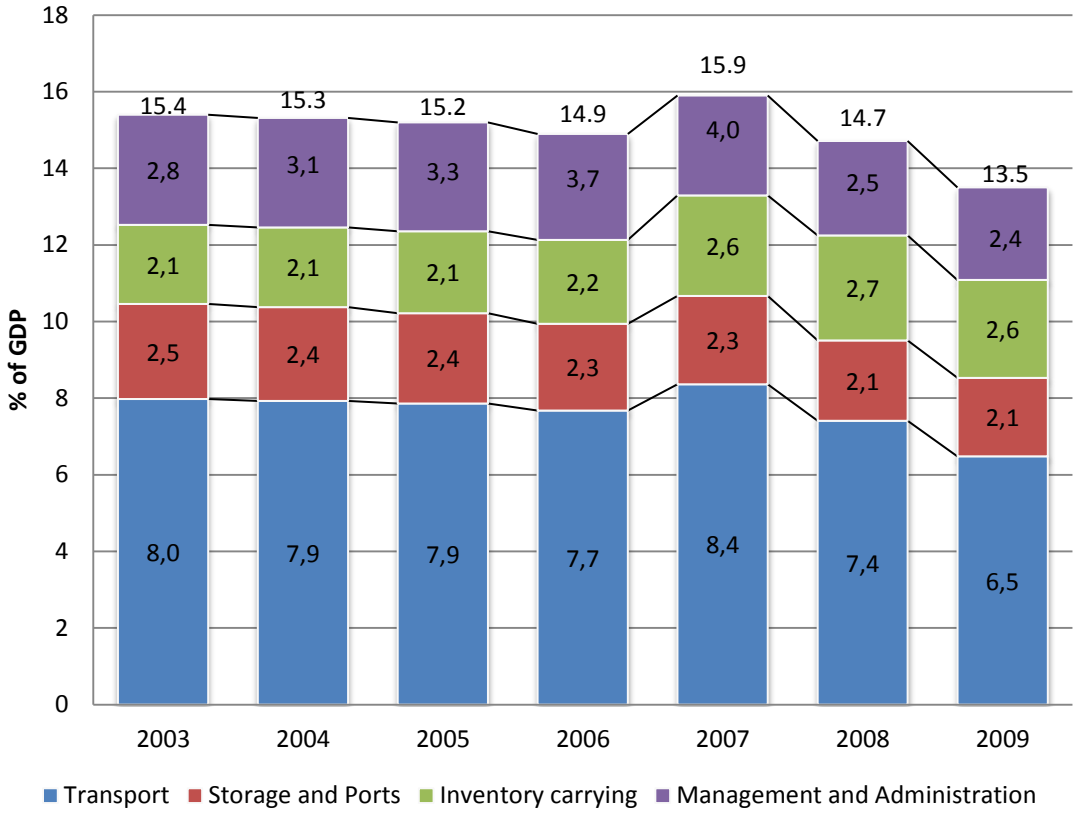


Figure 33 Total logistics costs per cost component in South Africa in 2003–2009 as a % of GDP (State of Logistics Survey for South Africa 2010, 19)

Logistics costs are divided into four categories: transportation, inventory carrying, storage & ports, and management & administration & profit. In 2009, the total logistics costs for South Africa were 13.5% of GDP, or 1.2% less than a year earlier. Transport costs accounted for 48% (ZAR 155bn) of total costs, followed by inventory carrying costs (18.9% - ZAR 61bn), management and administration (17.9% - ZAR 58bn), and storage and ports (15.2% - ZAR 49bn). (State of Logistics Survey for South Africa 2010, 9–19)

3.1.2.3 Logistics cost statistics of the China Federation of Logistics and Purchasing

The China Federation of Logistics and Purchasing (CFLP) has published the figures of China's logistics industry on a yearly basis, based on data from the China National Bureau of Statistics. The latest available figures show that in 2010 the total logistics costs increased by 16.7% to RMB 7.1tn (EUR 805bn). Still, the cost-to-GDP ratio fell by 0.3% to 17.8% of GDP. Among total logistics costs, transport costs (RMB 3.8tn) accounted for 54% of total logistics costs. The second largest cost component was storage costs, amounting to RMB 2.4tn and accounting for 33.9% of total logistics costs. The last cost component, management costs (RMB 0.9tn), accounted for 12.1% of total logistics costs. (CFLP 2010) The development of logistics costs in China is depicted in Figure 34.

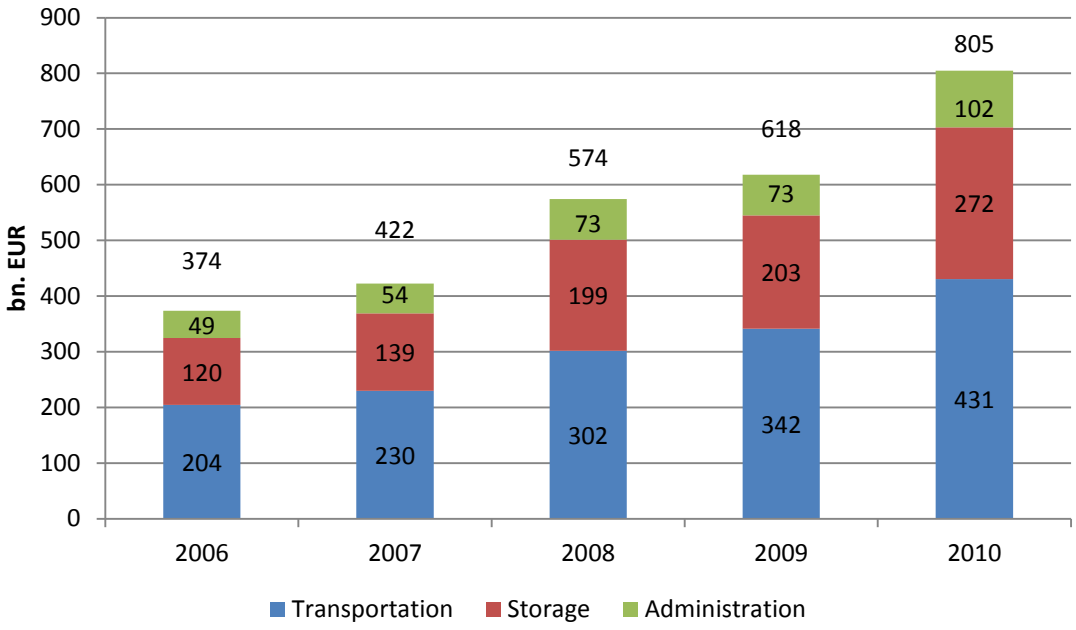


Figure 34 Logistics costs in China in 2006–2010 in bn EUR (data sources: CFLP 2011; CFLP 2010; CFLP 2009; CFLP 2008; CFLP 2006)

As depicted in Figure 34, the total logistics costs in China have more than doubled in just 5 years. A similar trend has emerged in all three cost components.

3.1.2.4 Studies of logistics markets in Switzerland

According to a logistics market study of Switzerland conducted by St. Gallen University, the volume of Swiss logistics markets is approximately 6.5% of GDP

(CHF 34.4bn). Several studies also provide comprehensive statistics of industry-specific logistics costs. For example, the study published in 2010 gives logistics costs for 43 different branches and cost-component specific results for seven main industries. The absolute value of the Swiss logistics market is shown in Figure 35. (Factsheet zur Logistikmarktstudie 2011: Volumen Logistikmarkt Schweiz; Stölzle, Hoffmann & Gebert 2009, 146–149)

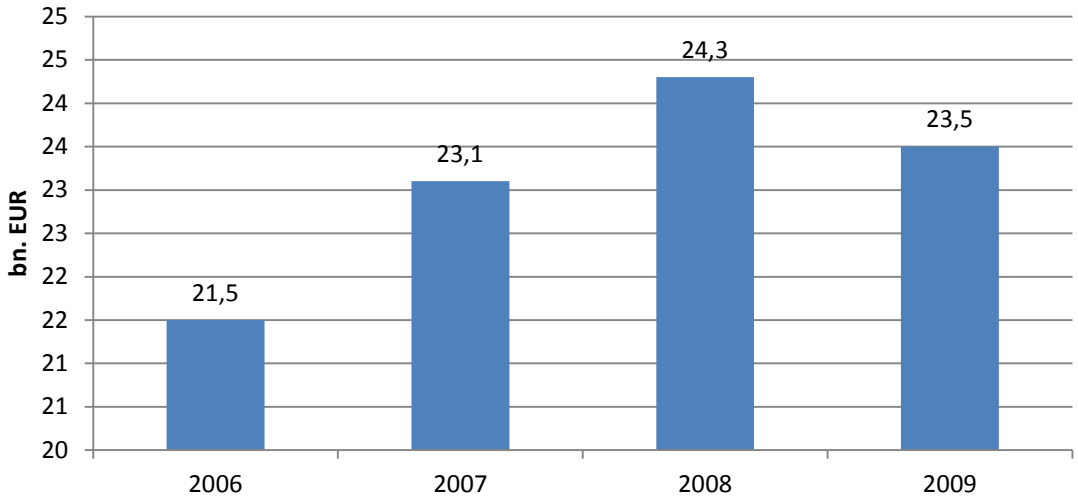


Figure 35 Volume of logistics markets in Switzerland in 2006–2009, bn EUR (Factsheet zur Logistikmarktstudie 2011: Volumen Logistikmarkt Schweiz)

Four main cost components were identified in the above study: transportation, handling, warehousing and other logistics costs. (Factsheet zur Logistikmarktstudie 2011: Volumen Logistikmarkt Schweiz) Three earlier studies combined cargo handling and warehousing under the same component. (Stölzle, Hoffmann & Gebert 2008, 145–149; Stölzle et al. 2009, 135) The share of each component in total logistics costs in the most recent studies is shown in Figure 36.

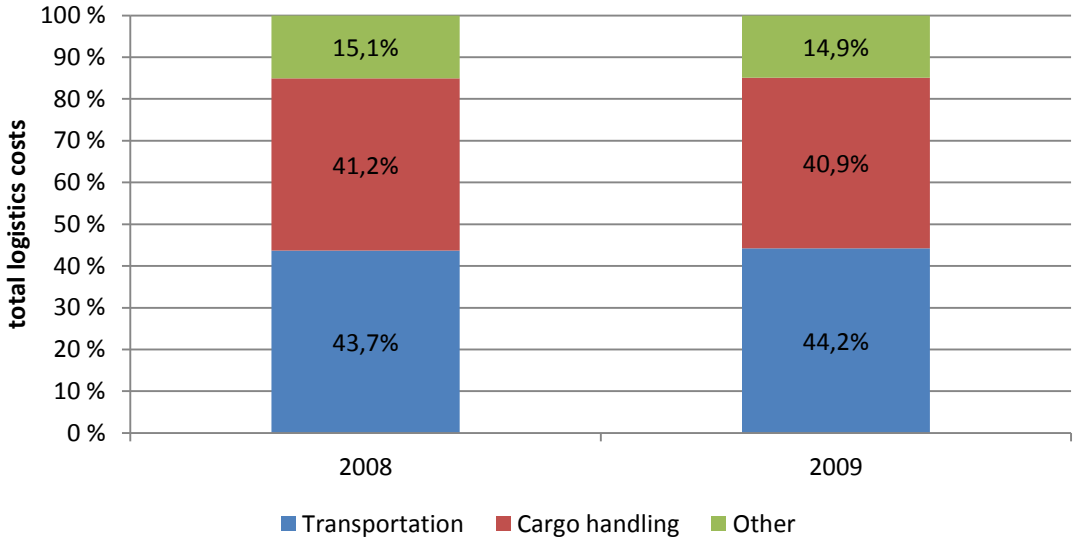


Figure 36 Share of logistics cost components of total logistics costs in Switzerland in 2008 and 2009 (data source: Stölzle et al. 2008, 87; Stölzle et. al 2010, 135)

The share of transportation costs in 2009 accounted for CHF 15.6bn (EUR 10.5bn). The corresponding figure in 2008 was CHF 15.6bn (EUR 9.8bn). Cargo handling/warehousing costs in 2009 were CHF 13.8bn (EUR 9.3bn), which was a bit less than in 2008 (CHF 14.7bn, EUR 9.7bn). The component of other logistics costs totaled CHF 5.1bn (EUR 3.4bn), which was almost the same as in 2008 (CHF 5.4bn, EUR 3.5bn). (Stölzle et. al 2008, 57; Stölzle et. al 2010, 135)

3.1.2.5 Dutch logistics study: De logistieke kracht van Nederland 2009 (Logistical Strength of the Netherlands 2009)

De logistieke kracht van Nederland 2009 was the second publication of its kind. The logistics costs in the Netherlands increased by 2.5% in 2009 and total costs were a little over EUR 46bn. The total logistics costs are divided into five groups: transportation, warehousing, inventory-carrying, administrative, and management/planning costs. (De Logistieke Kracht van Nederland 2009, 22–23)

Transportation costs accounted for the biggest share of total logistics costs, at EUR 20.5bn or 43% of total logistics costs. The second largest cost component was warehousing costs (EUR 11.5bn), followed by inventory-carrying costs (EUR 9.7bn). The total expenditures for administrative and management/planning costs were close to EUR 5bn. (De Logistieke Kracht van Nederland 2009, 23)

3.1.2.6 Logistics report Thailand

The Office of the National Economic and Social Development Board (NESDB) in Thailand has developed a model and database to publicize the country's official logistics since 2003. According to the latest report, published in 2009, the value of total logistics costs of Thailand in 2008 was equivalent to 18.6% of GDP (THB 1.7tn). This is 0.3% less than the previous year, when it was 18.9% of GDP (THB 1.6tn). The growth of total logistics costs was 5.2% in 2008. Three cost components were identified in the report: transportation, inventory-holding (including warehousing costs), and logistics administration costs. The development of costs per component is depicted in Figure 37 with the latest shares of total costs. (Logistics Report 2007 Thailand, 1; Thailand Logistics Report 2008, 5)

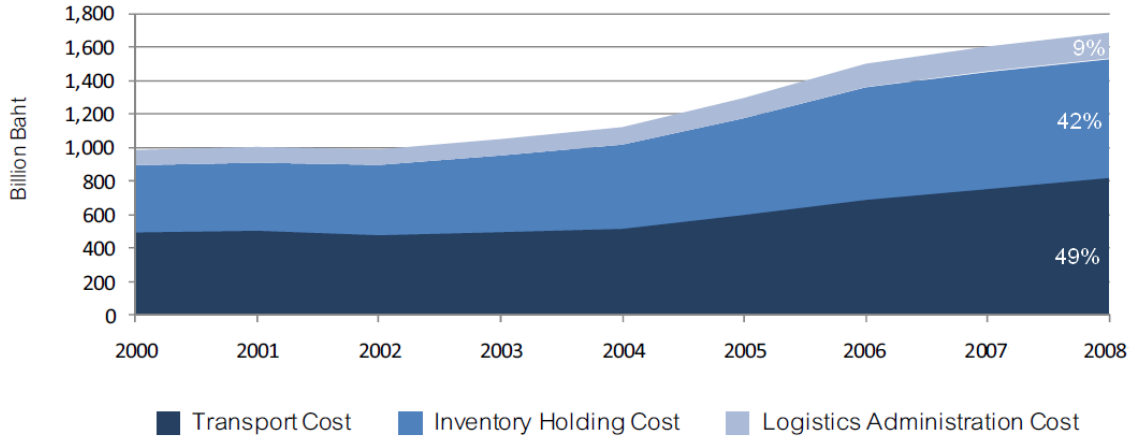


Figure 37 Thailand's logistics costs in 2000–2008 as absolute costs (Thailand Logistics Report 2008, 5)

Transportation costs, the largest cost element, made up 49% (THB 823bn / 9.1% of GDP) of total logistics costs (THB 757bn in 2007). The second largest component was inventory-holding costs with 42% (THB 705bn / 7.8% of GDP) share of total costs (THB 696bn in 2007). Logistics administration costs were valued at 9% (THB 153bn /1.7% of GDP) of total logistics costs (THB 145bn in 2007). (Thailand Logistics Report 2008, 5–7)

3.1.2.7 Estimates of macroeconomic logistics costs in the Republic of Korea

The Korea Transport Institute (KOTI) has provided some estimates of macroeconomic logistics costs in the Republic of Korea by evaluating the following logis-

tics cost factors: transportation costs, inventory-holding costs, packaging costs, stevedoring costs, information costs, and administration costs. (KOTI 2010, 89)

Transportation costs include all transport modes and stakeholders: rail (data from Korean National Railroad Administration Statistics), road (data from KOTI), air (data from the Ministry of Construction and Transportation), water, and cargo agencies (data for water and agencies obtained from the Transportation Industry Statistics Investigation Report). The second component, inventory-carrying costs, include warehousing, inventory holding, and inventory risk costs. Packaging costs, the third cost component, are calculated based on cardboard and pallet costs. Stevedoring costs cover handling and loading/unloading costs, for which data are obtained from the Transportation Industry Statistics Investigation Report. The fifth and sixth cost components, logistics information costs and administrative costs, are considered supporting activities and are derived from sales figures. (UN: Commercial Development of Regional Ports as Logistics Centres, 88–94) A more detailed description of components and data sources is provided in Table 9.

Table 9 Components and data sources of logistics costs in the Republic of Korea (KOTI 2010, 11; UN: Commercial Development of Regional Ports as Logistics Centres, 89)

Items	Class I	Class II	Class III	Sources
Transportation	Rail	Freight		Railway Statistics Annual Report
		Mini-load		
	Road	Public	Route	Transportation Industry Statistical Investigation Report
			Special	
			Zone	
			Contract	
			Other	
		Private	Operations	Own Calculation
			Tolls	Korea Highway Corporation
	Water	Inland port		Transportation Industry Statistical Investigation Report; Korea Vessel Agency Association
		Ocean	Domestic	
			Foreigner	
		Inland water		
	Air	National		Annual Report of Ministry of Construction & Transportation
		International	Domestic	
			Foreigner	
	Agency	Agency		Transportation Industry Statistical Investigation Report
Inventory Carrying	Custody	Public	Ordinary	Transportation Industry Statistical Investigation Report
			Cold storage	
			Dangerous	
			Agricultural	
			Other	
		Private		Korea Chamber of Commerce & Industry
	Inventory holding			Enterprise Management Analysis
	Breakage			Korea Chamber of Commerce & Industry
Packing	Corrugated cardboard			KCCA
	Pallet			Korea Chamber of Commerce &Industry
Handling and Lading/ Unloading	Land and Air			Transportation Industry Statistical Investigation Report
	Water			
Information				Korea Chamber of Commerce & Industry
Administration				Korea Chamber of Commerce & Industry

The latest report, published in 2010, estimates that the total logistics costs for the Republic of Korea in 2008 were KRW 128.3tn (approximately EUR 69.6bn), which accounted for 12.5% of year's GDP (KOTI 2010, 34). Figure 38 depicts the development of logistics costs for Korea as a % of GDP with the respective cost structure.

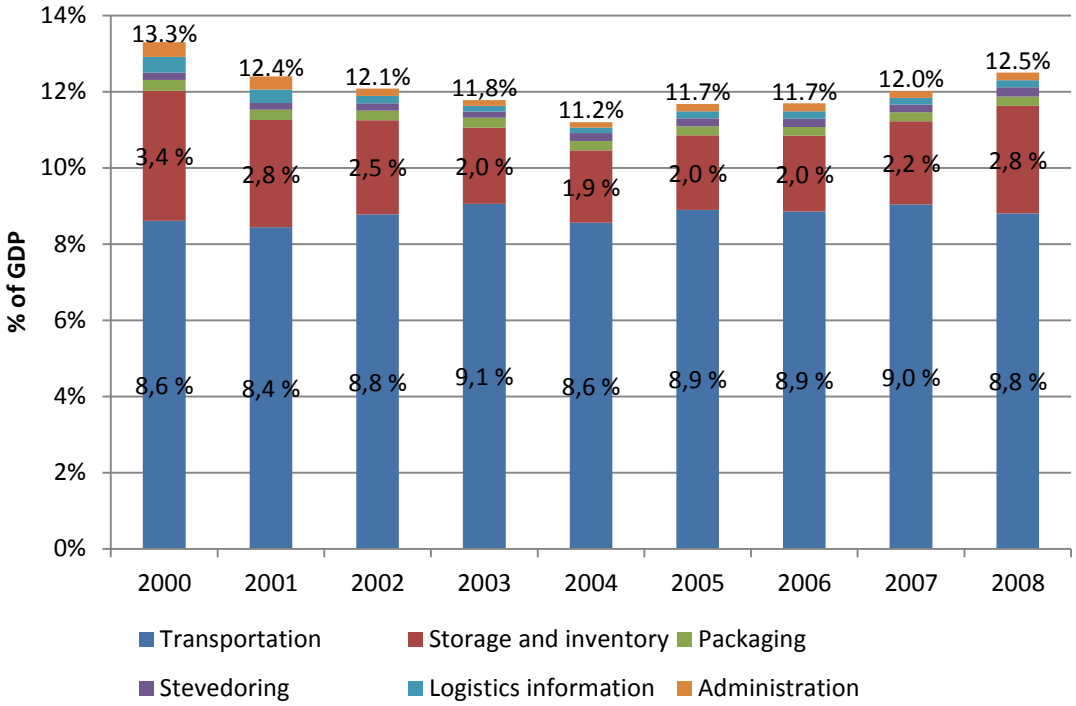


Figure 38 Logistics costs in the Republic of Korea as a % of GDP (data source: KOTI 2010, 34–35)

Compared to growth of GDP, the growth of logistics costs has been moderate in recent years. In addition, all cost components seem to have more or less stabilized. Transportation costs, together with storage and inventory costs, form the major part of total costs, as other components are around 0.2–0.5% of GDP.

3.1.2.8 Logistics in China 2008

The global consultancy firm KPMG has published their insight of China's logistics markets. According this outlook, also published in 2008, the expenditures of logistics services, transport, storage, and management functions reached EUR 370bn (RMB 3.8tn) in 2006. This figure was 13.5% higher than the previous year's and was equivalent to 18% of GDP. (KPMG: Logistics in China 2008, 1–2)

KPMG's study broke down logistics costs into three categories: transportation, storage and management. Transportation accounts for the largest share of total logistics costs (EUR 204bn / RMB 2.1tn), followed by storage costs (EUR 117bn / RMB 1.2tn) and management costs (EUR 29bn / RMB 500bn). Further results are shown in Figure 39.

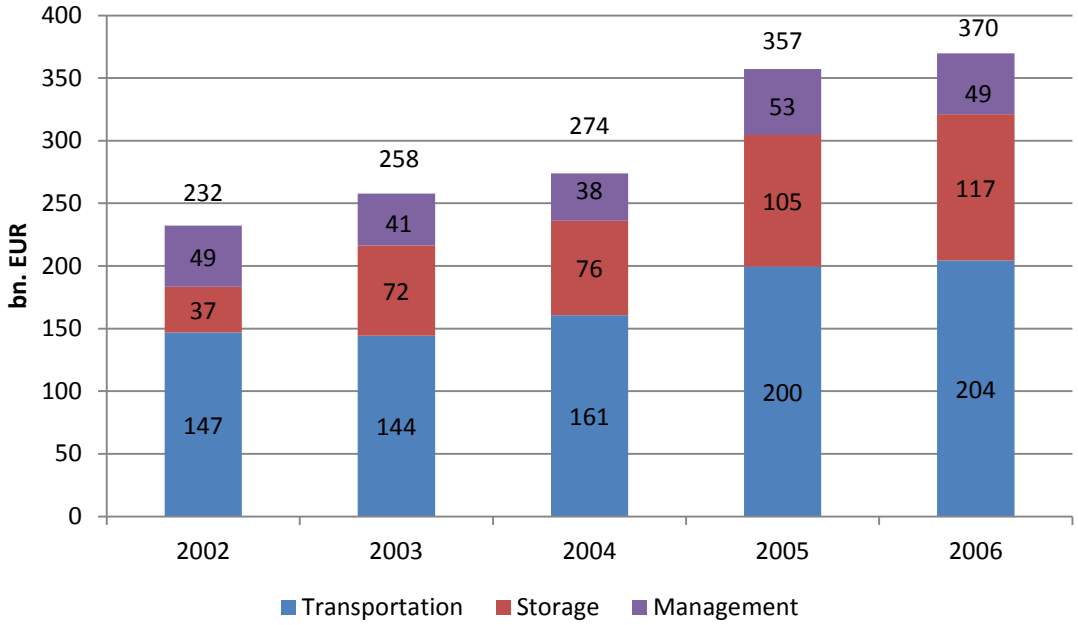


Figure 39 Development of logistics costs in China in 2002–2006, bn EUR (data source: KPMG: Logistics in China 2008, 2)

Despite the clear upward trend in cost development, compared to GDP the level of logistics costs has remained relatively stable since 2001. (KPMG: Logistics in China 2008, 2) The figure is still relatively high.

3.1.2.9 La Logistique du Commerce et la Compétitivité du Maroc 2006 (Logistics and Trade Competitiveness in Morocco)

La Logistique du Commerce et la Compétitivité du Maroc 2006 was initiated jointly by The World Bank Group and the Ministry of Transportation in Morocco. The study is combined from previous research results, national statistics, national accounts and hearings of several stakeholders in different industries, governmental bodies and export- and import organizations. An analysis was conducted among industries considered important to the Moroccan economy, including the automotive, electronics, textile, and fruit/grocery industries. (La Logistique du Commerce et la Compétitivité du Maroc 2006, 5–6; 111)

The total logistics costs in Morocco were approximately 20% of GDP. This is relatively high compared to other developing economies like Mexico or Brazil, where logistics costs were around 15–17% of GDP. The components of logistics costs in this study are categorized using the fourfold table (see also 2.3.1.), which divides costs between direct and indirect costs, as well as production and overhead costs (Figure 40). According to the study, indirect logistics costs formed a half of all logistics costs, which corresponds to 10% of GDP. For

example, the transportation costs for the textile industry in Marocco are more than twice the figure in the U.S., China or Thailand. (La Logistique du Commerce et la Compétitivité du Maroc 2006, 5; 19–20)

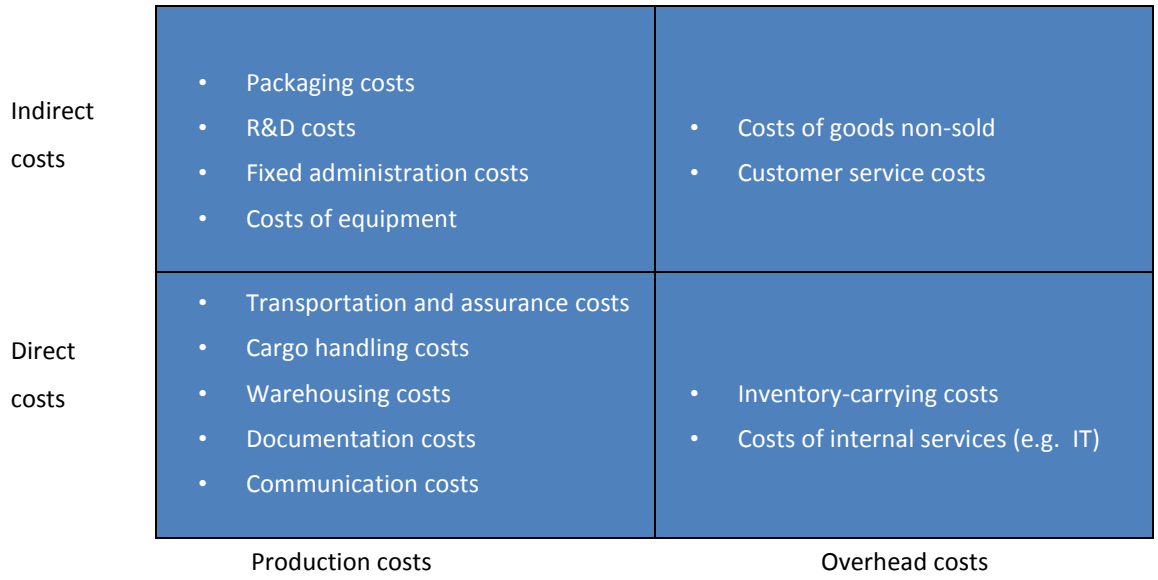


Figure 40 Components of logistics costs in Morocco in 2006 (La Logistique du Commerce et la Compétitivité du Maroc 2006, 112)

The largest individual logistics cost component is transportation and assurance costs, which total 60% of all direct logistics costs. The remaining 40% of direct logistics costs is split among other cost groups (non-transport costs). (La Logistique du Commerce et la Compétitivité du Maroc 2006, 112)

3.1.2.10 Vinnova - Svensk Makrologistik 1997–2005 (Macro Level Logistics in Sweden)

The aim of the Svensk Makrologistik study was to create a tool for measuring macro level logistics in Sweden based on national statistics. The study presents the level and structure of logistics costs in Sweden between 1997 and 2005. (Svensk Makrologistik 2008, 7–9)

The components of logistics costs in the study are grouped into four groups. Direct transportation costs are all the costs resulting from the transportation of goods. Warehousing costs are all the costs related to holding an inventory. These costs can be further broken down into costs of actual warehousing and inventory-carrying costs. Administration costs are defined as costs related to planning, implementation and tracking of transportation or warehousing. The results are

presented for small (0–49 employees) and large (over 50 employees) enterprises, as well as by industry. (Svensk Makrologistik 2008, 17; 19–21)

Direct transportation costs are combined by summing the costs of internally produced transportation activities with bought (external) activities. Inventory-carrying costs are combined by calculating the interest of 25% for inventory value and adding the warehousing costs, which are considered as the costs of warehousing premises and other costs related to these premises. Administrative costs are measured by calculating personnel costs and other overhead costs related to logistics activities. (Svensk Makrologistik 2008, 21–23)

The absolute costs of logistics in 2005 were SEK 233.3bn (EUR 25.7bn), of which the inventory-carrying costs accounted for the major share. Transportation costs increased mostly between 1997 and 2005, reaching SEK 85.5bn in 2005. Figure 41 illustrates the structure of logistics costs in Sweden between 1997 and 2005. The levels are presented as a % of total logistics costs.

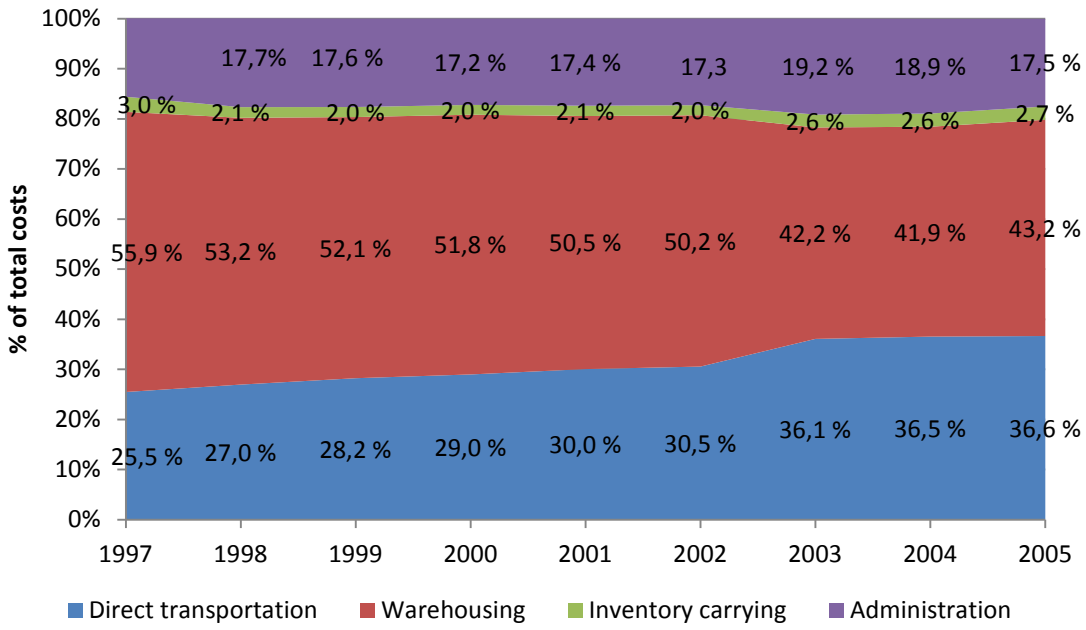


Figure 41 Logistics costs in Sweden in 1997–2005 as a % of total logistics costs (data source: Svensk Makrologistik 2008, 24)

Figure 41 indicates that, proportionally, transportation costs have increased the most. Correspondingly, warehousing costs have decreased the most, as inventory-carrying and administration costs have remained stable.

3.1.3 Summary of statistics-based studies

Figure 42 and Table 10 illustrate the results of statistics- based studies. The results from the latest available year are compiled in Figure 42. The geographical coverage of the relevant study and the data year are indicated after the name of the study.

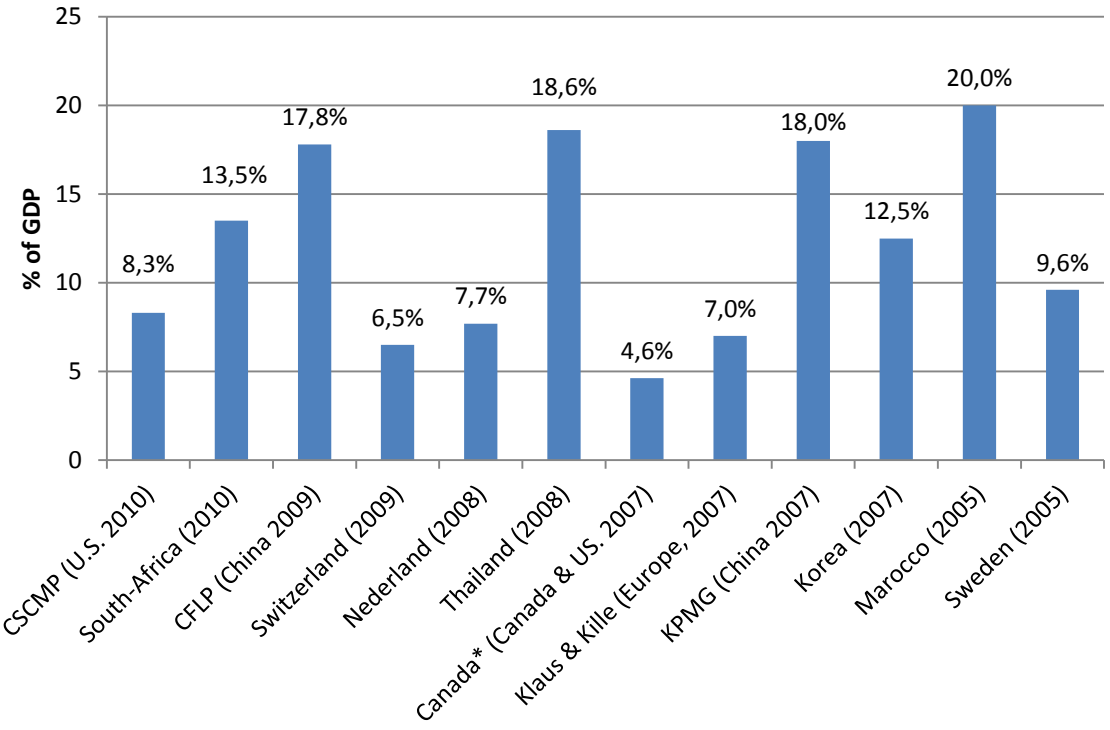


Figure 42 Level of logistics costs in statistics-based studies as a % of GDP (*% of sales)

As illustrated in Figure 42, the level of logistics costs varies quite a lot between studies conducted in different geographical areas. There also seems to be, as expected, a gap between developed economies and developing countries. Table 10 specifies the logistics cost components used in each statistics-based study, and presents some other aspects concerning logistics costs that emerged during the literature review. The results are presented in order of the year of publication.

Table 10 Summary of statistics-based logistics studies

Study (year of publication)	S- Africa (2011)	CSCMP (2011)	CFLP (2011)	Switzerland (2011)	Korea (2010)	Netherlands (2009)	Thailand (2009)	Canada (2008)	KPMG (2008)	Klaus (2010)	Morocco (2006)	Vinnova (2005)	COUNT
Scope (Multi/Single country)	S	S	S	S	S	S	S	M	S	M	S	S	
Cost components													
Transportation	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	11
Administration	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	10
Inventory-carrying	✓	✓			✓	✓	✓	✓		✓	✓	✓	9
Warehousing	✓			✓		✓			✓	✓	✓	✓	7
Cargo handling				✓	✓						✓		3
Transport pack.			✓		✓						✓		3
Communication											✓		1
Customer service											✓		1
Documentation											✓		1
Equipment											✓		1
Information					✓								1
Insurance											✓		1
… See appendix 8.30													
Industry classification													
Manufacturing								6.13					
Trade								3.13					
Total costs	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
Time series (publications)													
–1990		✓											
1991–1995		✓											
1996–2000		✓											
2001–2005	✓	✓											
2006	✓	✓	✓					✓			✓		
2007	✓	✓	✓			✓	✓			✓			
2008	✓	✓	✓				✓	✓	✓			✓	
2009	✓	✓	✓	✓		✓	✓						
2010	✓	✓	✓		✓								
2011	✓	✓	✓	✓						✓			
Scale of measurement and logistics costs in the most recent study													
% of sales/turnover				3.6				✓					
% of GDP	13.5	8.3	17.8	6.5	12.5		18.6		18		20	9.08	
Absolute costs (bn EUR)	36.5	828	805	28,7	69.9	46	42.3		370	930		25.7	
Recent trend	○	○	○	○	○	○	○		⇄			○	
Expectations in future cost level.				⇄			○			○			
Area covered	S-A	US	CHI	SWI	KOR	NET	THA	CAN/US	CHI	EU	MOR	SWE	

Table 10 cross-tabulates the findings of the statistics-based study review. The table indicates whether the coverage is sole country (S) or multi-country (M), and gives the employed cost component breakdown and the year of publication of the study. Furthermore, the level of logistics costs (also indicated in respect of industry if possible), and scale of measurement (% of turnover or sales, or % of GDP) are given. Due to the limited space available the comprehensive list of cost components is presented in Appedix 8.30.

3.2 Surveys

This subchapter discusses the results of a review of identified extant logistics cost surveys. Studies are further divided into multi-country and single country studies.

3.2.1 Multi-country studies

3.2.1.1 The Davis Logistics Cost and Service Database

The Davis Database, maintained by Establish management consultants specialized in the supply/demand chain, is an ongoing survey that allows companies to benchmark their logistics costs and service level. The database is based on a one-page website survey and is an internationally recognized source of cost information. However, it should be noted that although the coverage of the survey is theoretically global, the respondents are usually located in developed countries, mainly the U.S. The database was established in 1975 and its results are disseminated yearly at the CSCMP. (Davis Logistics Cost and Service Database; Davis Database Presentation 2009, 2; Davis Database Presentation 2010, 2)

The Davis Database reports costs as a % of sales employing a five-level cost breakdown. Total logistics costs of an average company in 2010 were 8.28% of sales (8.48% in 2009 and 9.28% in 2008). Five cost components are reported in the study; these are transportation, warehousing, inventory carrying, customer service/order entry and administration. Figure 43 presents the costs of an average company per cost component in three of the most recent studies. (Davis Database Presentation 2009, 6; Davis Database Presentation 2010, 9)

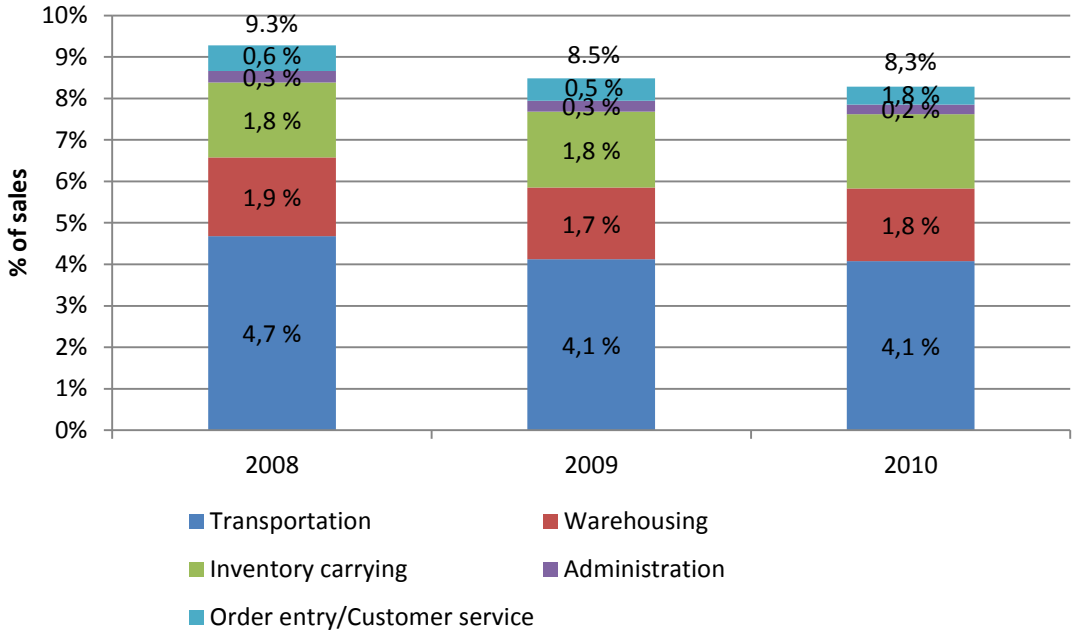


Figure 43 Logistics costs of an average company as a % of sales in 2008–2010 according to the Davis Database (Davis Database Presentation 2008, 16; 2009, 13; 2010, 9)

According to the Davis Database, transportation costs have formed almost half of the total logistics costs in recent years. The second biggest component has been inventory-carrying costs (22% in 2010), followed by warehousing costs (21% in 2010). Customer service/order entry and administration costs are relatively small compared to the top three groups. Results are also reported in respect of company size classification. Generally it can be said that the smaller the company, the greater are the logistics expenditures (Figure 44). (Davis Database Presentation 2008, 16–20; 2009, 13–15; 2010, 11–13)

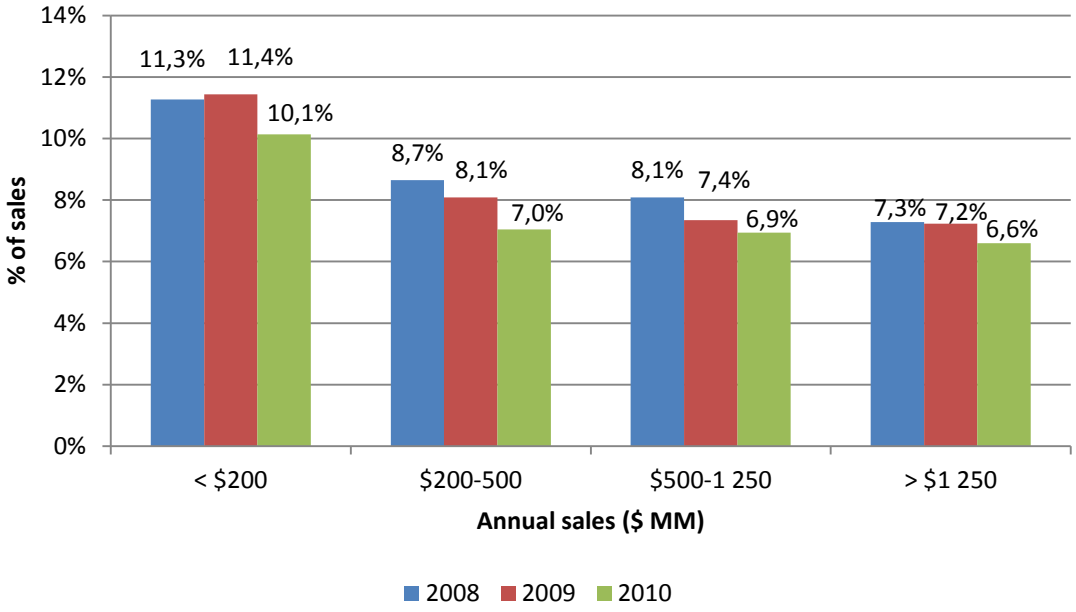


Figure 44 Global logistics costs in the Davis Database in respect of company size as a % of sales in 2008–2010 (Davis Database Presentation 2008, 20; Davis Database Presentation 2009, 15; Davis Database Presentation 2010, 13)

The Davis Database also provides a broad historical outlook of logistics costs from 1962. As seen in Figure 45, the first drop in costs was in the early 1970s, when the level dropped as low as 5% of sales. At the end of the 1970s, the costs had risen back to the 9% line. Since the start of the 1980s the trend has been slightly downward, except for few sharp increases followed by almost immediate corrections. The most recent increase in costs began in 2007.

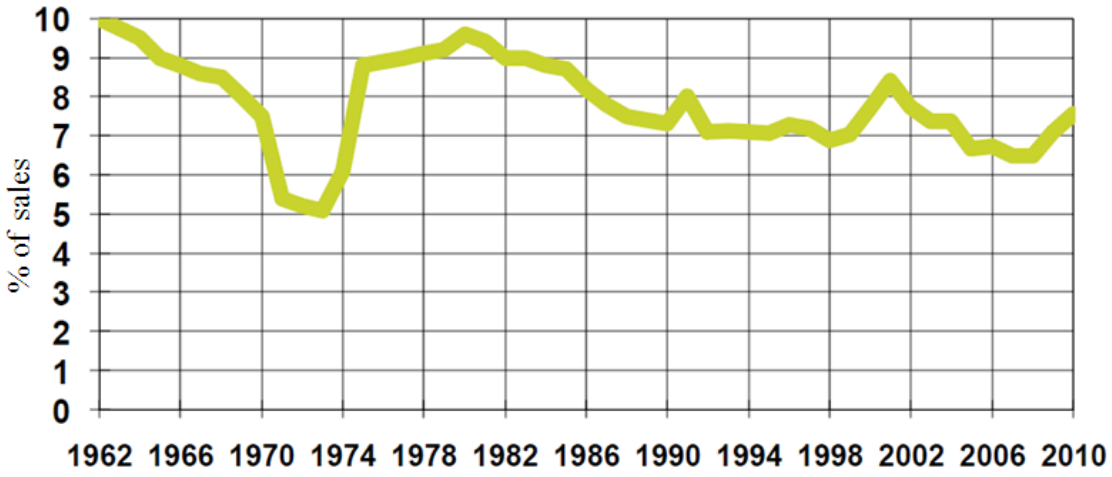


Figure 45 Historical development of global logistics costs from 1962 as a % of sales (Davis Database Presentation: Logistics Cost and Service 2010, 20)

The method of collecting data by open web-based questionnaire may at first sight seem unreliable. However, the form is well structured and especially logistics cost components are defined comprehensively. Transportation costs are requested for primary- and secondary transportation, respectively. Inventory-carrying costs are calculated by multiplying the average inventory of the last fiscal year by 0.18 (see also Appendix 4). (Davis Database Instructions)

3.2.1.2 GMA logistics surveys

The latest logistics surveys (2008 and 2010) conducted by the Grocery Manufacturers Association (GMA) collected the opinions of logistics executives in companies within the GMA membership. The number of respondents was 21 in 2010 and 45 in 2008. The average of total logistics costs declined from 6.9% of sales in 2008 to 6.75% in 2010. The average logistics costs in 2005 were 6.9 % of sales. The cost breakdown adapted in studies has been slightly different in 2005/2008 and 2010. The custom/special packaging component used in 2005 and 2008 was replaced in 2010 by the component other logistics costs (Figure 46). (The GMA Logistics Study 2008, 5–10; The GMA 2010 Logistics Benchmark Report, 9–10)

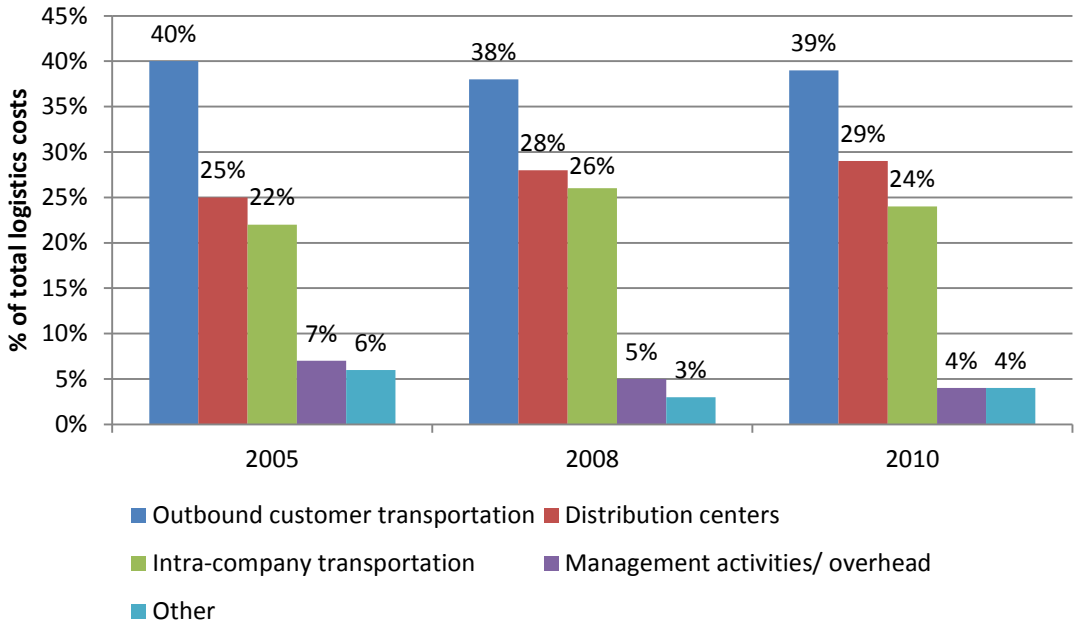


Figure 46 Level of logistics cost components in GMA surveys as a % of total logistics costs (The GMA Logistics Study 2008, 10; The GMA 2010 Logistics Benchmark Report, 10)

The largest individual cost component in three consecutive studies has been outbound customer transportation costs, which together with intra-company transportation accounted for 68% of total logistics costs in 2010. The second largest category was distribution centers with a 29% share of total logistics costs (28% in 2008 and 25% in 2005). The share of other cost groups remained at 8% in the two latest studies. (The GMA Logistics Study 2008, 11; The GMA 2010 Logistics Benchmark Report, 10)

3.2.1.3 Surveys of the European Logistics Association

The European Logistics Association (ELA) is a coalition of 30 national organizations covering most countries in Western and Central Europe. (ELA homepage, about us) Since 1982, ELA has published various surveys, some of them relating to logistics costs. According to the study *Innovation Excellence in Logistics – Value Creation by Innovation*, published in 2007, logistics service providers (LSPs) could reduce their logistics costs by 7% to 14 % with certain actions (Innovation Excellence in Logistics – Value Creation by Innovation 2007, 9; Supply-Chain-Excellence in der globalen Wirtschaftskrise; 6). From the viewpoint of logistics costs, the most informative studies are *Supply-Chain-Excellence in der globalen Wirtschaftskrise 2009* (author translation: Supply Chain Excellence in Global Economic Crises) and *Excellence in Logistics 2004 – Differentiation for Performance*. The 2009 study allocated logistics costs components to five categories: administration, inventory, warehousing, transportation and transportation packaging. Logistics costs have decreased significantly from 12.1% of sales (1987) to 7.3% (2008) and many individual cost components have decreased by almost 50%. The falling trend seems to be stabilizing, and in recent years the level of some components has even started to rise (Figure 47).

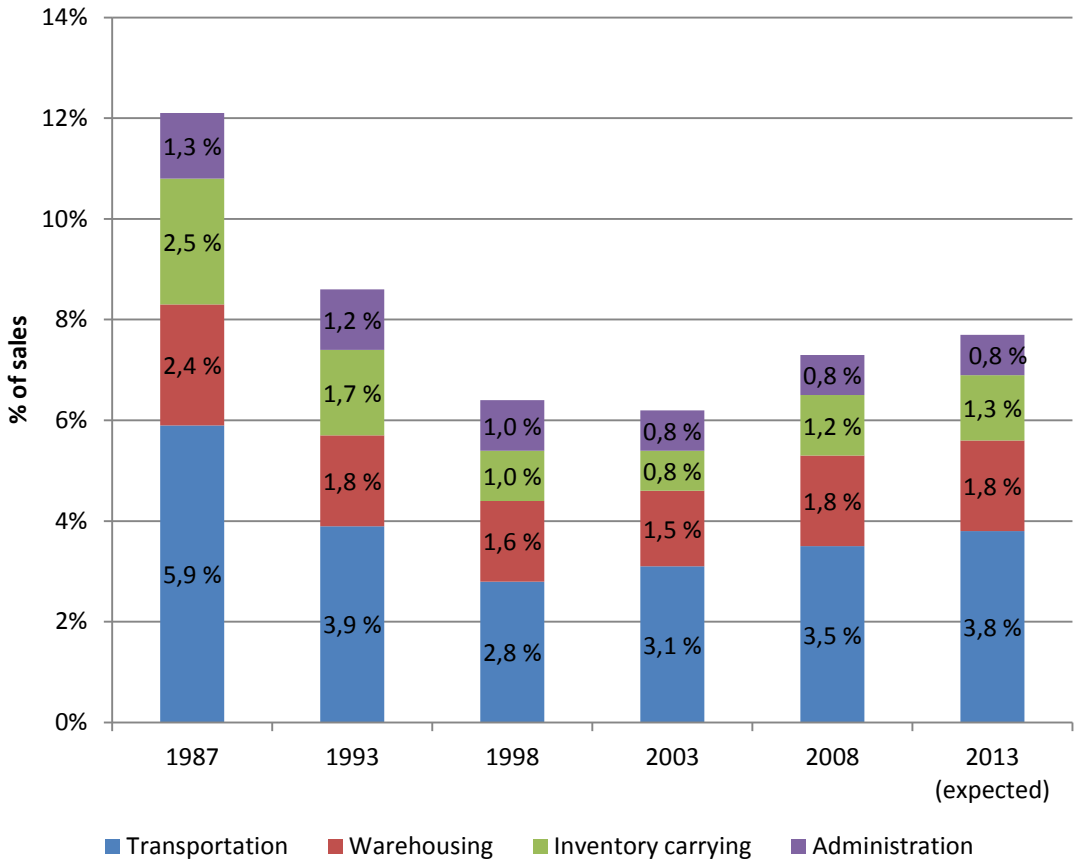


Figure 47 Development of logistics costs in Europe as a % of sales (Supply-Chain-Excellence in der globalen Wirtschaftskrise 2009)

Transportation costs represented the largest cost component and totaled 3.8% of sales in 2008. The trend was downward between 1987 and 2003, mainly due to liberalization and the removal of tariffs. Transport costs hit an all-time low in 2003, but since then the rise in fuel prices and implementation of road tolls have increased costs. Also longer transportation distances resulting from globalization and the rise in sea freight prices are factors increasing transportation costs. (Differentiation for Performance Excellence in Logistics 2004, 11–21; Supply-Chain-Excellence in der globalen Wirtschaftskrise 2009, 13–14)

Inventory-carrying and warehousing costs have halved since 1987 (from 2.5% to 1.3%). During the last couple of years, these cost components have increased relatively a lot, but at the same time the level of logistics administration costs has remained unchanged. In future, most of the costs groups are expected to remain stable, except for transportation costs, which are predicted to reach 3.8% of sales in 2013. (Supply-Chain-Excellence in der globalen Wirtschaftskrise 2009, 13–14)

3.2.1.4 Trends and Strategies in Logistics

As mentioned in Chapter 2.2.1.2, one of the rare textbooks that also provide empirical logistics cost results based on their own survey is *Trends and Strategies in Logistics* by Straube and Pfohl (2008). For analysis of logistics costs, the data for the study were collected from 897 German-based and 155 EU-based companies. The authors identify six cost components: administration, value-added services, packaging, transport, inventory carrying, and warehouse costs. (Straube & Pfohl 2008, 46–49)

According to the authors, the logistics costs rose by 0.5% (from 6.5% to 7.0%) between 2005 and 2008 in the industrial sector (blue line). The opposite happened in the trading sector (red line); logistics costs fell from 17% to 15.9% over the same period (Figure 48). (Straube & Pfohl 2008, 46–49)

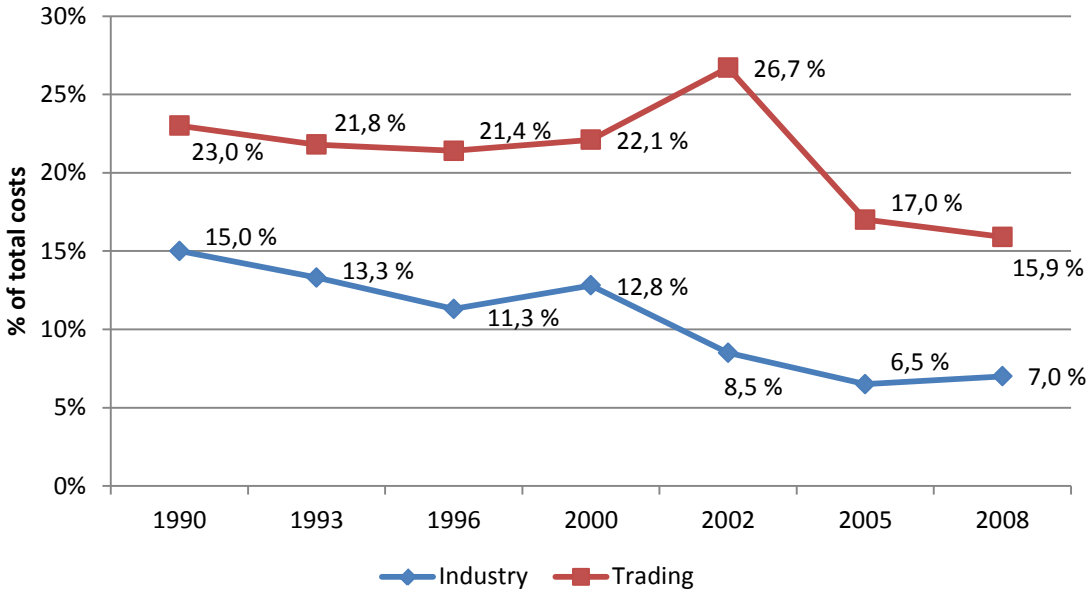


Figure 48 Development of logistics costs in as a % of total costs in 1990–2008 (Straube & Pfohl 2008, 47)

Although the costs are at different levels in manufacturing and trading, the decreasing trend in recent years is clearly identifiable. According to the study, the costs have fallen by almost 50% from 1990 to 2008. It is also interesting that the development of costs seems to follow a similar pattern, but logistics costs as a % of total costs of the company have remained higher for trading companies.

3.2.1.5 State of Logistics in the Baltic Sea Region

The State of Logistics in the Baltic Sea Region study was part of the LogOn Baltic project, which was funded by the European Regional Development Fund. The data for the study were collected from three industries: manufacturers, trading firms and logistics service providers, from eight countries in the Baltic Sea Region (BSR). The total number of respondents in this survey-based study, published in 2007, was 1 234, which represented the largest available database in the region. (Ojala et al. 2007, 17–21) Logistics costs were assessed for manufacturing and trading companies in accordance with five cost components: transportation costs (incl. cargo handling and packaging), warehousing costs, inventory-carrying costs (incl. capital tied in inventory), logistics administration costs, and all other logistics costs (Figure 22). (Ojala et al. 2007, 35–36)

The accumulated logistics costs, covering manufacturing and trading companies in all areas, varied from 16% (micro companies) to 11% (large companies) of turnover. Between these two extremes, the logistics costs of small companies were roughly 14% of turnover, and medium-sized companies achieved slightly over 13% (Figure 49). (Ojala et al. 2007, 37)

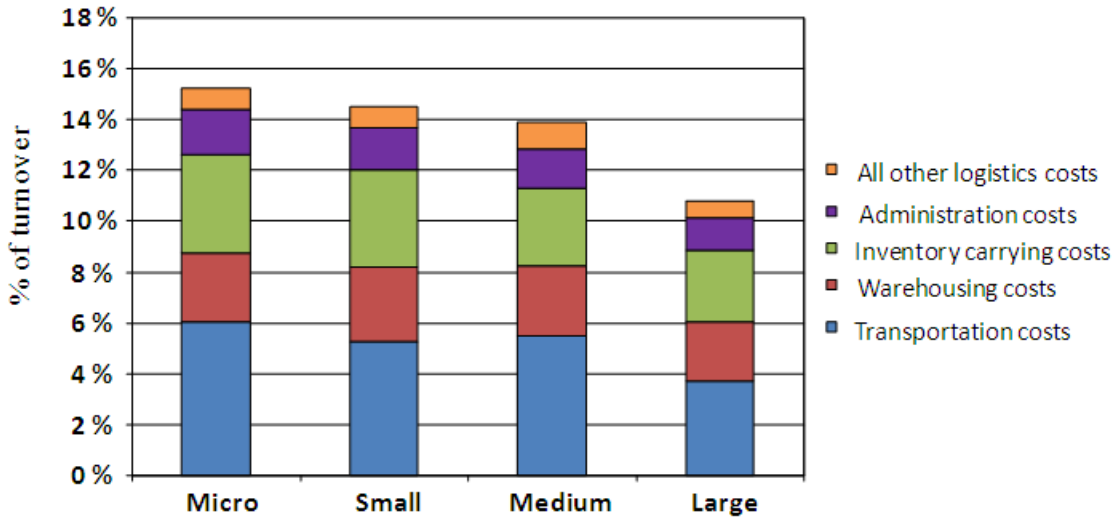


Figure 49 Logistics costs in the BSR as a % of turnover in 2007 (Ojala et al. 2007, 38)

The study recognized the negative correlation between the level of logistics costs and company size. Transportation costs were the largest individual cost component, followed by inventory-carrying and warehousing costs. Other logistics costs represent a relatively small portion of total costs in all company sizes. The regional differences in cost components are illustrated in Figure 50.

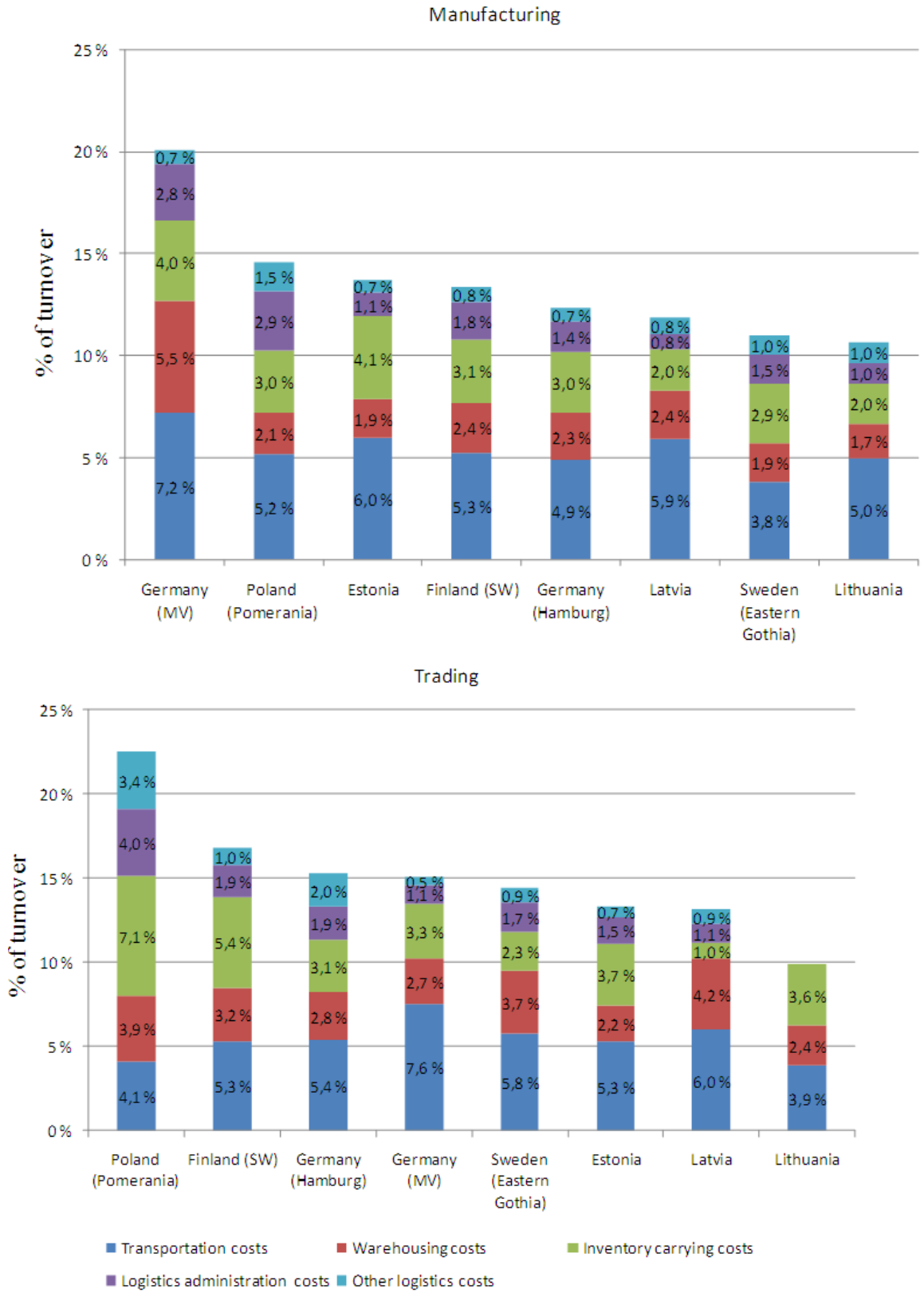


Figure 50 Regional logistics costs in the BSR for trading and manufacturing industries in 2007 as a % of turnover (SW – South West, MV – Mecklenburg-Vorpommer) (Ojala et al. 2007, 40–43)

Transportation, inventory-carrying and warehousing costs retained their places as the largest cost groups across the region. The level of logistics costs in trading varied from 23% to 10% and in manufacturing from 20% to 8%. (Ojala et al. 2007, 40–43)

3.2.2 Single-country studies

3.2.2.1 SCI Verkehr Logistikbarometer, Germany

SCI Verkehr, an independent consultancy company focused on traffic economy and traffic engineering, publishes a monthly logistics barometer that analyses logistics indicators selected by 200 managers in the transport and logistics industries. The first barometer was published in June 2003. (SCI Verkehr Logistikbarometer November 2009, 5; SCI Verkehr website) Even though the barometer does not directly address the elements of logistics costs or disclose their value, it indicates the current trend in cost development (Figure 59).

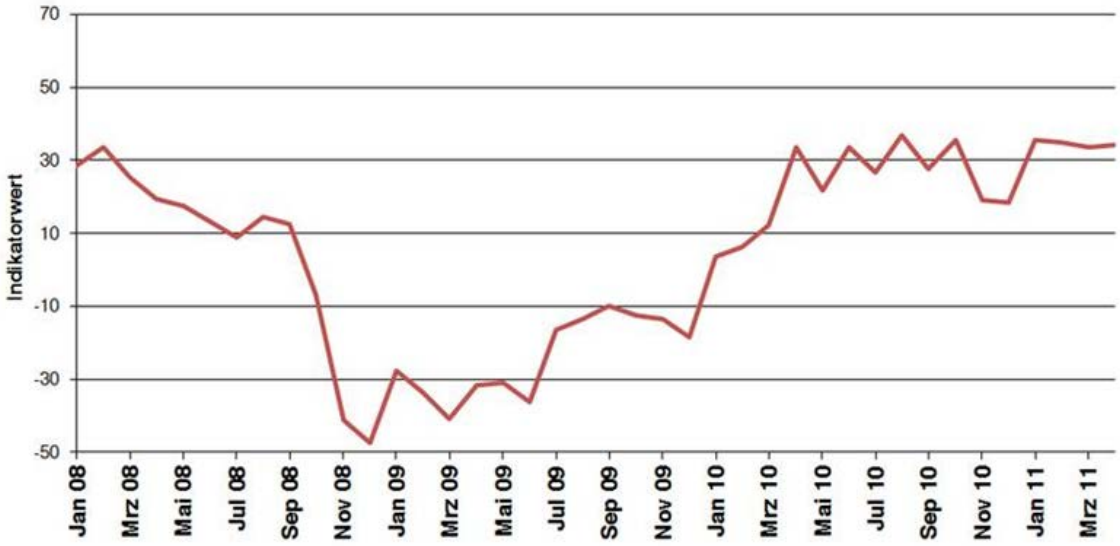


Figure 51 SCI Logistikbarometer (SCI Verkehr Logistikbarometer July 2011, 2)

According to the latest available barometer, published in April 2011, logistics costs stabilized in 2011. However, two of three respondents believed that the costs would rise in the future. (SCI Verkehr Logistikbarometer July 2011, 2)

3.2.2.2 Finland State of Logistics surveys

The Finland State of Logistics 2012 survey continues the series of Finnish logistics surveys published in 1993, 1997, 2001, 2006, 2009, and 2010. A total of 2,732 respondents answered the 2012 on-line questionnaire. The distribution of respondents based on industry was: manufacturing and construction 32%, trading 28%, LSPs 25%, consultancy 5%, and teaching 10%. The respondent enterprises were further classified into four groups based on enterprise size (micro, small, medium, and large). (Solakivi Ojala, Lorentz, Laari, Töyli 2012, 3) Based on the number of respondents, this is the most comprehensive database globally.

The logistics cost components are comprised based on the cost items linked with companies' physical flows of goods, including the costs of storage and capital tied in inventory. To clarify the concept of logistics costs, the authors have used the fourfold table to systemize the classifications of logistics costs (see also 2.3.1). Based on this, five logistics cost groups were formed: 1) transportation, 2) warehousing, 3) inventory carrying, 4) logistics administration, and 5) other logistics costs. In earlier editions transport packaging was considered as its own component, but in the 2012 survey it was combined with transportation costs. (Solakivi et al. 2010, 74; Solakivi et al. 2012, 3) Based on the review of identified extant research, this is a common cost breakdown in several other studies.

Compared to previous reports from 2006, 2009, and 2010, the level of logistics costs decreased. (Solakivi et al. 2010, 74; Solakivi et al. 2012, 3) The results of Finland State of Logistics surveys and of further analysis are described in chapter 7.

3.2.2.3 Survey of the Institute of Transport Economics (TÖI), Norway

The Institute of Transport Economics of Norway (TÖI) conducted a survey of logistics costs in the Norwegian manufacturing and trade sectors during the fall of 2008. The number of valid answers to logistics cost-related questions in this study was 525. The response rate in this e-mail invitation-based survey was 6.8%. (Hovi & Hansen 2010, i; Hansen & Hovi 2010, 2)

The study reports that logistics costs on average constitute 14.2% of the turnover of Norwegian companies (16.7% for wholesalers and 13.7% for manufacturers). This corresponds to 14.7% of Norwegian mainland GDP in 2007. The seven-component cost breakdown employed in the study is presented in Figure 52 with results per industry.

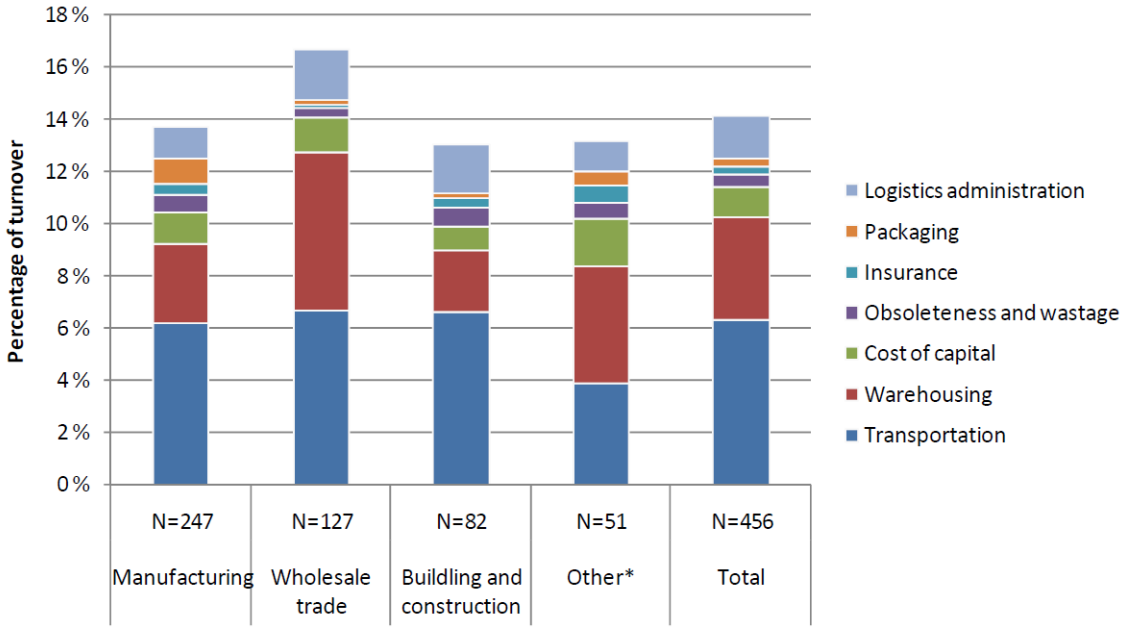


Figure 52 Logistics costs in Norway in 2007 as a % of turnover for different industries (Hovi & Hansen 2010, iii)

As depicted in Figure 52, wholesale trade industries have higher logistics costs than other industries. Transportation and warehousing costs are the two largest individual cost components for all industries.

3.2.2.4 Norsk Logistikkbarometer (Norwegian Logistics Barometer)

Norsk Logistikkbarometer is a survey-based study, conducted for the first time in 2003. The total logistics costs in 2003 were EUR 155m (NOK 162m), equivalent to 14.5% of turnover of respondents. (Hansen & Hovi 2008, 16; Norsk Logistikkbarometer results 2003)

In 2005 logistics costs increased to 20.7% of turnover, but 2 years later (2007) the average fell back to 10–15 % of turnover. (Hansen & Hovi 2008, 16; Norsk Logistikkbarometer results 2007) The study has reported the results in different ways depending on the year. The latest report categorizes the costs into eight components, which are shown in Figure 53 with the average given as a % of total company logistics costs.

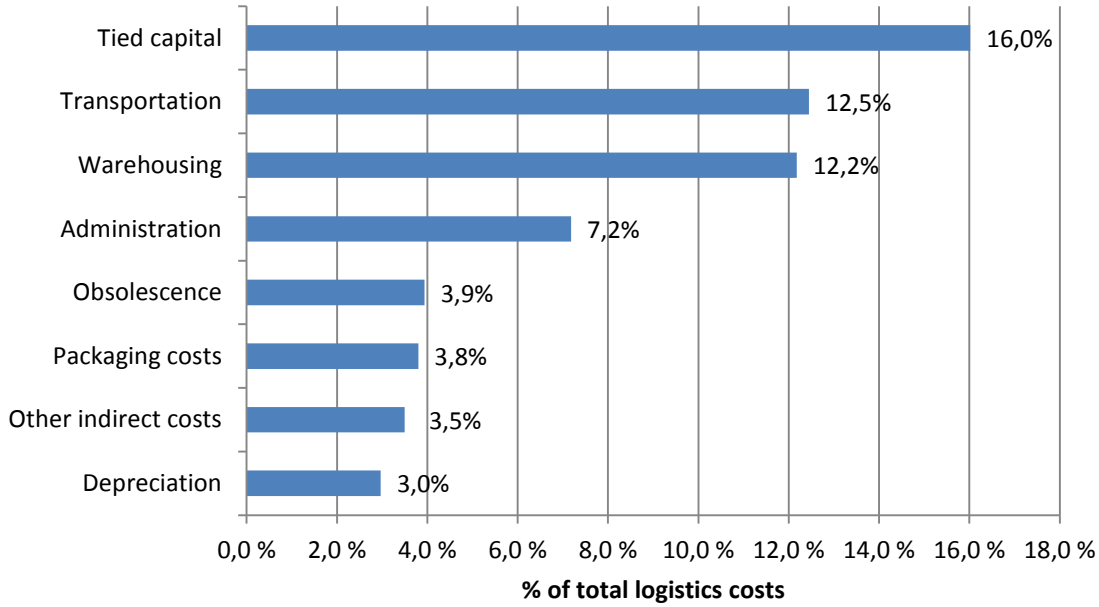


Figure 53 Level of logistics costs per cost component in Norway in 2009 as a % of total logistics costs (Norsk Logistikkbarometer 2009 results)

Tied capital, which is the largest cost component, is calculated as an average percentage of all purchases. The second largest component, transportation costs, consists of all costs of physical inbound and outbound transportation. (Norsk Logistikkbarometer 2009 results)

3.2.2.5 ASLOG – L'état de l'art de la logistique française (the state of French logistics)

The first French logistics study was conducted in 2005/2006, followed by a second one in 2008/2009. The purpose was to assess the state of logistics in France and to gather information for creating metrics that would allow comparison of logistics costs with other countries. The data are based on interviews with 346 French companies, of which 5% were small (turnover <EUR 10bn, <50 employees), 37% medium-sized (turnover <EUR 50bn, <250 employees) and 58% large. (ASLOG – L'état de l'art de la logistique française 2010)

The total logistics costs were 11.9% (2008/2009) of turnover, which was higher than the 9.9% achieved in 2005/2006. The costs were highest in the retail industry (14.3% of turnover), while the automotive industry enjoyed the lowest cost level at 9.9% of turnover. The study classifies costs into three main components: transportation, warehousing/inventory carrying, and administration costs (Figure 54). (ASLOG – L'état de l'art de la logistique française 2010)

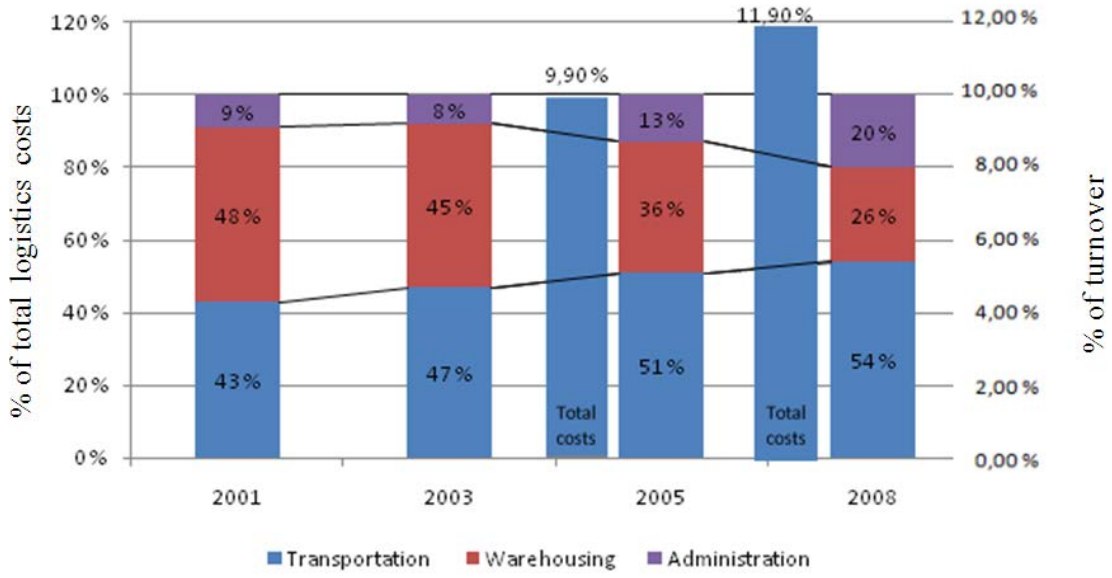


Figure 54 Logistics costs per cost component in France in 2001–2008 as a % of total logistics costs, and total costs as a % of turnover (ASLOG – L'état de l'art de la logistique française 2010)

According to the report, transportation costs are the largest cost component, and its share has increased constantly. Correspondingly, the share of warehousing costs has almost halved since 2001. The total logistics costs rose by 2% between 2005 and 2008. (ASLOG – L'etat de l'art de la Locistisque Française 2010)

3.2.2.6 Colombia national logistics survey

The Latin America Logistics Center (LALC) has published a national logistics cost survey, which among other things describes the financial indicators of Columbian logistics. These indicators also include total company logistics costs. The costs of logistics, based on the figures provided by 322 participating companies, are indicated as a % of sales. (Rey 2008, 2–7)

According to a sample of 123 companies that provided logistics cost figures, the total logistics cost as a % of sales in Colombia was equivalent to 12.48% in 2008 (median 9.41%). (Rey 2008, 93–94) The logistics cost figures of different industries are depicted in Figure 55.

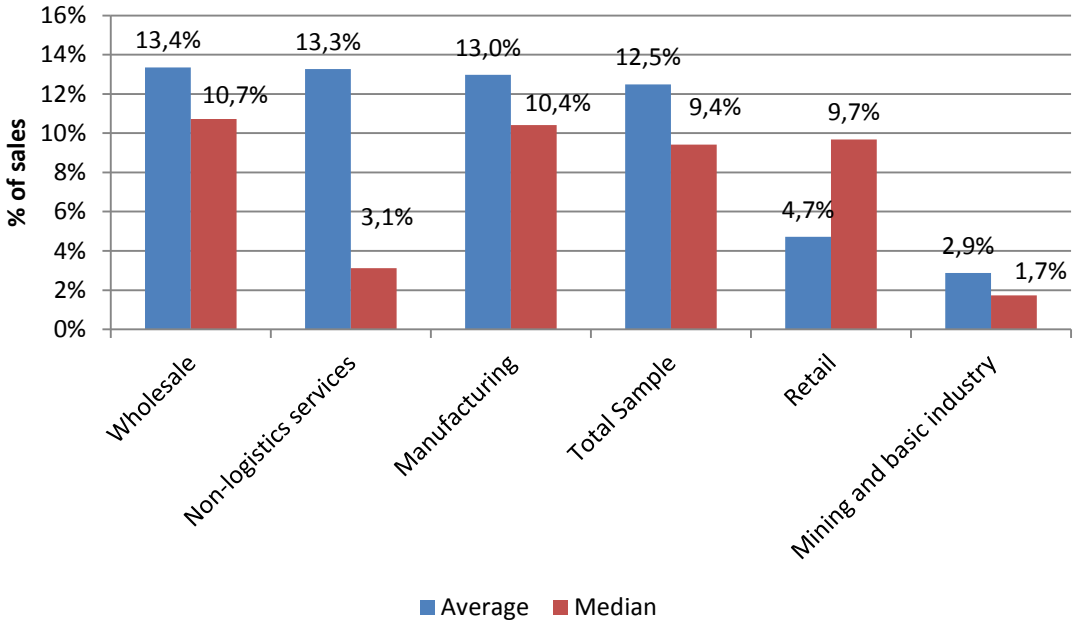


Figure 55 Total logistics costs in Colombia in 2008 as a % of sales (Rey 2008, 93)

As depicted in Figure 55, the total logistics costs for Colombia are the highest in the wholesale industry, followed by services and manufacturing that all hit above average logistics cost levels. Some fairly large differences exist between average and median levels, indicating a large variation in figures quoted by sample companies.

3.2.2.7 Sourcing and Logistics in China

Consultancy firm PricewaterhouseCoopers conducted a study called Sourcing and Logistics in China 2008. It explored the opinions of 203 German procurement and logistics managers concerning their experiences with sourcing and logistics in China. The respondents represented six sectors: manufacturing of machinery and equipment (42%), automotive (14%), electronics (11%), chemicals and pharmaceuticals (10%), retailing (9%), and service providers (7%). (Sourcing and Logistics in China 2008, 3)

The study introduced several components of logistics costs. Shipping/freight costs represent the largest share (8–10%) of the total cost of procurement. The other cost groups in the study were: insurance costs, customs costs, delivery costs, warehousing costs, costs of damage, management costs, and appraisal costs. The results per cost group are not disclosed in exact figures, but on a four-level opinion scale (high – less high – low – can't say). However, the logistics costs of some sub-industries in manufacturing were disclosed. The costs were highest in the automotive industry (15–20% of procurement costs), followed by

machinery (12–14%) and the chemical and pharmaceutical industry (8–12%). Weighting these figures by the percentage of respondents gives the total logistics costs of manufacturing as 13.54% of procurement costs (see Appendix 3). (Sourcing and Logistics in China 2008, 20–21)

3.2.2.8 Database of the Japan Institute of Logistics Systems

The Japan Institute of Logistics Systems (JIL) maintains a nationwide database for transport and logistics developments. The database also includes logistics cost data, recorded since 1991. (JIL Database) Logistics costs are divided into three cost components: transport, storage, and other costs. In the latest available year, 2007, the total logistics costs hit JPY 45 992bn (approx. EUR 279bn), of which transport costs accounted for the largest share with 62.1%. The second largest component was storage costs at 33.8%, and other costs accounted for 4.1% of total logistics costs. Figure 56 depicts the development of Japanese logistics costs as a % of GDP. (JIL Database – Logistics Cost Data)

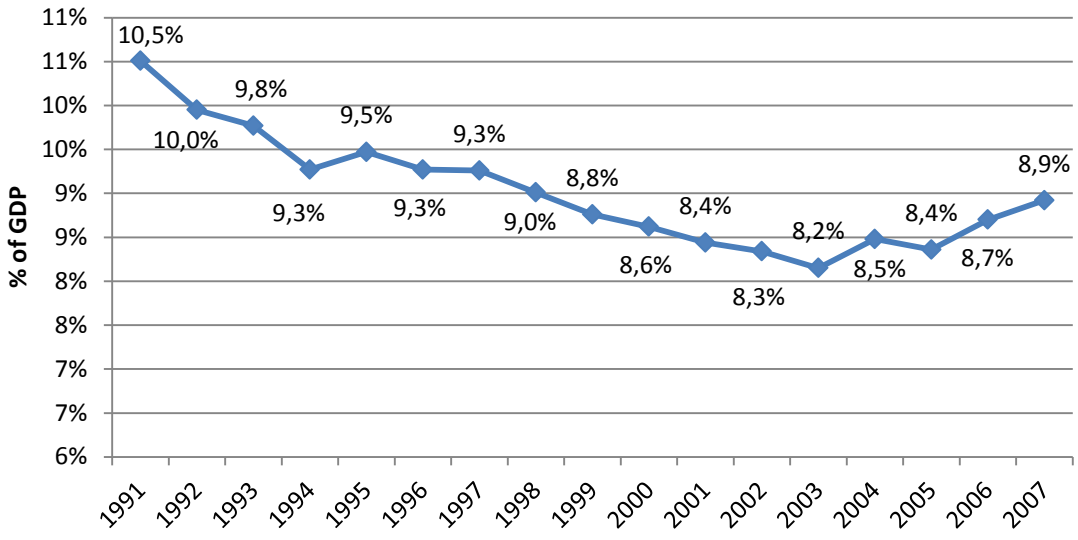


Figure 56 Development of logistics costs in Japan as a % of GDP (data source: JIL Database – Logistics Cost Data)

As illustrated in Figure 56, logistics costs for Japan fell throughout the 1990s and early 2000s. However, in 2003 the costs compared to growth of GDP started to rise again, reaching 8.9% of GDP in 2007.

3.2.2.9 Studies by Transportbrukernes Fellesorganisasjon, the Federation of Norwegian Transport Users (TF)

TF has published two studies regarding the industry's logistics costs and resource utilization (1997 and 2003). In 1999, TF also published a similar study of trading companies. The number of respondents in these questionnaire-based studies was 127 (1999) and 430 (2003), respectively. (Hansen & Hovi 2008, 24; Industriens logistikk - en studie av logistikkostnader og ressursbruk i norskindustri 2003, 2).

According to the 2003 study, in most companies the sum of logistics costs has increased more than decreased. Logistics costs were the highest among process industry companies, in which they totaled 10.4% of turnover. (Industriens logistikk - en studie av logistikkostnader og ressursbruk i norskindustri 2003, 4–5)

The study divided logistics costs into five components, of which transportation costs comprise 67% of all logistics costs. Other components were warehousing, inventory holding, administration, and other logistics costs (Table 11). (Industriens logistikk - en studie av logistikkostnader og ressursbruk i norskindustri 2003, 19)

Table 11 Logistics costs in Norway in 2001 as a share of total logistics costs (Industriens logistikk - en studie av logistikkostnader og ressursbruk i norskindustri 2003,19)

Cost component	Share of total logistics costs
Transportation costs	67.0%
Warehousing costs	15.6%
Inventory-holding costs	10.2%
Administration and planning costs	5.4%
Other costs	1.8%

In the 2003 study, logistics costs were divided in three cost components: transport, warehousing, and administration. Transportation costs consisted of both inbound and outbound transport. Warehousing costs covered handling related costs like employees, premises and packaging, while inventory holding costs covered the costs of interest and obsolesce. Administration and planning costs were considered to be related to production planning, purchasing, ICT etc. According to the study, the logistics costs of manufacturing companies as a % of turnover in 2001 were: transportation 5.62%, warehousing 2.55%, and administration/planning/other costs 0.93%. The total costs as a share of turnover fell

slightly between 1997 and 2001. (Hansen & Hovi 2008, 25; Industriens logistikk - en studie av logistikkostnader og ressursbruk i norskindustri 2003, 19–20)

For retail companies the costs were slightly smaller than for manufacturing companies. According to the 1999 study, the total costs were 9.2% of turnover, of which 4.1% was accrued from transportation costs and only 1% from administration costs. Warehousing costs also totaled 4.1% of turnover. (Hansen & Hovi 2008, 25)

3.2.3 Summary of questionnaire-based surveys

Figure 57 and Table 12 summarize the results of the reviewed questionnaire-based studies. The figure below shows the level of total logistics costs as a % of sales or turnover in different countries. The year quoted indicates the year of data collection.

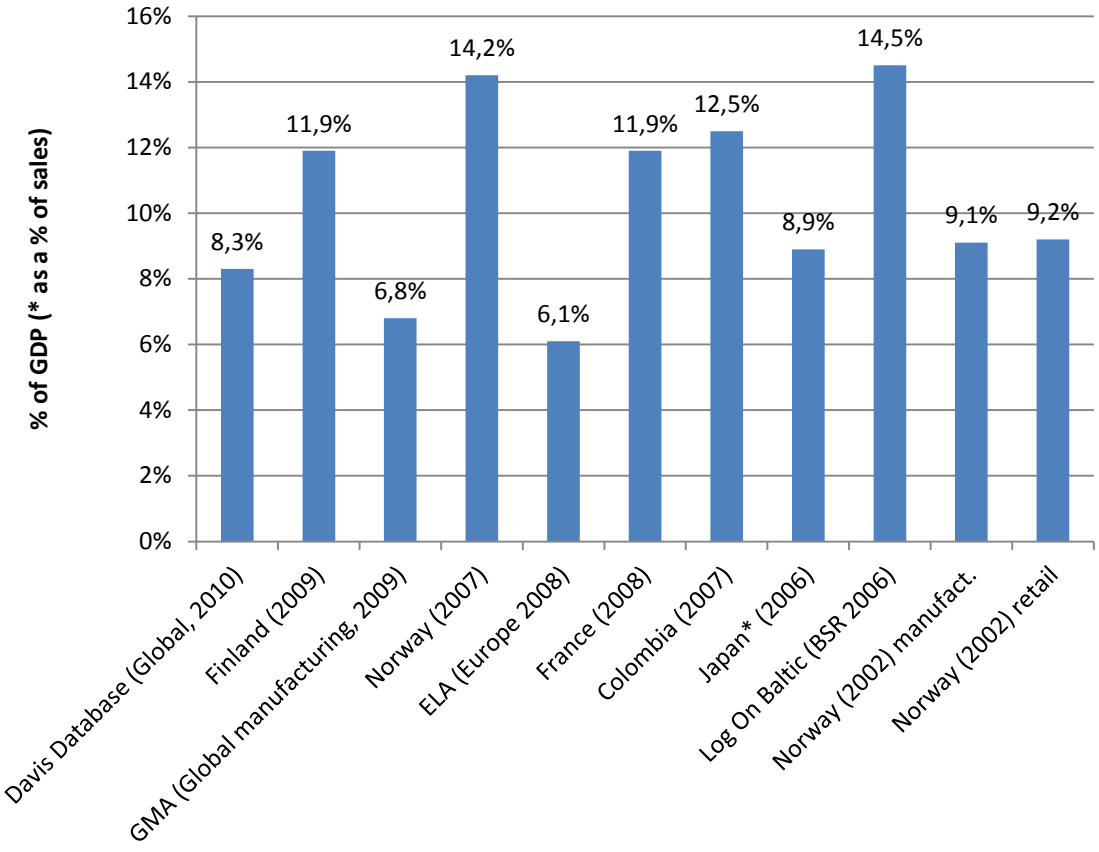


Figure 57 Level of total logistics costs in single country studies as a % of GDP (*as a % of sales)

As seen in Figure 57, the questionnaire-based method has been used mainly in western countries. Also it is evident that single-country studies show a somewhat higher level of logistics costs than do multi-country studies. Table 12 summarizes the essential aspects of the studies.

Table 12 Summary of questionnaire-based surveys

Study (year of publication)	SCI (2011)	Davis (2010)	Finland (2010)	GMA (2010)	TÖI (2010)	ELA (2009)	Norway (2009)	Aslog (2009)	Straube (2008)	Colombia (2008)	PwC (2008)	Japan (2007)	Baltic (2007)	TF 2003 (ind.)	TF 2003 (ret.)	COUNT
Scope (Multi/Single country)	S	M	S	M	S	M	S	S	M	S	S	S	M	S	S	
Cost components																
Transportation		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	12
Warehousing		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	12
Administration		✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	11
Inventory carrying		✓	✓			✓	✓		✓				✓	✓		7
Other logistics			✓	✓								✓	✓	✓		5
Transport pack.			✓		✓		✓									3
… See appendix 8.30																
Industry classification																
Manufacturing			✓	✓	✓				7	✓	✓		15.3	✓	✓	
Trade			✓		✓				15.9	✓			13.7			
Total costs	✓	✓	✓		✓	✓	✓	✓		✓			✓			
Time series (year of publication)																
–1990		✓	✓													
1991–1995		✓	✓									✓				
1996–2000		✓										✓				
2001–2005	✓	✓	✓	✓		✓	✓					✓		✓	✓	
2006	✓	✓	✓					✓				✓				
2007	✓	✓				✓	✓					✓	✓			
2008	✓	✓		✓					✓	✓	✓					
2009	✓	✓	✓			✓	✓	✓								
2010	✓	✓	✓	✓	✓											
2011	✓	✓														
Scale of measurement and logistics costs in the most recent study																
% of sales/turnover		8.3	11.9	6.75	14.2	6.1	✓	11.9		12.5			14.5	9.1	9.2	
% of GDP			8.7		14.7				✓			8.9				
Absolute costs (bn. euro)			25.4		32							279		28.8		
% of procurement											✓					
Recent trend	⇄	○	○	⇄		↑	↑		○			↑	↑	○		
Expected direction	⇄		↑			↑			↑							
Area covered	DE	Glo	FI	Glo	NO	EU	NO	FRA	EU/US/CHI	CO	CHI	JPN	BSR	NO	NO	

As in Table 10, the coverage of study (S/M), employed cost components, and year of publication are indicated. Also the level of logistics costs (also indicated in respect of industry if possible), scale of measurement, recent trend, expectations, and study area are provided. Due to the limited space available the comprehensive list of cost components is presented in Appedix 8.30.

3.3 Case studies and other studies

Studies that could not be categorized as surveys or statistics-based studies are covered here. The research employing case study methodology is also presented in this context.

3.3.1 Case studies

This subchapter briefly explores the results of identified extant studies conducted with a case study approach. This approach is primarily used in countries where sufficient statistical data are unavailable or the environment is otherwise unfavorable to data collection (e.g. low penetration of internet). It should be noted that the relevance and comparability of the results in these studies fluctuates significantly. The two following subchapters look first at case studies conducted by the World Bank, then at miscellaneous case studies. The studies are presented chronologically.

3.3.1.1 Case studies conducted by the World Bank

The World Bank Group has published many papers on trade logistics and logistics costs. One of the latest is *Improving Logistics Costs for Transportation and Trade Facilitation* (Policy Research Working Paper 4558), published in 2008 by Gonzalez et al. The results regarding logistics costs in this study are presented as a part of total costs in Figure 58. (Gonzalez et al., Guasch & Serebrisky 2008, 10)

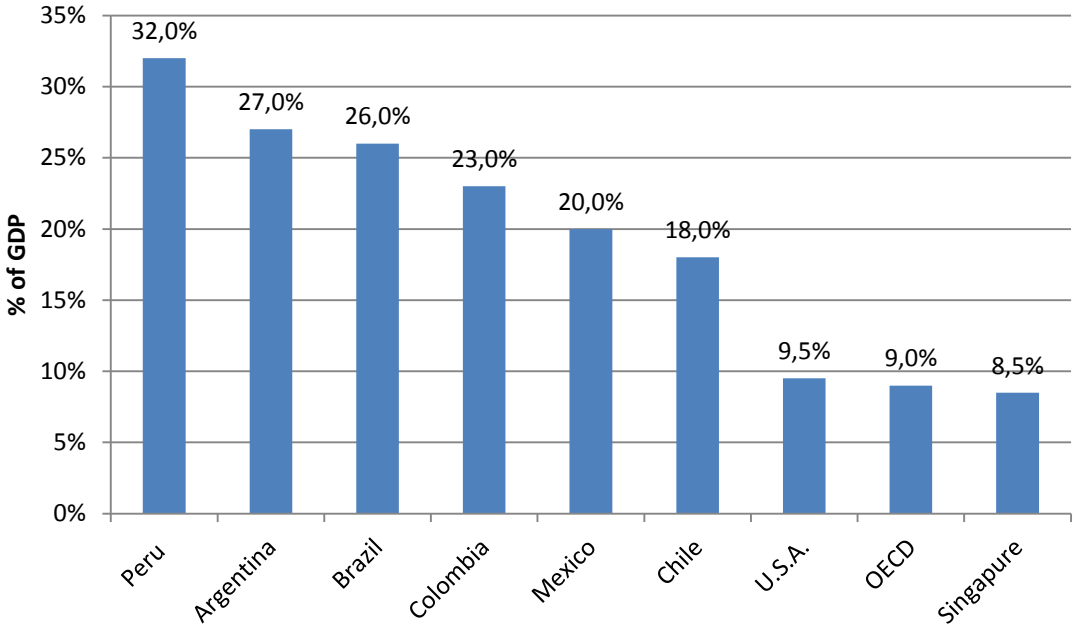


Figure 58 Logistics costs in Latin America and selected developed countries as a % of GDP (Gonzalez et al. 2008, 10)

In several World Bank reports, a three level breakdown of logistics costs is applied. It has been considered that logistics costs include: 1) transaction costs (costs related to transport and trade processing of permits, customs and standards), 2) financial costs (inventory, storage, security), and 3) non-financial costs (insurance). This same grouping is employed for example in *Argentina – The Challenge of Reducing Logistics Costs* (report No. 36606-AR) and in *Latin America: Addressing High Logistics Costs and Poor Infrastructure for Merchandise Transportation and Trade Facilitation*. (Gonzalez et al. 2008, 8; World Bank reports 1 2006, 19; World Bank reports 2 2007, 6)

In the World Bank Working Paper 4258 (2007), Arvis et al. propose a different grouping of logistics costs. This is mainly due to the subject of their study, which examines logistics costs in landlocked countries. This particular character allows the authors to assess the level of logistics costs by measuring transit transportation. In their grouping, the total logistics costs also consist of three components: 1) transportation costs, 2) other logistics costs, and 3) delay hedging costs. Transportation costs are fees that are paid for actual transit transportation services to trucker or rail operators. Other logistics costs combine transit overheads, like fees, procedures, and facilitation payments. This cost component also includes the fixed costs of shipment. The last cost component is called delay hedging costs, which includes the costs of moving inventory in transit, as well as induced costs to hedge unreliability inventory and warehousing costs, or a shift to faster or more expensive mode of transportation (Arvis, Raballand & Marteau 2007, 15–16)

The World Bank estimates that logistics costs as a % of GDP (or sale value of the product) in Latin America are significantly higher than the OECD average (Figure 59). Argentina suffers the highest logistics costs in the region (27% of GDP), followed by Brazil (24.5%) and Colombia (21%). The figures are from 2002 and 2004. (World Bank reports 1 2006, 20–21)

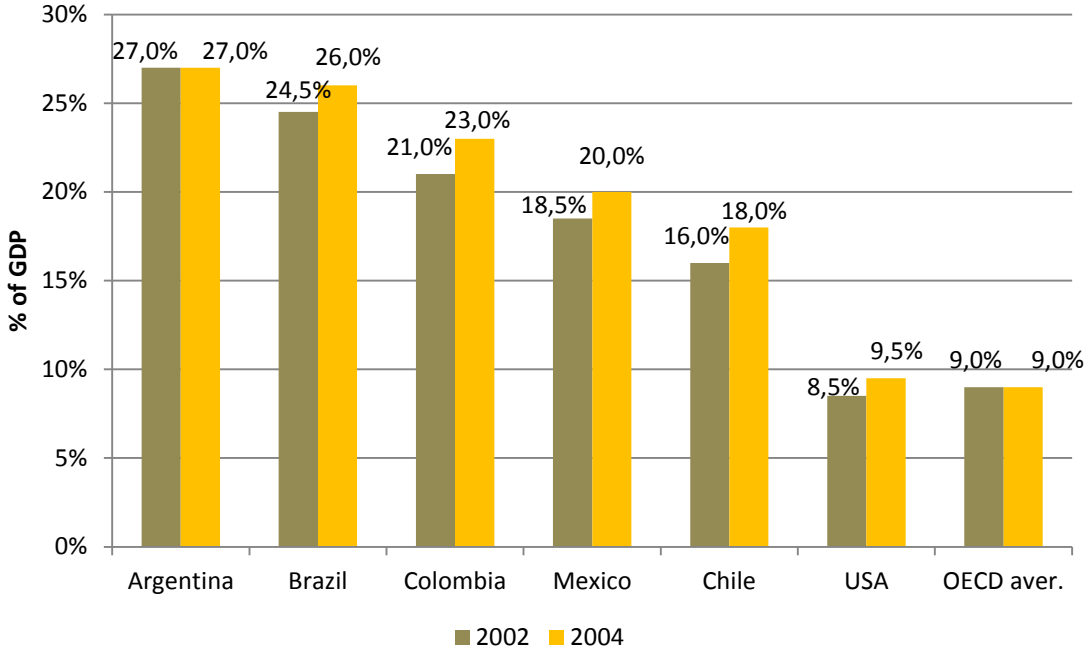


Figure 59 Logistics costs in Latin America, U.S., and OECD (average) as a % of GDP in 2002 and 2004 (Arvis et al. 2007 9–10; World Bank reports 1 2006, 20–21; World Bank reports 2 2007, 8–9)

As illustrated in Figure 59, the trend was upward between 2002 and 2004 in almost every country. The only exception is Argentina, where logistics costs remained at practically the same level.

In addition to the above, several other studies have been published for the World Bank by various academic and research institutions. For example, Ojala examined trade logistics issues in Albania in 2008. The results of this and other similar studies are summarized in Table 13.

Table 13 Logistics costs in selected World Bank reports

Study	Area	Year	Logistics costs % of GDP (m USD)
Ojala: Moldova Trade Diagnostic Study, Chapter 7: Trade Facilitation Constraints related to Transportation and Logistics	Moldova	2003	22.2% (356)
Ojala, Kitain, Touboul: TAJIKISTAN TRADE DIAGNOSTIC STUDY, Transportation and Trade Facilitation	Tajikistan	2004	27.2% (318)
Ojala: Albania Country Economic Memorandum, Trade Logistics input. (Mimeo)	Albania	2008	19.2% (2 042)
Ojala, Dyachenko: Ukraine: Trade and Transit Facilitation Study	Ukraine	2009	18–20%

3.3.1.2 Other case studies

This subchapter presents the results of identified extant case studies conducted by other authorities or organizations. The studies are presented in chronological order.

The Logistics Report 2011 UK was published by the Freight Transport Association (FTA) of the United Kingdom. The report employs data acquired from several different sources, of which the most important one was the FTA Logistics Industry Survey 2010/11 (annual survey of FTA's members' experiences on the trading environment). Other employed source include the FTA Manager's Guide to Distribution Cost, which divides logistics costs into four key areas: wages, vehicle operating, warehousing, and haulage. As the FTA's report surveys logistics costs from a LSP point of view, it does not provide too much data, besides the cost classification, for the present research problem. (The Logistics Report 2011 UK, 6–7)

According to case studies undertaken as a part of the "Understanding Transport Costs and Charges" by the Ministry of Transport in New Zealand, the total logistics costs of New Zealand represented around 8.4% of companies' total turnover (weighted average). The total logistics costs were further divided into direct transportation costs (international/domestic movements, mode interchanges), indirect transportation costs (port charges, customs/biosecurity, insurance), and other costs (packaging, warehousing, inventory holding, stock wastage, administration, information systems). The share of direct transportation

costs of total costs was almost 60% of turnover. (Ministry of Transport in New Zealand 2010, 2–21)

The Cambodian Institute for Cooperation and Peace surveyed the logistics cost and time of 20 exporting firms. The findings concluded that logistics costs in Cambodia are still very high. The results were quoted per 20-foot container. (Sotharith & Vannarith 2010, 84)

A local SME's view for logistics costs was adapted by Campos-Garcia, Garcia-Vidales and Gonzalez-Gomez in a case study of 99 SMEs located in Queretaro, Mexico. According to the analysis, the mean value of logistics costs in the sample was 21.94% (with standard deviation of 12.3) and the mode figure was 20%. (Campos-Garcia, Garcia-Vidales & Gonzalez-Gomez 2010, 1245–1250)

The Catalonia Logistics Barometer in Spain continuously measures the evolution of costs of transportation and logistics companies. The index is calculated using the weighted average costs of 1) staff (incl. personnel, social charges, operations, administration, and temporary jobs), 2) store (costs associated with running the store), 3) transport (incl. outsourced transport activities), and 4) other costs (all logistics related not mentioned in other groups). (Catalonia Logistics Barometer methodology, 1) According to the latest barometer available, Q2/2009, the index of logistics costs had grown by 0.5%, reaching an index value of 110.3 compared to initiation of the index in 2006. (Catalonia Logistics Barometer Q2/2009 Final, 1–2)

The consultancy and research company Frost & Sullivan conducted the *Voice of Customer* study in 2009 that explored the state of logistics service providers in four ASEAN countries (Thailand, Malaysia, Indonesia, and Singapore). According to the study, the logistics costs as a % of total sales were the lowest for Singapore (approximately 8%) and the highest for Indonesia (19%). (Frost & Sullivan 2009) However, it seems that the logistics costs for Indonesia have since fallen, since the Indonesian Ministry of National Development Planning indicated that in 2010 the average of Indonesia's logistics cost was 14.08% of sales. (Indonesian Ministry of National Development Planning 2011, 6) Logistics costs in Malaysia and Thailand accounted for approximately 17% and 12%, respectively. Transportation was the biggest contributor to total logistics cost in all the countries. (Frost & Sullivan 2009)

In their study *Formulating regional logistics policy: the case of ASEAN*, Banomyong, Cook & Kent (2008) examine, among other things, logistics costs in the ASEAN region, covering Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. The results of the study are based on seven questionnaires related to logistics activities in the following sectors: customs, ports and maritime transport, rail-, road-, inland waterway- and air transport as well as logistics services. (Banomyong, Cook &

Kent 2008, 360–362) The ratios of selected export logistics costs as a percentage of sales in ASEAN are presented in Table 14.

Table 14 Export logistics costs in ASEAN as a % of sales (Banomyong et al. 2008, 367)

Industry	Sourcing cost	Inventory holding	Warehousing	Transportation	Export process costs	TOTAL
Food	0.3	0.2	0.5	1	2	5
Textiles	4	2	2	6	3	17
Wood	3	3	2	5	11	24
Auto	2	1	2	5	6	16
Electrical goods	3	1	2	2	2	10
Average costs	2.5	1.4	1.7	4	4.8	14.4

As shown in Table 14, the logistics costs in ASEAN countries are considerably higher than in western countries for most industries. They seem to be highest in the wood industry, i.e. 5% higher than the second ranked industry, textiles.

The *Pakistan Logistics Cost Study* was conducted in 2006. The results show a decrease in average logistics costs from 11.01% (1996) to 6.11%. (Pakistan Logistics Cost Study 2006, 2)

A few years later the Ireland National Institute for Transport and Logistics attempted to survey logistics costs among Irish companies. The sample was small, 20 representatives, of whom 58% reported that they did not know their total costs of supply chain. However, according to those who were able to estimate costs, supply chain costs were on average 34% of turnover (warehousing costs being on average 5.1% of turnover). (Smith & Huber 2005, 15–19)

Wajszczuk & Wielicki (2004) conducted a study of logistics costs in the Wielkopolska region of Poland in 2003 among four local agricultural stakeholders, consisting of three to five unit farms. The authors divided logistics costs into three main categories: 1) physical flow of material, 2) inventory costs, and 3) cost of information processes. The costs were quoted as absolute costs per hectare. (Wajszczuk & Wielicki 2004, 196–200)

In 1999, the Ghana Ministry of Health estimated the costs of logistics in their logistics system. The methodology was based on interviews, as well as reviewing inventory records and accounting reports. The study divided the logistics costs

between three functions: procurement (7%), storage (73%), and transportation (20%). (Huff-Rouselle & Raja 2002, 5–6)

3.3.2 Other studies

This chapter briefly reviews the studies that could not be categorized as statistics-based, questionnaire-based, or case studies. The studies are presented in order of latest to earliest.

3.3.2.1 Indian Logistics Industry Insight 2007

Logistics costs in India in 2005–2006 were INR 4 226bn (approx. EUR 443bn), accounting for 13% of GDP. According to the study, for example in Japan the corresponding figure was 10.5%. The level of logistics costs in India increased between 2001 and 2006, during which time spending on logistics nearly doubled. (Indian Logistics Industry Insight – Aviation, 14) Cost components with their respective figures are illustrated in Figure 60.

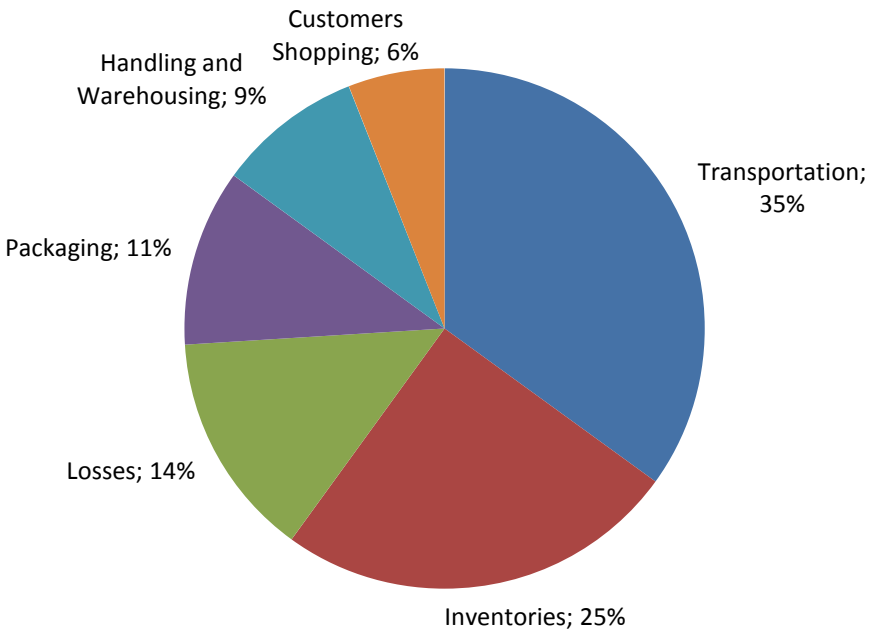


Figure 60 Logistics costs per cost component in India in 2005–2006 (data source: Indian Logistics Industry Insight – Aviation 2007, 14)

As depicted in Figure 60, the transportation costs are the major cost component also in India. Also costs related to inventories have a significant share of

total logistics costs. Other individual cost components are noticeably minor compared to these.

3.3.2.2 Logistics in Australia

One slightly older working paper was published in 2001 by Australia's Bureau of Transport Economics under the title *Logistics in Australia: A preliminary analysis.* The paper reviewed several studies conducted in Australia (two) and the UK (three), as well as in some other countries, in the 1990s. The Australian studies were (Logistics in Australia: A Preliminary analysis 2001, 28) the following:

- Hall (1999), according to whom logistics costs were 9.8% of the average selling price. This mainly comprises of transport costs (4.3%) and warehousing costs (4.7%).
- Gilmour (1993), who estimated the logistics costs for Australia to be 21.1% of sales. The main cost component was inventory carrying costs (7.2%) followed by packaging costs (3.2%), administration costs (2.8%), transport costs (2.7%), warehousing costs (2.2%), order processing costs (2.0%), and costs related to receiving and dispatch of goods (1.0 %).

As no other relevant UK sources were found, the sources and results quoted in the Australian study are presented. These are (Logistics in Australia: A Preliminary analysis 2001, 28):

- The office of National Statistics, UK, indicated logistics costs as a % of gross output. Considering pure logistics activities only, this figure was nearly 4%.
- The Department of the Environment, Transport and Regions (1998) estimated logistics costs to be 5–10% of business costs. However, this figure only includes the freight transport component of logistics costs.
- A more accurate figure was provided by the Institute of Logistics and Distribution Management, which assessed logistics costs as a % of sales. According to the study this figure was 7.4%, of which transport represented the largest share with 2.9%. The other cost components were warehousing (2.3%), inventory carrying (1.3%), administration (0.6%), and packaging (0.3%).

3.3.2.3 Hausman, Lee and Subramanian (2005)

Logistics indicators were researched by Hausman et al. (2005), who examined the effect of logistics costs and time on bilateral trade relationships. The study uses data from global logistics indicators of 80 economies to create a three-stage

estimation process and logistics index, which would comprise several logistics indicators. The authors also apply the total landed cost model, which includes the following logistics cost components:

- Transportation (shipping) costs
- Trade-related costs (processing, customs clearance, port operations and alike)
- Inventory-holding costs for in-transit inventory
- Inventory-holding costs for safety stock inventory

The logistics indicators are used to explain the residuals of the gravity model's variables (GDP, corruption, and regional trade agreement variable). Finally, the single logistics index is created based on coefficients derived by the logistics indicators. (Hausman et. al. 2005, 1–4; 19–21)

3.4 Profile of logistics costs measurement in identified extant research

The main objective of chapter 3 is to conduct a comprehensive review of identified extant research on macro logistics costs. Several aspects are included in the review:

- Study methodology (statistics-based, questionnaire-based, case study, other methodology)
- Scope of the study (single- or multi-country)
- Cost components
- Industry classification (manufacturing, trading, total costs)
- Year of publication
- Scale of measurement (% of sales/turnover, % of GDP, absolute costs)
- Recent costs trend (between the two most recent consecutive studies)
- Expectations on development of logistics costs
- Area covered in the study

The findings of the review are presented in respect of the applied methodology in the summary tables after chapter 3.1 (statistics-based studies) and chapter 3.2 (questionnaire-based surveys). As one of the objects of this study was to create a generic model for measuring macro logistics costs, summary tables are not presented for case studies and other studies, as most of these did not contribute in terms of logistics cost components.

Chapter 3.4 presents the profile of logistics costs measurement in identified extant macro logistics cost studies. The dimensions examined in this chapter include geographical coverage and employed methodology. First, Figure 61 illustrates the positioning of all the studies presented in chapter 3 in respect of: 1) theme, 2) methodology, and 3) coverage.

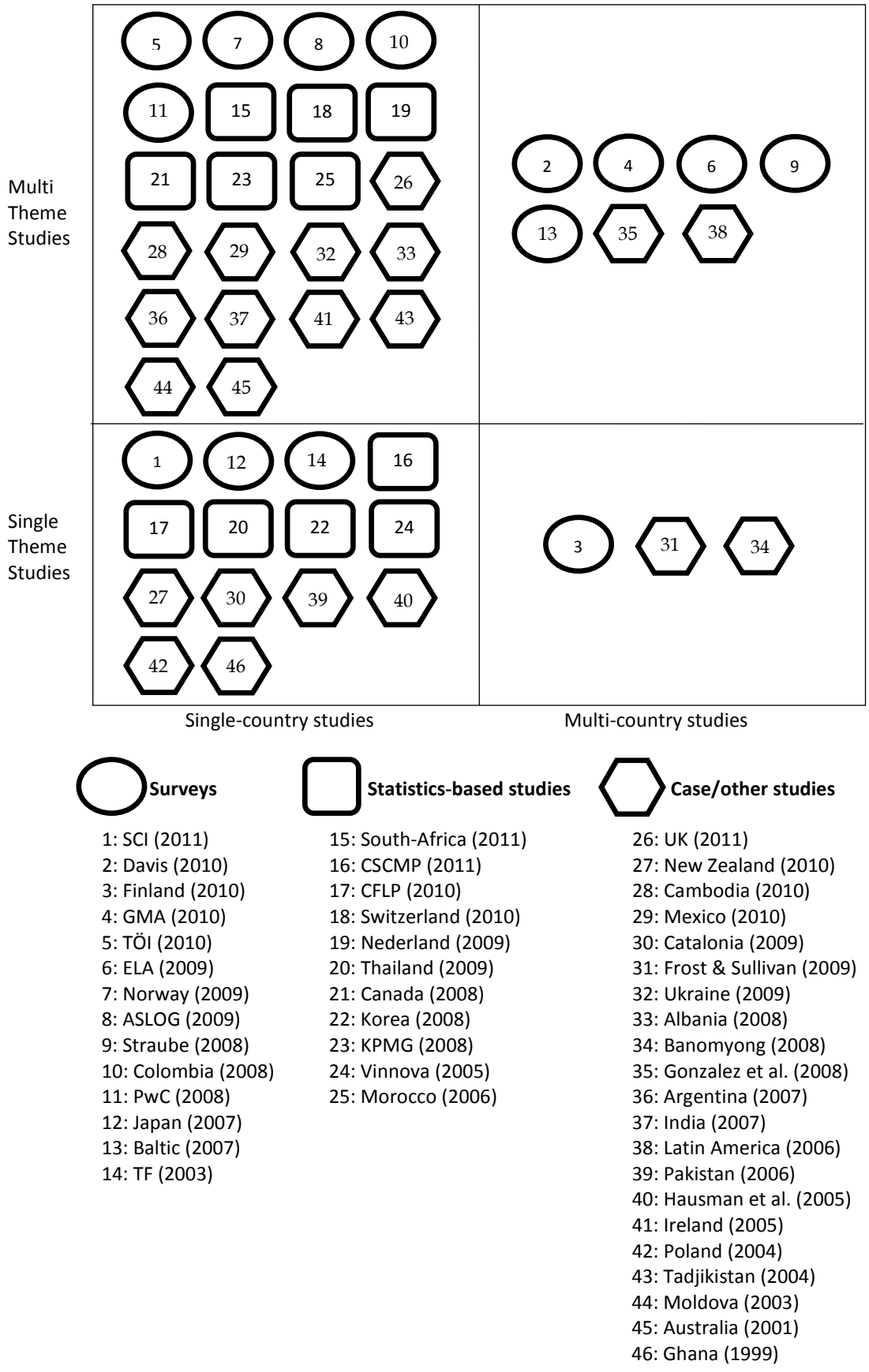
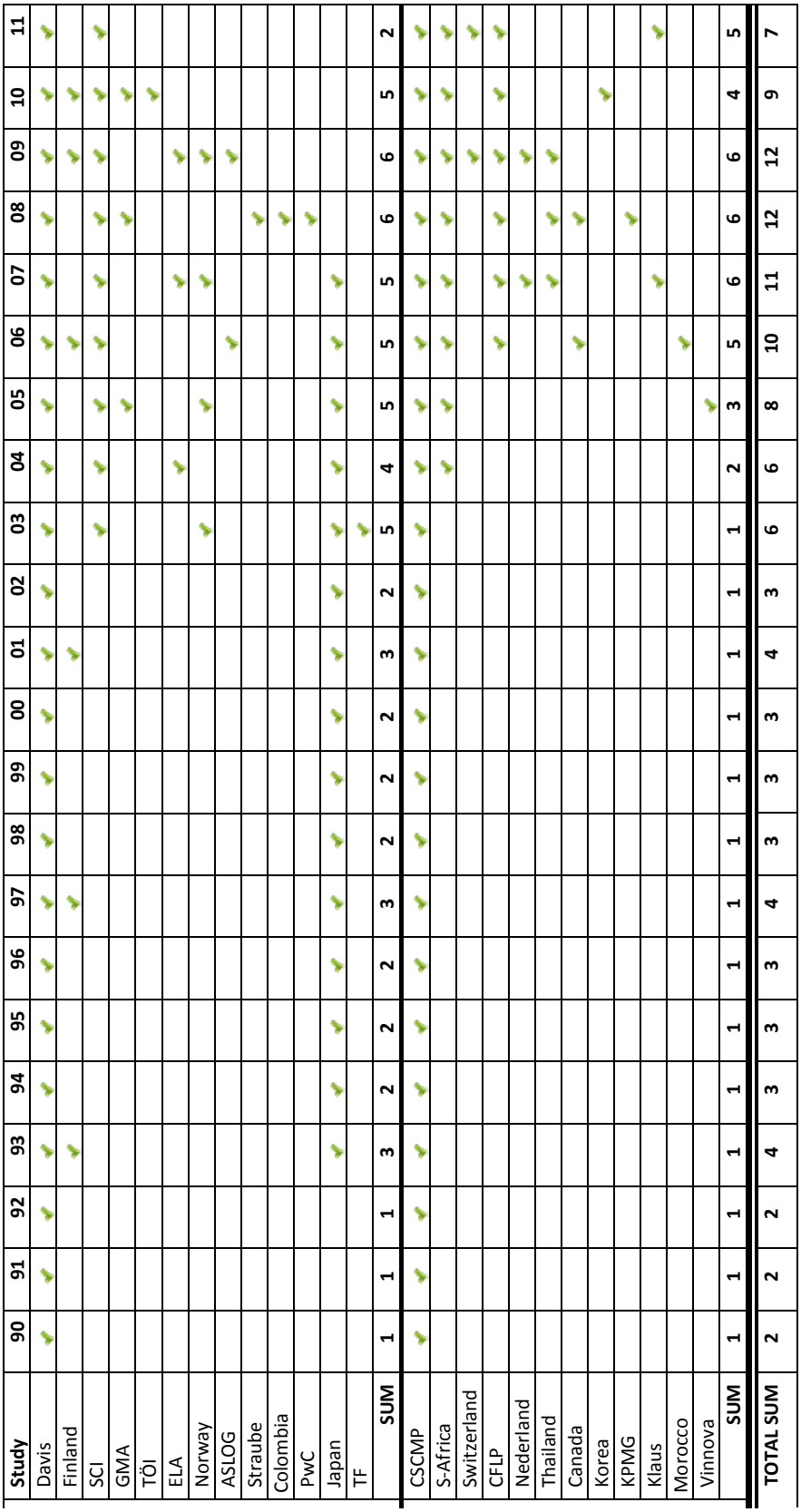


Figure 61 Positioning of logistics studies in accordance with applied methodology, coverage, and theme

As depicted in Figure 61, logistics costs are usually studied in a single-country context (92.5% of all studies). In addition, more than half (60%) of these cover multiple themes. Around 30% of reviewed studies employ a survey method, 23% a statistics-based method, and 47% a case study method or some undisclosed method. However, it should be noted that survey or statistic-based methods are usually more reliable. Surveys usually include multiple themes, which makes sense given that several themes can be covered in one survey with very marginal additional work. Next, identified extant questionnaire-based surveys and statistics-based studies are depicted by year of publication (Table 15). This provides an overview of the frequency of consecutive studies. Case and other studies are excluded at this point, as these are most often one-time studies.

Table 15 Timeline of surveys and statistics-based studies (excluding case and other studies)



Study	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11
Davis	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Finland				✓				✓				✓					✓			✓	✓	
SCI														✓	✓	✓	✓	✓	✓	✓	✓	✓
GMA																✓			✓		✓	
TÖI																					✓	
ELA															✓			✓		✓		
Norway														✓		✓		✓		✓		
ASLOG																	✓			✓		
Straube																			✓			
Colombia																			✓			
PwC																			✓			
Japan				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
TF														✓								
SUM	**1**	**1**	**1**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**5**	**4**	**5**	**5**	**5**	**6**	**6**	**5**	**2**
CSCMP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
S-Africa															✓	✓	✓	✓	✓	✓	✓	✓
Switzerland																				✓		✓
CFLP																	✓	✓	✓	✓	✓	✓
Nederland																		✓		✓		
Thailand																		✓	✓	✓		
Canada																	✓		✓			
Korea																					✓	
KPMG																			✓			
Klaus																		✓				✓
Morocco																	✓					
Vinnova																✓						
SUM	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**5**	**6**	**6**	**6**	**4**	**5**
TOTAL SUM	**2**	**2**	**2**	**4**	**3**	**3**	**3**	**4**	**3**	**3**	**3**	**4**	**3**	**6**	**6**	**8**	**10**	**11**	**12**	**12**	**9**	**7**

Some studies (e.g. Davis Database) were published before 1990, but as the 1990s were the first period that had several, the table gives that as the starting point. As depicted in the table, the number of studies has grown significantly in the past two decades, as has the number of studies published consecutively. This is illustrated in Figure 62 including questionnaire-based surveys, statistics-based studies, case studies, and other studies.

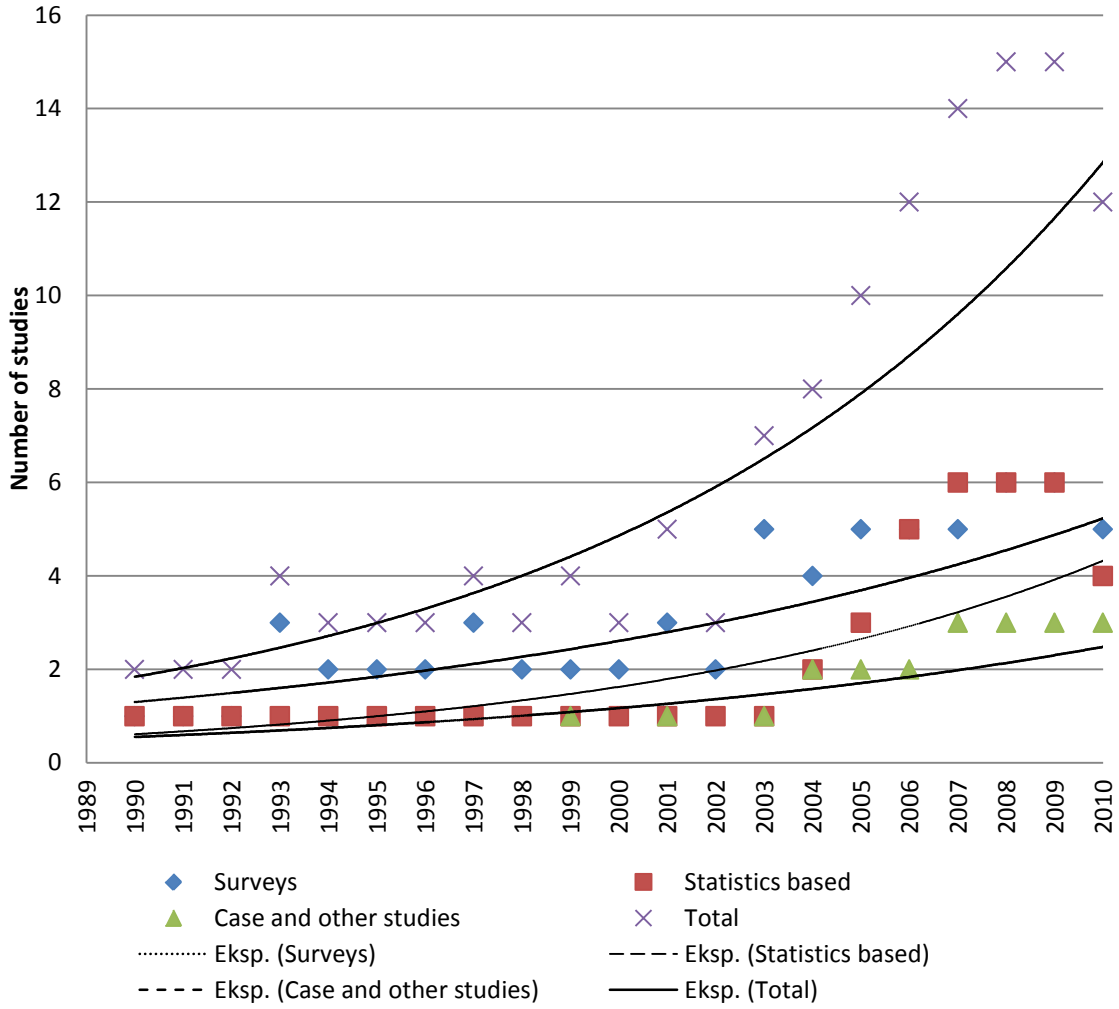


Figure 62 Number of published macro logistics costs studies since 1990

The upward trend reflects the growing interest in macro logistics costs. The number of conducted studies has grown steadily during the past 20 years, reaching 10 published studies per year in 2005. The trend lines illustrate the development of published studies by methodology employed. The number of statistics-based studies has increased more steeply than those of case studies and surveys. The total number of published studies also rose sharply from 2003 to 2008.

Finally, the geographical distribution of published studies is illustrated in Figure 63. The LPI world map (see also Figure 4) pinpoints where they were conducted (Figure 63).

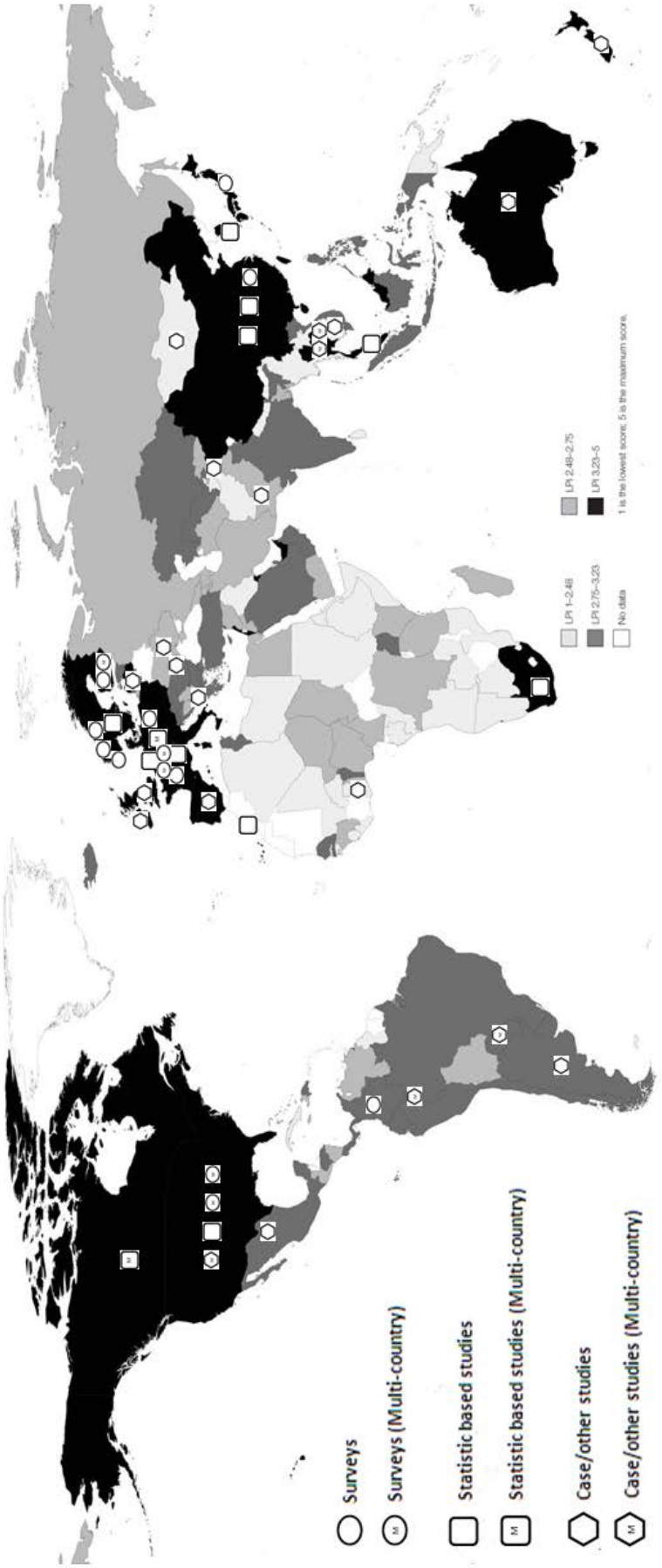


Figure 63 Identified extant studies on the LPI world map (LPI map: Arvis et al. 2010)

Several interesting conclusions can be drawn from the figure. First, there is a clear relationship between LPI ranking and areas in which studies are conducted. This may indicate that countries with a high interest in logistics costs also score highly in the LPI ranking. Still, the LPI score is usually higher in developed countries that naturally also have better resources to conduct studies. Yet, this reflects to some extent the importance of logistics cost research for the level of logistics efficiency and logistics costs.

In general, it is possible to conclude that logistics costs research is strongly concentrated in developed countries at least in the context of surveys and statistics-based studies. Case and other studies conducted in developing countries are mainly funded and initiated by such organizations as the World Bank Group. Europe and North America are the powerhouses of logistics costs research, and especially the Nordic countries have excelled in researching logistics costs. One difference between European and North American macro logistics cost research is that surveys are favored in Europe, while North American studies more often rely on statistics-based approaches.

4 COMPLETION OF THE STUDY AND RESEARCH METHODS

This chapter describes how the research was conducted. First the approach and methodological issues are considered. This is followed by a comprehensive discussion of research process. Finally the reliability and validity of the research is addressed.

4.1 Research approach

Research methods are described as the guiding principles for creating knowledge. They should be differentiated from methodology, which refers to the understanding of how methods are constructed. (Arbnor & Bjerke 1997, 8–9) The method section is the heart of the paper and has two main purposes. The first is to introduce the research methods so clearly that the reader can repeat the experiment. The second is to provide relevant information for the reader to judge the validity of the study. (McBurnley & White 2009, 83)

Choosing the most suitable research method can be a challenging task. According to McBurnley and White, the most suitable method is the one that best answers the purposes of the research (McBurnley & White 2009, 348). In addition, the methods used must fit both the problem and the presumptions in order to be effective, as they guide the choice of both technique and tools. This emphasizes the importance of choosing a consistent and constructive method. (Arbnor & Bjerke 1997, 16)

Research methods are commonly split into two mainstreams, quantitative and qualitative (Saunders, Lewis & Thornhill 2009, 13; Yin 2012, 178). Qualitative studies are often defined as “soft” research, while quantitative ones are more “hard-nosed” and data-driven (Yin 2012, 178). One distinctive difference between the two is that quantitative methods optimize control and generalizability, while qualitative methods maximize realism (Kotzab, Seuring, Müller & Reiner. 2005, 16). Some other essential characters of quantitative studies are the importance of earlier conclusions and theories, concept definitions (alongside data collection), and analyzing methods (Hirsjärvi et al. 2003, 131). On the other hand, qualitative inquiry focuses on meaning in context and requires sensitive data collection instruments (Merriam 2009, 2). In this context, it should be clarified that case study is a rather popular form of qualitative research (Merriam

2009, vii; Yin 2012, 178), and in chapter 3 case studies are presented in their own group. The decision was made to further distinguish between studies that use broad survey data and case studies. Drawing the line between them is not a simple task, and sometimes unnecessary. Furthermore, research projects like this one may include both quantitative and qualitative elements. (Hirsjärvi et al. 2003, 127–128; McNeill & Chapman 2005, 21)

Mentzer and Kahn agreed in their article *A Framework of Logistics Research* that much of logistics literature and research is mainly managerial-based and lacks a rigorous orientation towards theory building. The result also concluded that current logistics research, published in North American journals, is heavily quantitative. (Mentzer & Kahn 1995, 231–233) This was also agreed in the research by Kotzab et al. (Kotzab et al. 2005, 18).

There are several different typologies to classify research strategies that provide a general plan of how research intends to answer research questions (Saunders et al. 2009, 600). Hirsjärvi, Remes and Sajavaara identify the following three strategies: experimental research, survey-research, and case study research (Hirsjärvi, Remes & Sajavaara 2003, 125). This typology is also partially applied here to the classification of previous studies in chapter 3. Saunders, Lewis and Thornhill provided a more detailed classification of research strategies. Their seven main strategies are: experiment, survey, case study, action research, grounded theory, ethnography, and archival research (Saunders et al. 2009, 141). Most of these strategies fall under the experimental research in typology of Hirsjärvi et al. The empirical analysis of this study includes mainly features of survey research (as empirical data was collected with the questionnaire-based survey method), but especially the theory building section contains features of experimental research.

Arbnor and Bjerke identify three methodological approaches in today's business research. These are analytical, system approach, and actors approach. The analytical approach is the oldest and most widely used in modern business research and consulting. (Arbnor & Bjerke 1997, 49–50; Arbnor & Bjerke 2009, 248) Also this study includes several elements and characteristics of the analytical approach.

The analytical approach aims to generate pictures of objective reality. These can be illustrated in models that may also contain quantitative elements. Models, in the context of research, are pictures or prototypes that simplify the whole by addressing the relevant characteristics of reality. Although the theory contains models, these two should not be equated, but models should rather be seen as tools for constructing theory. However, models make their own valuable contribution to the research process (see also Figure 65). (Arbnor & Bjerke 1997, 82–83; Hirsjärvi et al. 2003, 136)

The analytical approach is characterized by its cyclical nature. This means that the approach begins with the facts and ends with the facts. The cyclical nature connects the theoretical world and the empirical world (the factive world). (Arbnor & Bjerke 2009, 90) The theories are formed through inductive reasoning based on facts in the empirical world. Afterwards, the formed theories are deductively compared with the facts of the real word in order to validate them. A model is also applied to the real world data by analyzing existing data in accordance with the created model. (Arbnor & Bjerke 1997, 91–92) The cyclic nature of the analytical approach, related to the phases of this study, is illustrated in Figure 64.

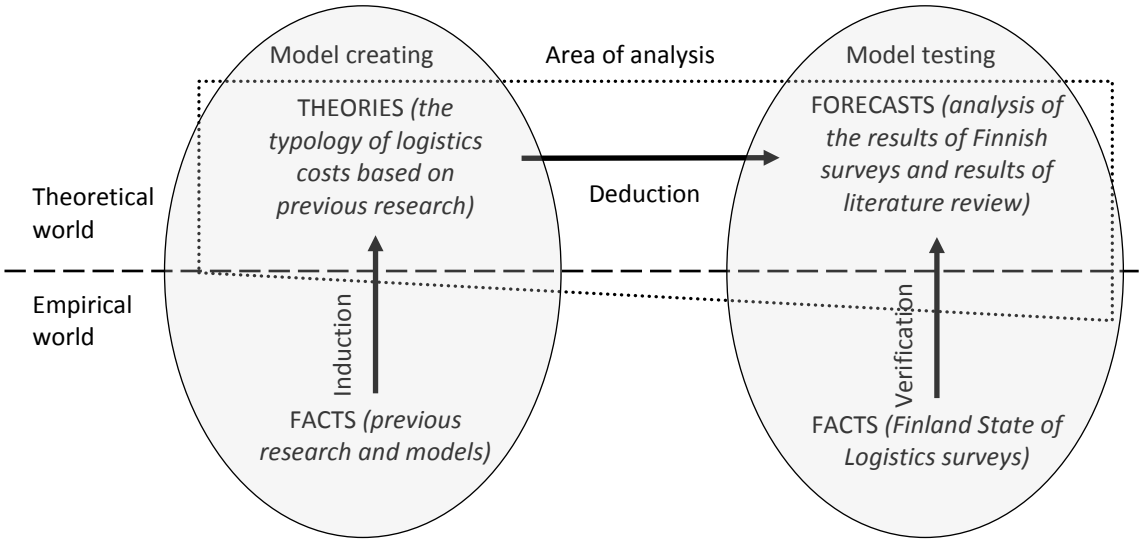


Figure 64 Analytic approach in the study (partly adapted from Arbnor & Bjerke 1997, 92)

As illustrated in Figure 64, this study includes both inductive and deductive characteristics. Two main research problems are associated with the inductive approach, namely those related to mapping the current state of macro logistics cost research and creating a generic model for measuring macro logistics costs. That associated with the deductive approach is measuring the level and structure of logistics costs in Finnish companies.

Prerequisites for using the analytical approach are existing theory and techniques that make rendering of verification or falsification possible. The analytic approach replicates reality by reproducing causal relations (seeking explanatory effects) by finding the prior or current cause. In general, the greater the number of proven causes, the stronger is the explanation. As a result, this approach produces pure cause-effect relations, logical models and representative cases. (Arbnor & Bjerke 1997, 56)

Finally, the study can be characterized as descriptive, as it deals with questions of what things are like, not why they are the way they are (De Vaus 2002, 18).

Descriptive research presents accurate descriptions of studied phenomena, as well as precise documentation of interesting observations. It can be qualitative or quantitative. (Hirsjärvi et al. 2003, 129–130) Again, due to the unique approach and not so well established concepts applied in the current research, this study also includes normative characteristics, as it not only collects facts but also points out the characteristics of potential improvements (pursuing the "pure" concept of logistics costs). (Arbnor & Bjerke 1997, 84–85; Hirsjärvi et al. 2003, 149)

Because of the descriptive nature and uniqueness of subject of this study, creation of a traditional hypothesis is difficult in this context. However, this does not mean that there are no clear objectives, rather that they are of are the kind that should not be restrained in the form of strict hypotheses — which in this case could constrain the creation of a theory.

4.2 Research process

4.2.1 Overview of the research process

The research process begins with the development of a research idea. The idea for this study evolved from a shortage of previous macro logistics cost research. The problem is acknowledged in the literature (e.g. Farahani et al. 2009). The research process began with the identification and review of extant research. Mentzer and Kahn identify three types of literature reviews; integrative, methodological, and theoretical. (Mentzer & Kahn 1995, 231–233)

There are several examples of using meta-analytical literature in studies that involve analysis of a large amount of identified extant research in several different disciplines (e.g. Spijker, Trijsburg & Duivenvoorden 1997; Underhill 2006; and Zhao, Luo & Suh 2004). According to Zhao et al. (2004), meta-analysis is a methodology that has often been employed in several fields of business research such as marketing, organizational behavior, and strategic management. The method is especially suitable for heterogenic samples of different studies, and the approach permits not only the statistical aggregation of findings, but also a systematic evaluation. This is crucial, for example, in international business research, which has been widely examined in a substantial number of empirical studies with valuable (but mixed) findings, requiring more conclusive quantitative summaries. It applies also to this study, and also Zhao et al. have studied a subject related to transaction costs. (Zhao et al. 2004, 525) The approach has also been adopted in various subfields of management research, including assessment of the relationship between strategy and performance (Datta & Narayanan, 1989, 469).

In this research, the literature review serves a dual purpose, and is not limited to the literature itself but involves all relevant studies. First, it examines various dimensions of identified extant macro logistics cost research (methodological literature review) including e.g. research methods, structure and level of logistics, and covered area. Second, the review of previous research forms a solid foundation for creating a macro logistics cost model (theoretical literature review). The framework of the research process is shown in Figure 65.

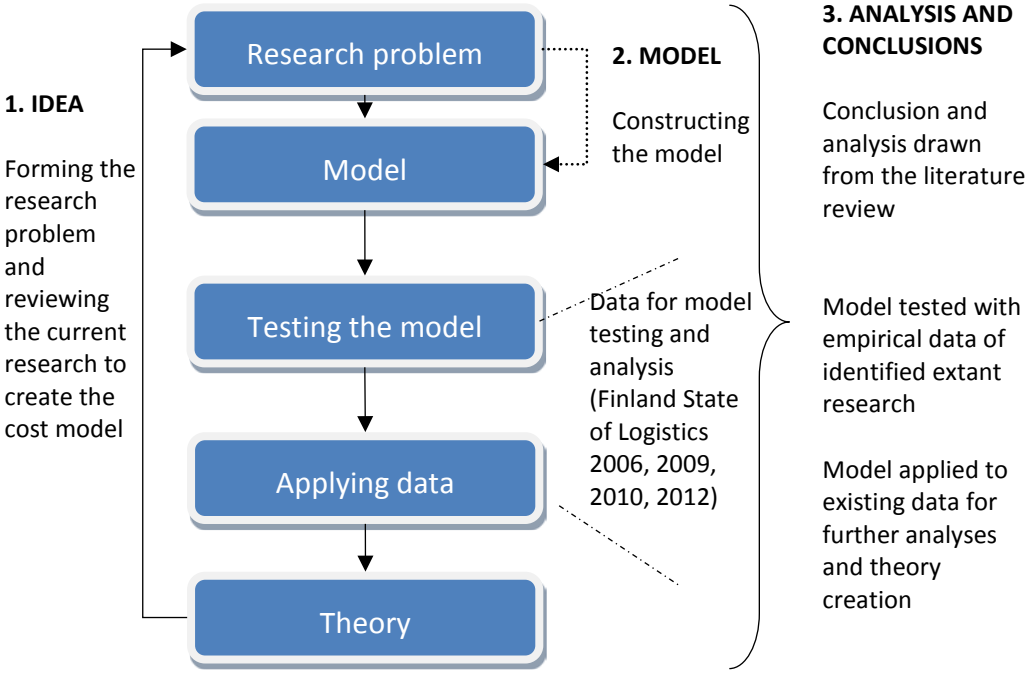


Figure 65 The research process (partly adapted from Hirsjärvi et al. 2003, 136; Mentzer & Kahn 1995, 234)

Here, *model* refers to a logistics cost typology developed from the meta-analysis of previous research. After creating the model, data collected from Finland State of Logistics surveys (see 4.2.2) are applied to it in order to measure the logistics costs of Finnish manufacturing and trading companies.

Applying the model to empirical data can be considered quantitative research, but as mentioned above, it is not expedient to form hypotheses. (Arbnor & Bjerke 1997, 84–85; Hirsjärvi et al. 2003, 149) While conducting such research it should be kept in mind that the researcher must either use previous constructs, drawn from the theory base, or generate new ones. The research design outlines the strategies to be used. This includes issues related to data collection, sampling and other data analysis procedures. (Mentzer & Kahn 1995, 237) Issues related to empirical analysis are discussed in the following subchapters.

4.2.2 Description of the data

The empirical part of this study can be split into two parts. In the first, data were collected during an extensive review of identified extant studies. This data was used to create a generic macro logistics model, but also to draw conclusions regarding the current state of macro logistics cost research. The steps for creating the model are presented in chapter 5. The reviewed research consists of totally 66 national and international studies, articles, and textbooks. A more specific classification is given in Table 16.

Table 16 Classification of previous research

	Text books	Scientific articles	Studies;	,of which national	,of which regional or global	Case studies
No. of sources	8	9	29	(21)	(8)	20

The most important source of identified extant research was macro level logistics studies, conducted around the world. Three studies provided the estimates of logistics costs in a global context, two at EU level, one in the BSR, and two in some other specific areas. Coverage is further ensured by 20 case studies, which guarantees a broad outlook of logistics costs in an international context.

Since no comprehensive literature review or database of logistics costs research were available, collecting the reference data for the model had to be started from scratch (Brewer et al. 2001, 510; Dianwei 2006, 592; Farahani et al. 2009, 57; Havenga 2010, 476; Straube & Pfohl 2008, 48–49). Based on this background, conducting an extensive study review was the only adequate and practicable research method (Kotzab et al. 2005, 97).

As it was assumed that not all relevant publications are indexed in academic listings or other databases, the only possible option to ensure coverage of data collection was to also conduct search with an internet-based search tool. In this respect Google is superior in terms of both coverage and accessibility (Brophy & Bawden 2005, 498). Chen compared Google and Google Scholar with major academic library federated search engines, MetaLib and WebFeat, and concluded that these could be characterized as a one-stop shop. The main pitfall with search engines (in this case Google) is that they rank results in order of the “best” first, based on a search algorithm. (Bar-Ilam 2007, 155) To overcome this, a large number of search results (the 200 first results retrieved) from each keyword combination (see below) were reviewed. In addition, if a larger number of results were subjectively considered relevant, these were also included in the review.

Special attention was paid to the reliability of results. The following aspects were considered in the evaluation of relevance: author, publisher, year of conduction, employed methodology, and references.

Several keywords and combinations of keywords were employed during the data search. These are provided in Table 17.

Table 17 Keywords used in data search

Keywords	Defining words (also plural forms were applied)
Logistics cost State of logistics Logistics market Logistics expenditure	'cost' ,'study', ' survey' , 'research', 'report', 'barometer', 'trend', 'questionnaire', 'data', 'value', 'findings' , 'annual', 'national', 'indicators'

Keywords formed the core of the data searching process. These were input first without defining words or quotation marks. The defining words, which expanded on the keywords, were combined (also in plural form) with each keyword for maximum relevance and coverage of results.

To increase coverage and relevance, the search was replicated by targeting the 47 biggest economies globally (Table 18). These were ranked based on the UN's latest available data (2009) of GDP per country at constant 2005 prices in U.S. Dollars (United Nations Statistics Division: National Accounts Main Aggregates Database). This ensured adequate geographical coverage.

Table 18 Country-specific data searches

Keywords	Countries included (in order of GDP in 2009, from largest to smallest)
"Logistics cost" "Logistics expenditure"	United States, Japan, China, Germany, France, United Kingdom, Italy, Brazil, Spain, Canada, India, Russian Federation, Australia, Mexico, Republic of Korea, Netherlands, Turkey, Indonesia, Switzerland, Belgium, Poland, Sweden, Austria, Norway, Saudi Arabia, Iran, Venezuela, Greece, Denmark, Argentina, South Africa, Thailand, United Arab Emirates, Finland, Portugal, Colombia, Ireland, Hong Kong, Israel, Malaysia, Czech Republic, Egypt, Singapore, Nigeria, Chile, Romania, Philippines

Alongside Google, a search was also conducted within several library databases consisting of articles, research papers and other relevant publications. The

keywords and databases are described briefly in Table 19. The number of reviewed results was similar with internet search.

Table 19 Article search engine and data base searches

Keywords	Data base / Search Engine	Description
"Logistics cost"	NELLI	The National Electronic Library Interface is a tool for retrieving information from electronic resources, used by Finnish universities. (www.nelliportaali.fi)
	Summon	Web-based service enabling search of content found in library collections (incl. books, videos, e-resources such as articles)
"Logistics expenditure"	The World Bank Document Search	Search tool for official published documents in the World Bank's Archives (http://econ.worldbank.org/)
	OECD iLibrary	OECD's electronic library for books, papers, statistics, analysis and databases. (http://www.oecd-ilibrary.org/)

Textbooks and journal articles were mainly used to clarify the concept of logistics costs. Some of these sources also provide estimates of macro logistics costs. These were used in comparison with other studies, if empirical data in the article was not acquired from an original study presented in chapter 3. In these cases, solely data from the primary source, or study, were presented. The World Bank's and OECD's libraries produced a rather small number (around 40 respectively) of hits, all of which were reviewed.

Identified extant research reviewed for this study included sources published in 12 languages: Chinese, English, Finnish, Flemish, French, German, Japanese, Korean, Norwegian, Spanish, Swedish, and Swiss. This included studies written entirely (excluding summary) in some other language than English. Google Translate was used for translation, as it is acknowledged to be a valid tool for translating especially western languages, although with certain languages the performance is not that solid (Nguyen-Lu, Reide & Yentis 2009, 97). Google Translate also translates pdf files and html pages, which makes it easily adaptable to different file types. Google Translate was also selected as part of the Thirteenth Annual Best Free Reference Websites list in 2011 (Boykin, Cunningham, Danowitz, Lee, Lehmann, Nail, Scanlon, Seale, Shuyler & Sonsteby 2011, 20–21).

The second part of the empirical analysis is based on datasets of four consecutive Finland State of Logistics surveys, conducted by the Turku School of

Economics. These surveys (Finland State of Logistics 2006; 2009; 2010; 2012) provided a broad outlook over the current state of logistics costs among Finnish manufacturing and retail companies. The data were collected from online surveys, excluding some additional telephone interviews for the 2006 study (identical questionnaires were used in both telephone interviews and web questionnaire).

In practice, surveys were carried out by sending out a personal link to the survey to the email addresses of potential recipients, combined from several address databases. The web-based online survey and analysis software tool, Webropol, were employed in data collection. Raw data were then refined for analysis.

The link for the 2006 survey was sent to 16 231 recipients in manufacturing, trading and logistics companies. The response rate was 13.9%, totaling 2251 respondents. The corresponding figures in the 2009 and 2010 surveys were: 2 705/26 311 (2009), and 1 813/25 535 (2010). Total response rates in 2009 and 2010 were 10.2% and 7.1%, respectively. In the 2012 edition of the survey, the request for participation was sent to 38 834 receivers, resulting in 2 732 valid responses (response rate 7.0%). Not all respondents contributed to the questions related to logistics costs, and in this context only data from manufacturing companies and trading companies were included in the analysis.

Several background variables were asked in order to categorize respondents. With respect to this study the most important ones were industry (including manufacturing and trading) and company size (micro / small / medium / large). Other industries were not the focus of the study and are not discussed here. (Naula et al. 2006, 20; Solakivi et al. 2009, 32; Solakivi et al. 2010, 33–34) Table 20 gives a more detailed breakdown of respondents.

Table 20 Breakdown of respondents in Finland State of Logistics Surveys (Naula et al. 2006, 20; Solakivi et al. 2009, 32; Solakivi et al. 2012, 33)

	Manufacturing				Trading			
Company size	**2006**	**2009**	**2010**	**2012**	**2006**	**2009**	**2010**	**2012**
Micro	583	608	394	648	523	490	310	576
Small	170	156	79	116	149	194	70	128
Medium	110	96	36	52	63	50	21	36
Large	118	136	61	59	53	60	32	33
Total	**981**	**996**	**570**	**875**	**788**	**794**	**435**	**773**

Company size classification is based on yearly turnover with the following thresholds: micro companies EUR <2m, small companies EUR 2–10m, medium-sized companies EUR 10–50m, and large companies EUR >50m. (Solakivi et al. 2009, 31)

Chapter 7 applies GLOCS to the data (of manufacturing and trading companies) of consecutive Finland State of Logistics surveys. The industry classification employed in these surveys for manufacturing companies is presented in Table 21.

Table 21 Background variables in Finland State of Logistics Surveys 2006, 2009, 2010, 2012 (manufacturing)

Question	Option No.	Industry; Manufacturing of…	N 2006	N 2009	N 2010	N 2012
Please choose the industry that best fits your firm's field of business.	1	…food products, beverages and tobacco	90	74	26	42
	2	…textiles and textile products	223	267	18	11
	3	…leather and leather products	34	27	2	4
	4	…wood and wood products	233	269	22	31
	5	…pulp, paper and paper products	205	71	4	7
	6	Publishing and printing	87	70	4	12
	7	…coke, refined petroleum products, and nuclear fuel	7	8	0	0
	8	…chemicals, chemical products and man-made fibers	30	22	14	13
	9	…rubber and plastic products	27	20	9	17
	10	…other non-metallic mineral products	10	4	2	9
	11	…basic metals and fabricated metal products	118	131	89	101
	12	…machinery and equipment	79	90	45	77
	13	…electrical and optical equipment	48	37	24	20
	14	…transport equipment	12	12	9	10
	15	Other manufacturing	77	66	44	72
	16	Construction	178	227	146	210
		TOTAL	1458	1394	458	636

Table 21 allocates a number to the industry, which is used in later chapters, and the number of respondents (N) in each industry. Numbers of respondents are indicated for all surveys. The corresponding figures for trading industries are presented in Table 22.

Table 22 Background variables in Finland State of Logistics Surveys 2006, 2009, 2010, and 2012 (trading)

Question	Option No.	Industry;	N 2006	N 2009	N 2010	N 2012
Please choose the industry that best fits your firm's field of business.	1	Retail: food, beverages and tobacco	52	39	10	17
	2	Retail: other	246	292	142	217
	3	Wholesale: food, beverages and tobacco	29	33	8	14
	4	Wholesale: other	205	246	123	158
	5	Agency	87	77	15	37
	6	Trade of motor vehicles, vehicle parts and accessories	74	62	29	56
	7	Trade of solid, liquid and gaseous fuels and related products	9	12	4	4
		TOTAL	**702**	**761**	**331**	**503**

Logistics costs were asked in respect of a six-component breakdown in the 2006, 2009, and 2010 surveys. Respondents were able to choose the appropriate level of logistics costs from a dropdown box showing full percentages from 0 to 100. In the 2012 edition, transport-packaging costs were included in transport and cargo handling costs, since few international surveys were separating these costs and doing so did not generate much added value to the results. In addition, respondents were able to enter the level of logistics costs themselves (i.e. without a dropdown box) to within one decimal point. In order to make the results commensurable the figures are rounded to full percentages in this study. This does not affect the results, as rounding off was done in the previous studies with the drop-down boxes. Questions related to logistics costs are presented in Table 23.

Table 23 Questions related to logistics costs in Finland State of Logistics surveys 2006, 2009, 2010, 2012

Question
Please estimate the following logistics costs of your firm expressed as percentages of firm turnover (Transportation and cargo handling)
Please estimate the following logistics costs of your firm expressed as percentages of firm turnover (Warehousing)
Please estimate the following logistics costs of your firm expressed as percentages of firm turnover (Inventory carrying costs)
Please estimate the following logistics costs of your firm expressed as percentages of firm turnover (Logistics administration)
Please estimate the following logistics costs of your firm expressed as percentages of firm turnover (Transport packaging) NOTE: COMBINED WITH TRANSPORTATION AND CARGO HANDLING COSTS IN THE 2012 SURVEY
Please estimate the following logistics costs of your firm expressed as percentages of firm turnover (Other logistics costs)

To increase the validity of the results, responses declaring logistics costs considered to be oversized (>39%) or zero cumulative costs were omitted from the analysis. Blank answers (all components empty) were also excluded. For respondents who only indicated the level of one or more cost component but left blanks, the other components were automatically registered as 0 (zero), the assumption being that they did not exist if the respondent was able to indicate the level of at least one component.

4.2.3 Designing and applying generic macro logistics cost model

Creating a generic logistics cost model has a central role in the study. This emphasizes the importance of extensive meta-analysis of previous research, conducted in chapters 2 and 3. The model itself is designed, based on the output of these chapters, in chapter 5. Since the steps involved in constructing the model are comprehensively presented and justified in chapter 5, the attributes of the model are not addressed at length here. However, Figure 66 gives an overview of the model construction methodology.

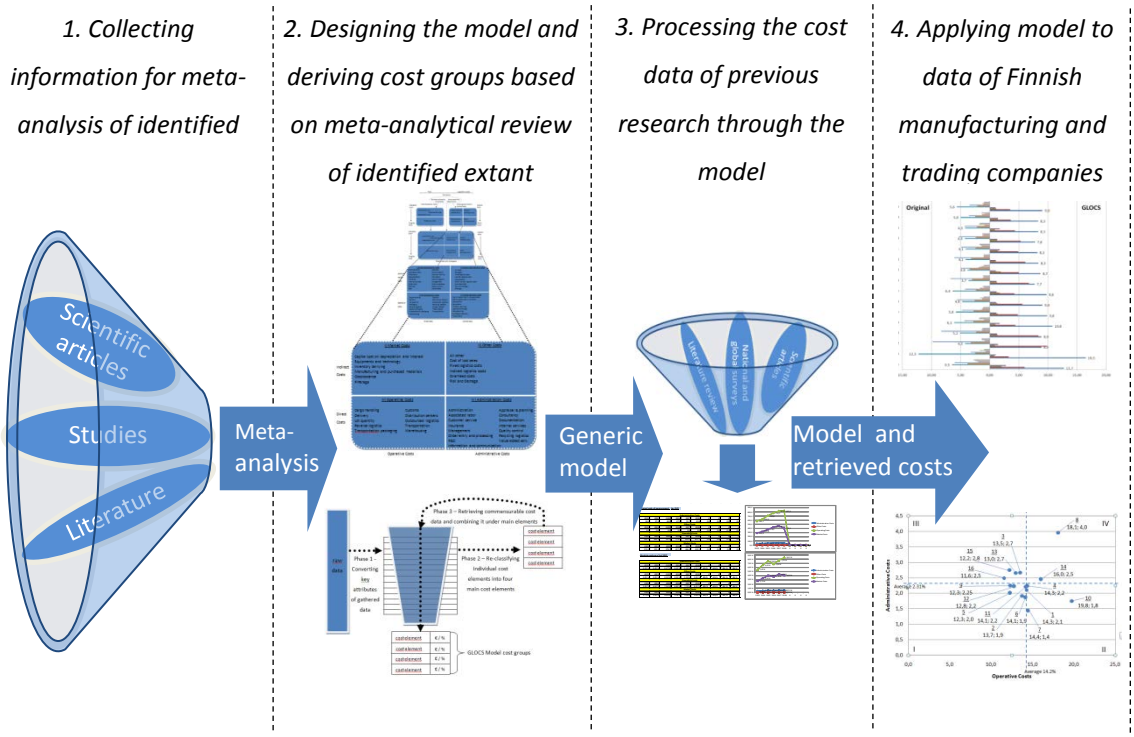


Figure 66 Phases of designing and applying the generic logistics cost model

As mentioned above, the model evolves from a meta-analytical review of previous research (phase 1), the output of which is used in the following phase. In order to create a generic logistics cost model (phase 2), the elements of logistics costs identified in the first phase are re-grouped using e.g. the transaction cost approach (TCA). After finishing the model, cost data from previous studies are retrieved and processed through the model (phase 3). Finally, cost data from Finnish manufacturing and trading companies, collected for Finland State of Logistics surveys, are applied to the model. Next, the results are analyzed in order to present the level of logistics costs for different industries in consecutive years (phase 4).

4.3 Reliability and validity of the research

Reliability, validity, and research ethics are major concerns in any research (Merriam 2009, 234). Despite the fact that every researcher tries to avoid mistakes, the possibility for errors is present. Therefore, as reliability and validity vary from one study to another, they are discussed here.

Reliability refers to the repeatability of results, which in other words means research's ability to generate non-random results. If the study is reliable, the results should be exactly the same regardless of the research time or the person conducting the research (McNeill and Chapman 2005, 9). Therefore reliability also refers to the accuracy of the results. In general, smaller samples produce more random results than large samples, which have higher reliability. (Heikkilä 2000, 30, 187; Hirsjärvi et al. 1997, 216)

Considering the reliability of this study, two issues need to be addressed: reliability of the model and reliability of empirical data. The model is based on the output of an extensive literature review, the methods and sources of which are specified in chapter 4.2.2. The number of reviewed pieces of identified extant research was 46 (excluding case studies that were not used as building blocks of the model), with broad geographical coverage. In addition, the search process was well developed and justified (see chapter 4.2.2). However, as there is no centralized documentation of previous logistics cost studies, it is impossible to state that no relevant sources have been neglected. Some additional uncertainty is related to possible studies published only in some other language than English. Such studies were only identified if English keywords or and English abstract were included.

Still, there are several aspects that advocate sufficient coverage of the reviewed research. First of all, the keywords for data search were carefully considered and all major word combination searches were conducted. Also, all studies found were included in the review, even if they were not entirely

published in English. In these cases a web translator was applied. This study has also received strong professional backing from a number of parties, as has been constantly commented on by staff at the Logistics Department of the Turku School of Economics. The study has been disseminated to other research and academic organizations worldwide for feedback (see e.g. OECD's discussion paper 201204), which has allowed commentary on the coverage of the reviewed material. Finally, the author's master's thesis, which is strongly connected to this study, was linked to an initiative of the World Bank and was reviewed by professionals with extensive experience of macro level logistics cost research.

Some reliability aspects are also related to datasets from Finland State of Logistics surveys that have been collected through online surveys. For example Kotzab et al. (2005, 87) discovered substantial technological and methodological advantages to using web-based surveys. Compared to traditional data, most of these advantages are related to low variable costs, short response time, and convenience. The disadvantages of web-based surveys include low response rate, high fixed costs, and lack of sample control. (Heikkilä 1998, 69; Kotzab et al. 2005, 87) The link to the web-based questionnaire of Finland State of Logistics studies was sent to approximately 16 000 Finnish companies in 2006, and around 26 000 companies in 2009 and 2010. The link to the 2012 survey was sent to almost 39 000 recipients.

The number of respondents (see Table 20) is considerable high, also in a global context. This markedly increases the reliability of the data and results. Some industries naturally had a very low number of responses, and the reliability of results in these cases should be assessed on a case-by-case basis. The exact number of respondents in certain industries is presented and analyzed in chapter 7.

Also the validity of the study needs to be discussed. Validity refers to the ability of chosen meters and methods to form a true picture of studied phenomena (McNeil and Chapman 2005, 9). In another words, the study measures the issues it is supposed to measure (Saunders et al. 2009 157).

Two dimensions of validity, internal and external, can be recognized. Internal validity is the validity (credibility) of causal relationship between theories and empirical results. (Heikkilä 1998, 29; Merriam 2009, 234) External validity, in turn, reflects the extent to which the results of particular research are generalizable to other relevant contexts (similarity of interpretations between author and other researchers). (Heikkilä 1998, 186; Saunders et al. 2009, 592)

In this study, the concept of validity is related to both credibility of the designed model and analysis of empirical data. The validity of model design is related to internal validity, i.e. how credible the theory is for empirical results. Internal validity is evaluated in the model-testing phase. Concerning the empirical part of the study, which is based on survey data, the validity is usually

connected to positioning the questions. This study employs datasets from Finland State of Logistics Surveys, which the author has co-authored. The questionnaire for these surveys was constructed by a research team with extended experience of conducting surveys. The questionnaire was available in both the official languages of Finland, Finnish and Swedish, which ensured geographical broadness of the data in the context of Finland. Several advantages of online survey exist compared to traditional questionnaires.

The questionnaire for Finland State of Logistics employed e.g. compulsory questions, dropdown boxes, and non-open questions. In general, the problems of questionnaires are mainly related to problems with interpretation, or even misunderstanding of the question. Problems might occur especially, as agreed in this study, with the concept of logistics costs, which seems to be rather inconstant. In the context of logistics costs, this could lead to different interpretations (the concept of logistics costs is considered to be narrower or broader than it was originally meant to be) among respondents.

Large samples reduce the possibility of errors caused by these interpretations. (Heikkilä 1998, 29) In the case of questions related to logistics costs, the respondent chose the answer from a dropdown box with a precision of one percent (excluding the 2012 edition – free numerical input field). Also the sample size was large, which diminishes the effect of possible interpretations. Still, a minor risk of misunderstanding always exists in every questionnaire. The employed question sets related to logistics costs (Table 23) were similar in each survey (excluding the 2012 edition – merger of two cost components). This allows direct comparisons to be made between years, without the possibility of errors related to distinct questionnaires.

5 GENERIC MODEL FOR ASSESSING LOGISTICS COSTS

A comprehensive review of previous research discussed in earlier chapters not only provided a unique outlook of macro logistics cost research, but the data is also exploited in building a more generic structure of logistics costs to be proposed in this study. The findings (classification of cost components) presented in the summary tables at the end of the subchapters are transferred as given into the model.

The main objective of this chapter is to create and describe the Generic Logistics Costs Structure (GLOCS) that is based on research presented in chapters 2 and 3. After designing and demonstrating the three phases of GLOCS and the MS Excel-based GLOCS Tool (chapter 5.1), an example of a possible approach to applying industry classification to GLOCS is provided. However, as many of the previous studies do not apply any industry classification, this is, at least in this study, only a theoretical approach is demonstrated with applicable identified extant research.

5.1 Generic Logistics Costs Structure (GLOCS)

The motivation of GLOCS is to make the results of different studies commensurable. This allows one to compare studies that originally employed different cost component breakdowns and means of reporting. GLOCS consists of three phases. First, in order to be able to create comparable results, the cost components of previous studies need to be extracted (Phase 1). As justified in chapter 1.4.2, there are some minor differences in the results when using % of GDP, or % of sales/turnover as a unit of measurement, but converting these units is not possible (or necessary) within the limitations of this study. If the results are reported as absolute costs, the GLOCS Tool systematically retrieves the national GDPs from the database of the International Monetary Fund (IMF) and converts absolute costs as a % of GDP. (International Monetary Fund, World Economic Outlook). Since studies also sometimes report results in different currencies, it is mandatory to convert local currencies into a common currency, which in this study is the euro (EUR). The method of currency conversion, which is also automatically carried out by the GLOCS Tool, is explained in the first chapter. Figure 67 illustrates the operating principle of GLOCS.

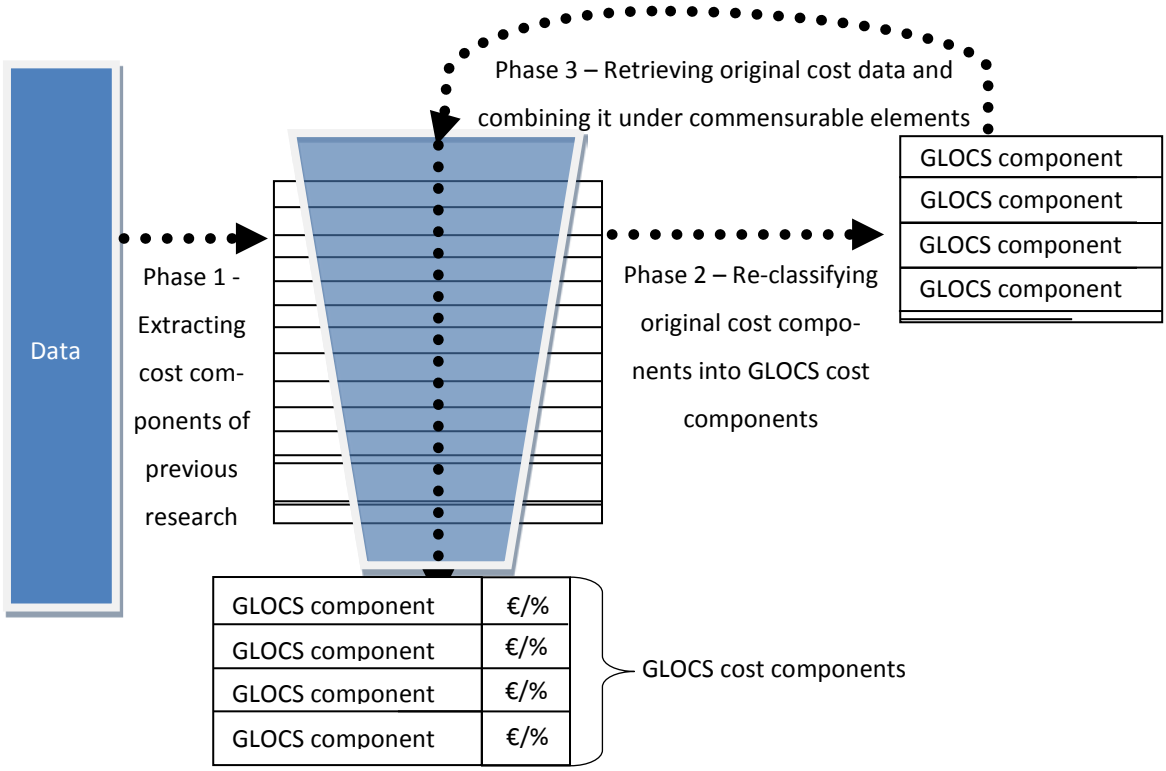


Figure 67 Operating principles of GLOCS (number of elements and block size are illustrative only)

In the second phase of GLOCS, the extracted cost components are re-classified under generic GLOCS cost components based on pre-defined attributes of components (Phase 2). GLOCS cost components are derived and justified in chapter 5.1.1. During the third phase, the original cost data is retrieved and processed according to GLOCS components. This process is demonstrated in chapter 5.1.2. After completing the process, it is possible to compare the macro logistics costs, originally applying different cost classifications.

5.1.1 Creating GLOCS cost components

The main purpose of this chapter is to relocate the various costs components that appear in the identified extant research into four main cost groups, henceforth referred to as GLOCS components. These four cost components are derived based on the fourfold table of logistics costs and TCA model, both presented in chapter 2.3. Based on the dimensions of these models, the cost components created in respect of direct/indirect costs and activity related/overhead logistics costs are labeled as:

- Indirect activity-related costs
- Indirect overhead costs
- Direct activity-related costs
- Direct overhead costs

First, all of the components of logistics costs that appear in the identified extant research are identified, after which the count of occurrences for each individual component is summed up. This allows clarification of the most frequently used components and elimination of duplicates. All cost groups mentioned in the identified extant research are presented in alphabetical order in Table 24 with the respective count of appearances. Additional information on combining the summary tables is given in Appendix 5.

Table 24 Aggregate of cost components in identified extant research

Sub Component of Logistics Costs	COUNT	Sub Component of Logistics Costs	COUNT
Administration	21	Management/overhead	1
Appraisal	1	Manufacturing	1
Associated labor	1	Obsolescence	3
Cargo handling	3	Order processing	2
Communication	3	Order processing / information	2
Consultancy	1	Other costs	13
Cost of capital	1	Other indirect log. costs	1
Cost of commodities space movement	1	Outsourced logistics	1
Cost of damage during transit	1	Packaging	6
Customer service	5	Permission losses	1
Customer service /order entry	2	Plan/management	1
Customs	2	Procurement	2
Damages	1	Purchased materials	1
Delivery	1	Quality control	1
Depreciation	1	R&D	1
Design, restructure and option cost	1	Recycling logistics	1
Distribution centers	1	Returned goods	1
Documentation	1	Reverse logistics	1
Equipment	1	Risk and Damage	3
Fixed costs	1	Shipper related	2
Forecasting	1	Stock-out costs	1
Indirect logistics costs	1	Substance consumption	1
Information	2	Tied capital costs (transportation)	3
Insurance	5	Trade costs	1
Internal logistics costs	1	Transport pack.	5
Internal services	1	Transportation	34
Inventory carrying	22	Wages, bonus, allowance	1
Logistics technology	1	Value-added services	1
Lot quantity	1	Warehousing	27

Next, the TCA model (see chapter 2.3.2 for more detailed information) and other approaches (i.e. fourfold table of logistics costs) are applied to position the cost components with respect to dimensions of direct/indirect costs and administrative/operative costs (see chapter 2.3). This process is derived and illustrated in Figure 68.

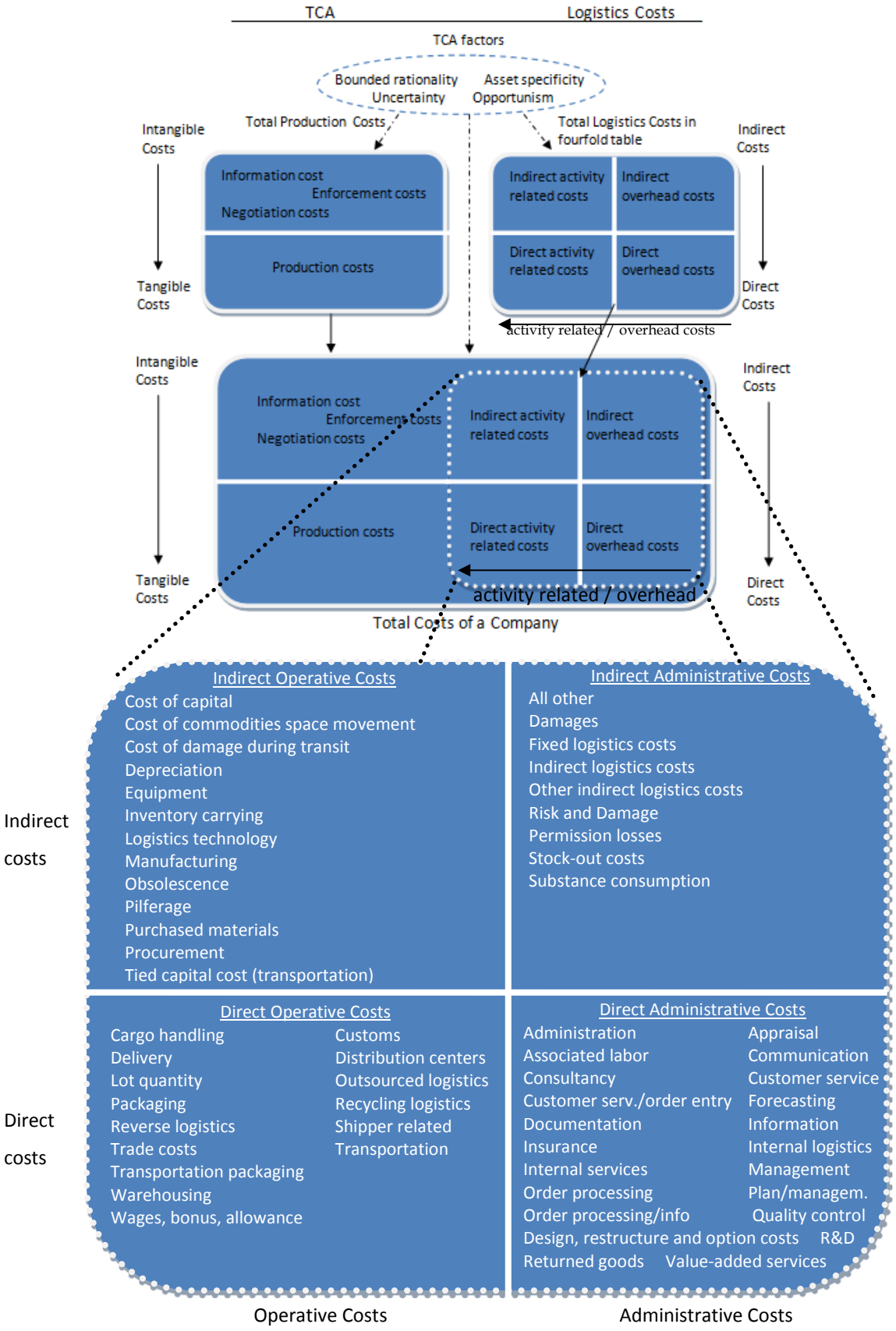


Figure 68 Combining TCA and logistics cost components under GLOCS components

Figure 68 has three dimensions resulting from the influence of four TCA factors (bounded rationality, uncertainty, asset specify, and opportunism). These dimensions, presented as three opposite concepts, are:

- Direct/indirect costs
- Tangible/intangible costs
- Activity-related/alternative costs

Understanding these dimensions helps to identify and position the logistics cost components. For methodological reasons (i.e. in order to avoid terminological misconceptions), one of the original dimensions of the TCA model (activity-related/alternative costs) is modified by adapting the opposite concepts of operative/administrative costs.

Operative costs are recurring expenses that are related to the logistics operations of a business, function, equipment, or facility etc. The opposite concept of operative costs is administrative costs incurred in controlling and directing organization and planning activities. These costs cannot be directly identified or linked to specific operations like production or marketing, but are rather related to organization as a whole. The comprehensive explanation of the differences between direct and indirect costs was provided earlier in chapter 2. The distinguished difference between these two is that direct costs can be easily addressed to certain cost objects like a department or product. Indirect costs, on the other hand, are more difficult to assign.

Since all costs groups were transferred directly to the fourfold table in

Figure 68, the model is simplified by eliminating a few costs groups with identical purposes but slightly different names. Also the final cost components of GLOCS (Figure 69) are renamed and transferred to the GLOCS Tool, which is presented later.

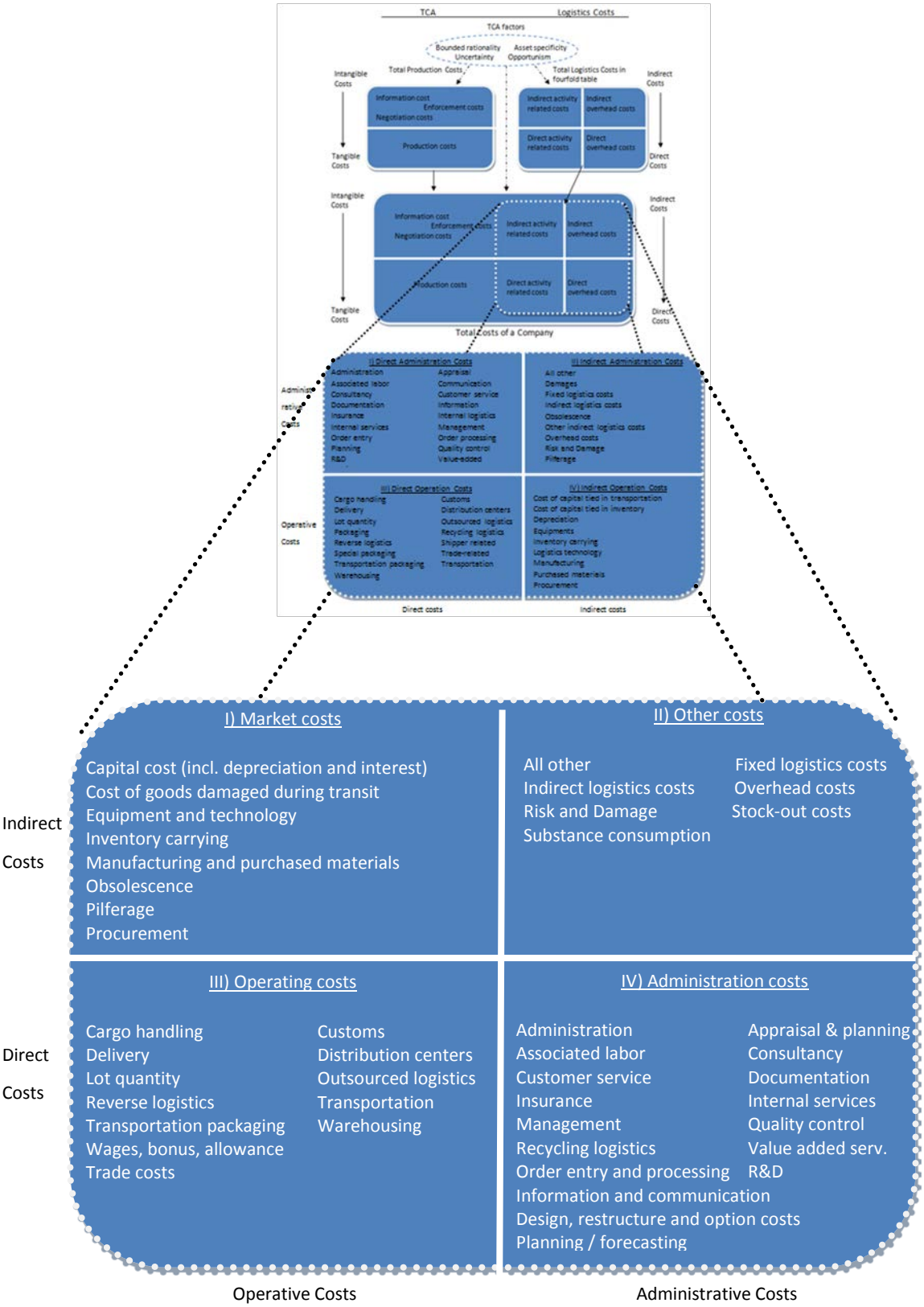


Figure 69 Combining the final cost components for GLOCS

Starting from the top left corner in the fourfold table of Figure 69, the first GLOCS component is *I) Market Costs*. These costs are indirect but can be still related to a given logistics operation like warehousing. A good example of costs in this component is inventory-carrying costs. It is characteristic for the costs of this component to be linked to operative activities, which do not necessarily (but may) create added value for the customers, but still need to exist. For example, inventory-carrying costs can be high due to high inventory levels, which guarantee shorter delivery times, creating added value to the customer.

The second GLOCS component is *II) Other Costs.* This sector includes costs that can be characterized as indirect but cannot be directly linked to a given logistics operation. Some common costs in this component are risk and damage costs, as well as fixed logistics costs, which are both usually caused by several operations and cannot be easily addressed to a specific one.

Moving to direct operative costs leads to the GLOCS component that is usually considered a core of logistics costs: *III) Operating Costs.* Transportation, warehousing, and packaging costs are typically assigned to this cost component, the elements of which can be easily linked to direct logistics operations.

The last GLOCS component is *IV) Administration Costs*. The costs in this component are direct and can be related to certain administrative activities (note: the term administrative should not be understood too narrowly in this context). The typical cost elements in this area are e.g. administration and management costs, as well as customer service and documentation, which are linked to management activities. The four GLOCS components are defined together and the general attributes of each one given in Table 25.

Table 25 Attributes of GLOCS components

	Cost Element	Costs include:
I) Market costs	Capital cost (incl. depreciation and interest)	Cost of capital (debt and equity) acquired for certain operations from different sources. Realized as paid interests or depreciation
	goods damaged (transit)	Cost of goods damaged during transportation
	Equipment and tech.	Purchase expenditures of equipment and technology for logistics
	Inventory carrying	Costs of holding finish products in inventory or during transportation. Includes cost of capital and service of inventory operations
	Manufacturing and purchased materials	Cost of holding work-in-process (manufacturing) and raw (purchased) materials in stock
	Obsolescence	Obsolescence that can be addressed to a certain logistics function
	Pilferage	Costs of internal and external pilferage
	Procurement	Costs of logistics related to procurement activities
II) Other costs	All other costs	Includes all logistics costs not directly related to certain operations and cannot be assigned to any other component
	Fixed logistics costs	Logistics costs that are not operation related and remain relatively the same in terms of output level
	Indirect logistics costs	Costs of joint usage of logistics functions
	Overhead costs	Indirect overheads that cannot be assigned to certain goods or service
	Risk and Damage	Costs of downsizing risk and avoiding damage in the organization
	Stock-out costs	Lost incomes due to inability to fulfill orders
	Substance consumption	Miscellaneous consumption caused by logistics activities
III) Operating costs	Cargo handling	Costs of loading, moving and unloading cargo
	Customs	Costs related directly to custom clearance
	Delivery	Cost of transferring goods or services to the customer
	Distribution Centers	Direct costs of maintaining the distribution center
	Lot quantity	Costs of inability to meet economic lot quantity
	Outsourced logistics	Costs of outsourced logistics operation
	Reverse logistics	Costs related to reuse of products incl. pulling back of defective ones
	Trade costs	Overall costs of trading (e.g. stevedoring)
	Transportation	Costs incurred from moving items from one location to another
	Transportation pack.	Costs of packaging product for transportation
	Warehousing	Costs of physical functions associated with storage of goods and material
	Wages,bonus,allowance	Wages etc. of personnel carrying out logistics activities
IV) Administration costs	Administration	Costs of staff in administrative and supporting functions
	Appraisal and planning	Costs of staff in analytical and planning functions
	Associated labor	Costs of labor associated to administrative functions not related directly to certain operation
	Consultancy	Cost of consultancy related to directing the organization
	Customer service	All costs incurred from interactions between organization and customer
	Documentation	Costs of preparing commercial documents for general use
	Design/restrict./ option	Costs caused by design and structuring logistics activities
	Insurance	Cost of insurance for the organization
	Planning / forecasting	Cost of planning and forecasting of logistics operations
	Internal services	Costs of supporting services for the whole organization
	Management	Management costs incurred from controlling and directing the organization and planning activities
	Quality control	Costs of quality control functions for all operations
	Order entry/processing	Costs of work related to processing orders in the organization
	Recycling logistics	Costs of recycling logistics as a part of the organization's supporting functions, not as a core business
	R&D	Costs of functions discovering solutions to problems/creating knowledge
	Value-added services	Cost of function aimed at creating advantage to add value of services/products
	Information and communication	Costs of physical solutions and staff working with information and communication tasks in organization level.

In order to utilize GLOCS, one needs to retrieve the collected data from previous studies and relocate the cost components and data in respect of the four GLOCS components. However, this can be only done with studies that declare component-specific cost figures or equivalent information. Chapter 5.1.2 introduces the MS Excel-based GLOCS Tool, which helps significantly by providing an efficient and accurate data processing ability, and which also converts currencies and units of measurement automatically (the process of converting currencies to GDP is explained on page 29).

5.1.2 Retrieving cost data with the Excel-based GLOCS Tool

Retrieved original cost data are combined under the four GLOCS components by filtering the data through the MS Excel GLOCS Tool. The operational principles and phases of the tool are described in this chapter.

The first phase of the GLOCS Tool (Figure 70) is data input, covering background information (country, year of data, currency, and scale of measurement) of the relevant study. The background cells also include a built-in dropdown list, which allows the user to enter only such values that have a counterpart in the currency exchange rate and country-specific GDP database sheets. Also original cost components have a dropdown list, which contains all individual cost components found in the review of identified extant research.

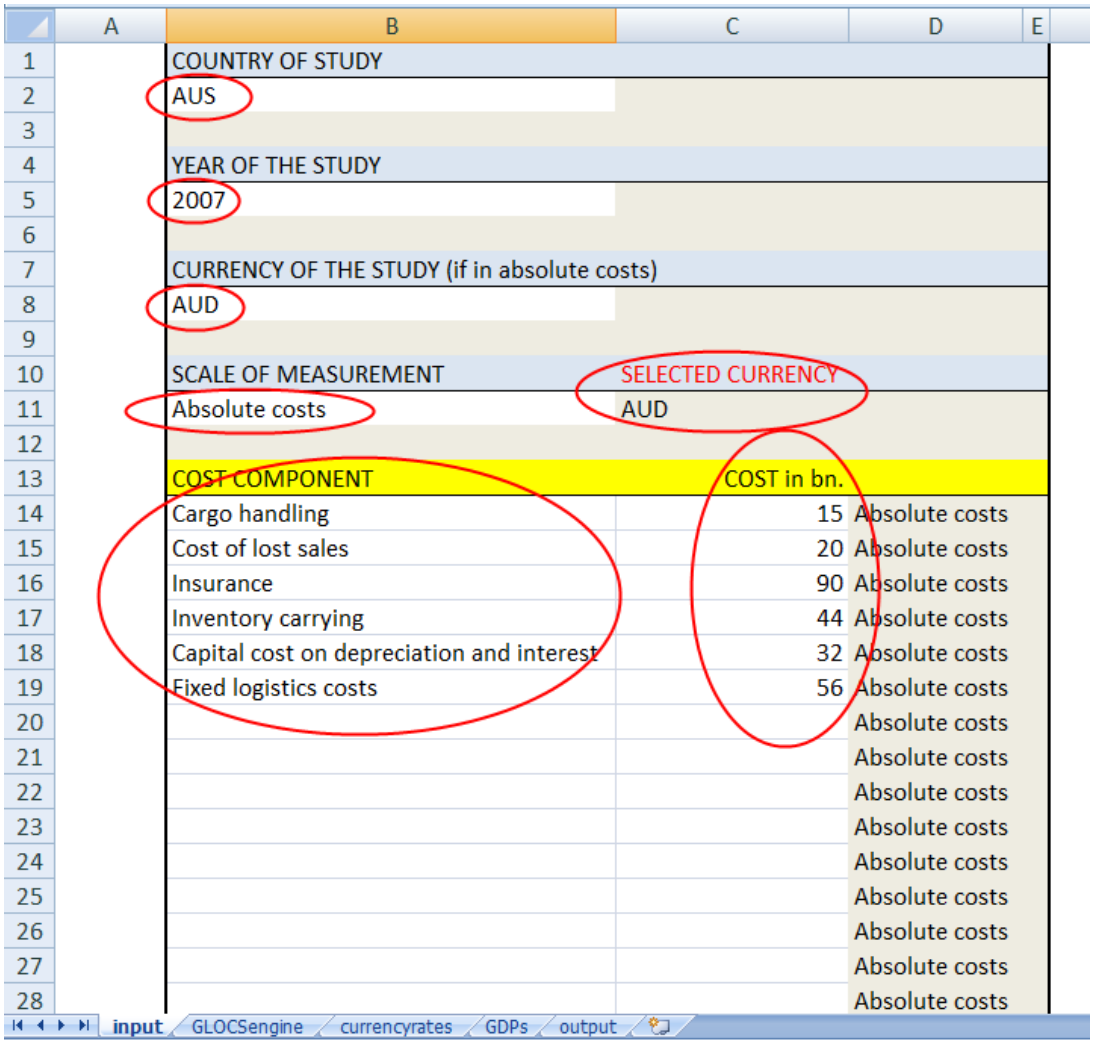


Figure 70 Screenshot of the GLOCS Tool input phase (figures are illustrative only)

The country of study cell specifies the country where the original study was conducted. This allows the GLOCS Tool to automatically convert the scale of measurement from absolute costs to a % of GDP by retrieving the GDP data of the country in question.

The purpose of specifying the year of the study data has two aspects. First, it allows the GLOCS Tool to retrieve the GDP data from the same year's statistics. The GLOCS Tool also has an in-built currency rate converter, which converts the currencies employed in the original study into euro using the currency exchange rate year the study data were collected. The GLOCS Tool database covers GDP information for 182 countries from 1980 to 2011 (estimation) in current prices. Currency exchange rates are available in 39 currencies from 1980, at the rate of each year's first week day. Currency data are retrieved from the statistical database of the ECB and GDP data from the database of the IMF.

The last background information needed is the scale of measurement in the original study. Three options are in-built: 1) % of GDP, 2) absolute costs, or 3) %

of sales/turnover. Where the original study employed absolute costs or % of GDP, the results are automatically quoted both ways.

The actual cost input is done in the cost component fields. In this phase it is possible to pick the cost component from 59 logistics cost components based on the outcome of review of identified extant research and relocated in accordance with TCA (see chapter 5.1.1). The user may enter up to 16 different cost components from 10 different years, allowing the GLOCS Tool to create comparable results from several years.

Based on the background variables and cost components input by the user, the GLOCS Tool relocates the cost data under the four GLOCS components. GLOCS also automatically converts absolute costs into euro, based on the exchange rate of the year the original study was conducted. The interface and operational principles of the GLOCS engine sheet are illustrated in Figure 71.

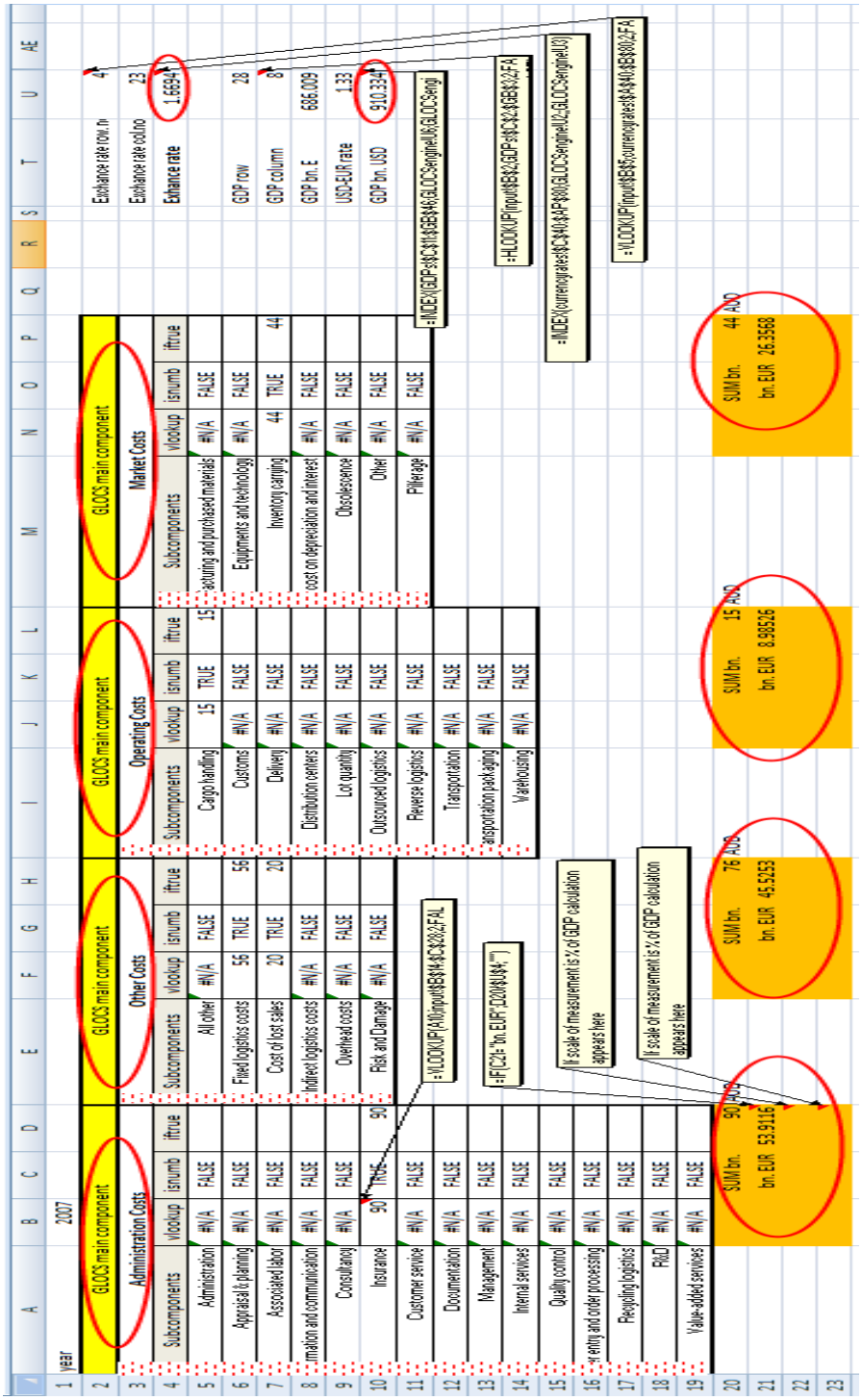


Figure 71 GLOCS Tool calculation engine (figures are illustrative only)

As illustrated in Figure 71, the GLOCS Tool combines the original components (thick dashed red line) of logistics costs and relocates them under the four GLOCS components (circled with a thin red line). As mentioned above, the GLOCS components are: 1) administration costs, 2) other costs, 3) operating costs, and 4) market costs. After relocating the components, the values of the

GLOCS components are generated in one of the orange cells depending on the scale of measurement. If the scale of measurement is absolute costs, the GLOCS Tool retrieves euro currency exchange rates in respect of the year of conduction and original currency (thin red circles in the rightmost column). Next, the costs in euro per GLOCS component appear in the orange cells. Also the GDP data of the country in question are retrieved and presented below the currency rates on the right. This allows the GLOCS Tool also to calculate costs as a % of GDP, even if data is input as absolute costs. If the user inputs the data as a % of GDP or as a % of sales/turnover, these figures also appear in the orange cells. The GLOCS Tool is able to process the cost data from 10 years at a time. The outline of currency rates and GDP datasheets are further presented in Appendix 6.

The final phase of the GLOCS Tool (Figure 72) presents the values of GLOCS components as an original scale of measurement (upper result box) in respect of each input year. Also the chart on the right side of the values is automatically generated by the GLOCS Tool.

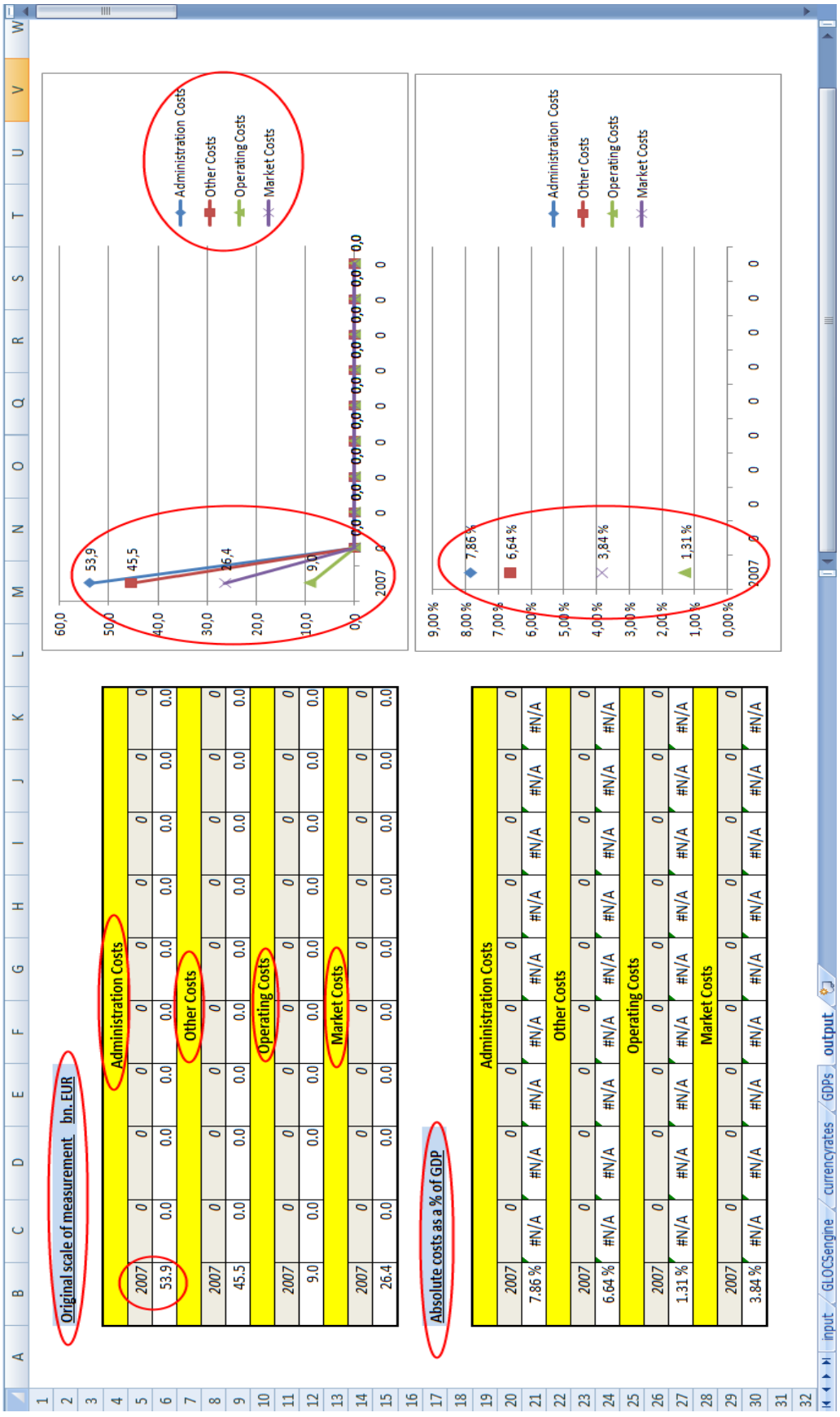


Figure 72 GLOCS Tool output phase (figures are illustrative)

If the original data was input as absolute costs, the GLOCS Tool automatically generates the share of costs as a % of GDP per GLOCS component. The values are presented in the lower result box. As above, the chart is generated automatically in this case as well. The GLOCS Tool is further presented in terms of real world cost data in chapter 6.

5.2 Motion to apply industry classification to GLOCS

As concluded in the review of identified extant research, different authors quote logistics costs with very different classifications. This also applies to the classification of respondents. Some studies present results with high accuracy (in terms of industry classifications), while many employ a looser grouping, even though logistics costs differ significantly from one industry to another. Thus, presenting only the industry-aggregated results may in some cases give the wrong impression of cost level.

In theory, this problem can be tackled relatively easily by applying some official industry classification. However, this requires sufficient information regarding the profile of respondents, which was not the case with most of the reviewed studies. Only six statistics-based studies and surveys (one and five respectively) of all reviewed studies gave either industry-classified results or adequate data (i.e. breakdown of respondent industries) to apply it. These are prerequisites for calculating industry-classified results. Even if sufficient information is available, additional problems may evolve from minor divergences of several industry classifications.

In the case of insufficient data there is little one can do, but different classifications can be made comparable with each other. This requires grouping of results according to some international classification. In this study the International Standard Industrial Classification of All Economic Activities (ISIC) is proposed. The first version of ISIC was adopted in 1947. ISIC, developed and maintained by the United Nations Statistical Division, has become widely used in both national and international contexts. (United Nations Statistical Division: ISIC Statistical Paper Rev.4, ix-x) It has also been broadly employed by several national statistics organizations, like Statistics Finland, as a basis for developing a national industrial classification (Statistics Finland).

The latest review of ISIC took place in 2000. The objective of the review was to strengthen its relevance and compatibility with other classifications like ANZSIC (Australia and New Zealand), NACE (Europe), and NAICS (North-America). (United Nations Statistical Division: ISIC Statistical Paper Rev.4, ix-x) The classification used by Eurostat (NACE Rev.2) is consistent with ISIC

Rev.4, which further guarantees international compatibility. (Eurostat Indicators Newsletter February 2009, 2)

5.2.1 Detailed structure of ISIC

ISIC employs a four-level structure of mutually exclusive industry categories. The first-level categories are called sections, identified alphabetically A-U. Each section is divided into more detailed categories, referred as divisions. Divisions are numerically coded with two-digit numbers. Similar numeric coding is also applied in third level classification (three-digit coding), of which sub-divisions are referred as groups. Sub groups in fourth level (four-digit coding) are called classes (Figure 73). (United Nations Statistical Division: ISIC Statistical Paper Rev.4, 3; 11)

- A-U SECTIONS (i.e. C –Manufacturing)
  - 01-99 DIVISIONS (i.e. 10 –Manufacture of food products)
    - 011-990 GROUPS (i.e. 107 -Other food products)
      - 0111-9900 CLASSES (i.e. 1072 –Sugar manufacturing)

Figure 73 Detailed ISIC structure with examples (United Nations Statistical Division: ISIC Statistical Paper Rev.4, 3)

Compared to earlier ISIC editions, fourth review provides a more detailed classification at all levels. Together with the comparability to national and regional statistic classifications, the edition provides a strong foundation for suggesting ISIC as the choice of classification method.

5.2.2 Suggested process for applying industry classification

As mentioned above, there are two main problems with applying industry classification to data of previous logistics cost research. However, it is possible to suggest how this should be applied where sufficient data are available. In theory, it is possible to apply the classification at all ISIC levels, from Sections to Classes, but in practice the first level classification is accurate enough. This means that all respondent groups are relocated under 21 ISIC Sections (Figure 74). Further justification for this is that a more accurate classification would mean a smaller number of respondents in each category, in some cases creating samples that are too small for reliable conclusions.

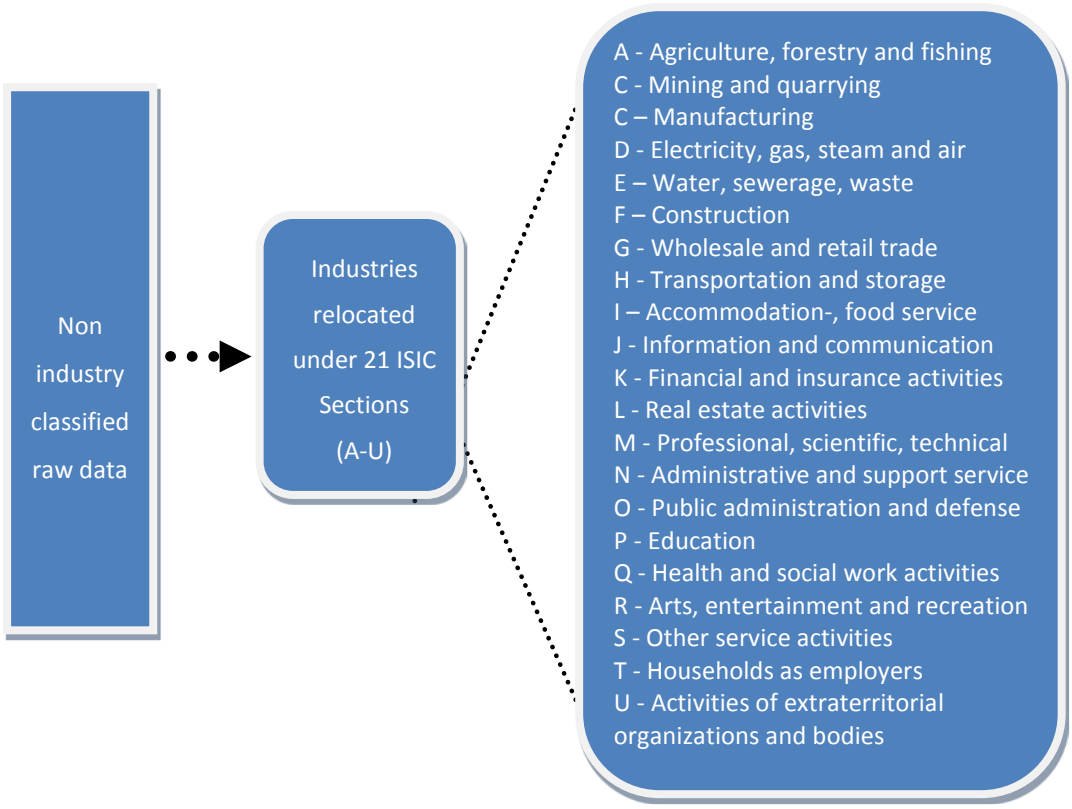


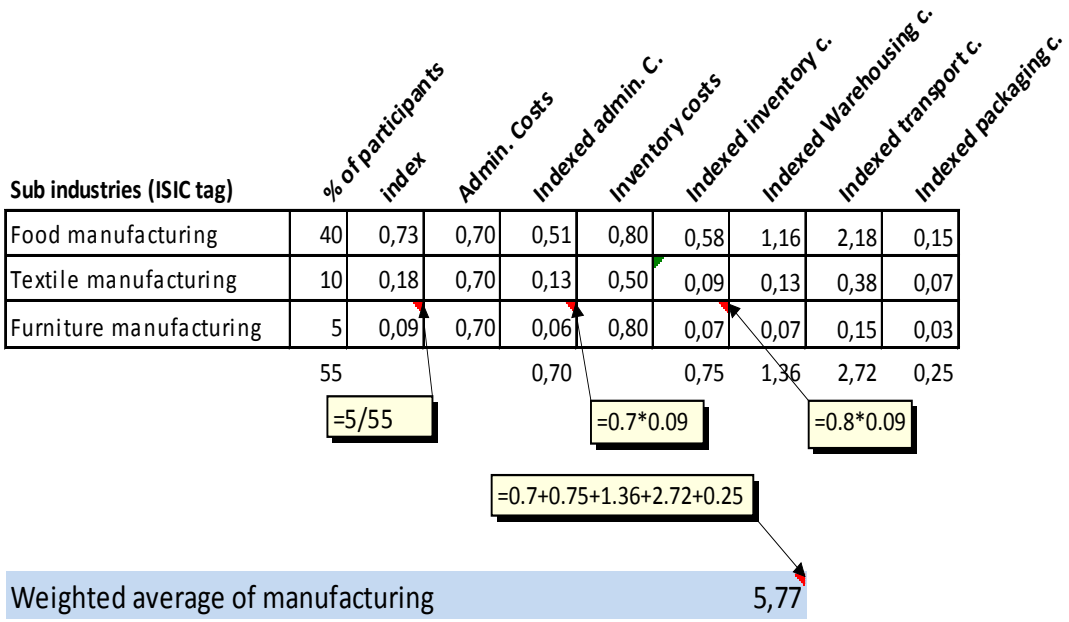
Figure 74 Proposed industry classification process (partly adapted from the United Nations Statistics Division)

As shown in Figure 74, the first-level classification is in itself quite accurate, precluding the need for a more accurate classification and thus overly small sample sizes as mentioned above. Of course a more accurate classification can be applied if study is, for example, conducted within a certain industry or data are collected mainly from a certain group of respondents.

The purpose of applying ISIC is to increase the value and compatibility of the results. By adapting a comprehensive and internationally harmonized classification of this kind, industry-specific results from different countries on different continents become comparable.

Finally, since different studies may have presented their results with very different accuracies, the weights of respondent quantities from different industries must be taken into account. This is suggested to be done by calculating the index-weighted averages for each respondent subgroup and summing these to get the weighted average of ISIC Sections. This is demonstrated in Table 26 for Section C, Manufacturing.

Table 26 Example of calculating weighted averages (figures are illustrative only)

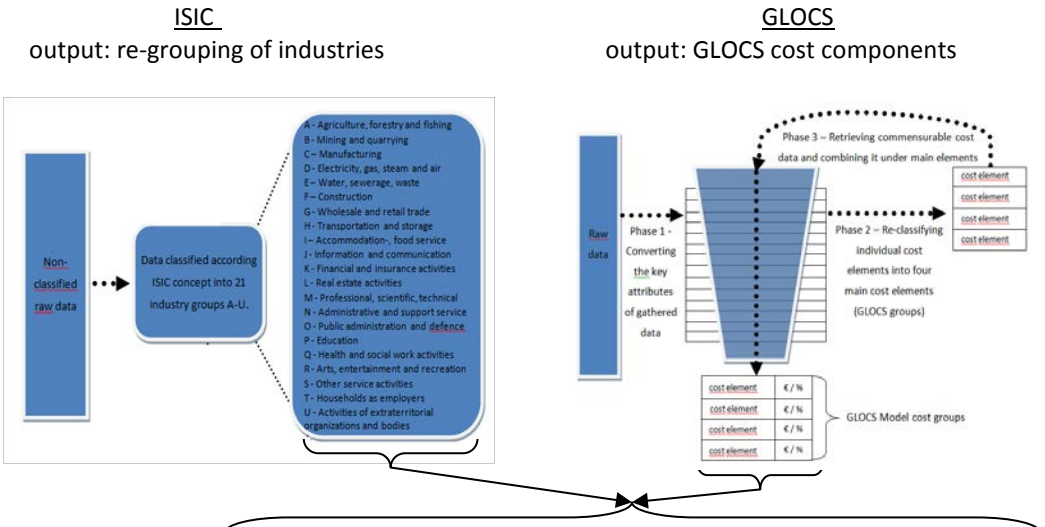


Sub industries (ISIC tag)	% of participants	index	Admin. Costs	Indexed admin. C.	Inventory costs	Indexed inventory c.	Indexed Warehousing c.	Indexed transport c.	Indexed packaging c.
Food manufacturing	40	0,73	0,70	0,51	0,80	0,58	1,16	2,18	0,15
Textile manufacturing	10	0,18	0,70	0,13	0,50	0,09	0,13	0,38	0,07
Furniture manufacturing	5	0,09	0,70	0,06	0,80	0,07	0,07	0,15	0,03
	55			0,70		0,75	1,36	2,72	0,25

Weighted average of manufacturing	5,77

As with applying industry classification, the calculation of weighted averages is only possible when sufficient information is available. In practice this means that at least the share of respondent groups per all respondents needs to be available along with the respective cost information. Adapting industry classification to GLOCS is discussed in the next chapter.

In an ideal situation, the proposed industry classification can be adapted to GLOCS to increase the informational value and add industrial aspects to macro logistics cost research. GLOCS alone provides important information regarding logistics costs of different cost elements, and allows analysis and comparison of the logistics costs between countries or regions. Applying ISIC broadens the scope of research to differences between industries (Figure 75).



Industry	Administration Costs	Operating Costs	Other Costs	Market Costs
C - Manufacturing	2	9	3	5
F - Construction	3	10	2	5
G - Wholesale and retail trade	4	11	1	6

Figure 75 Applying industry classification to GLOCS (figures are illustrative only)

In chapter 6, GLOCS is applied to the data of previous research introduced in chapter 3. This can be done for all previous statistics-based studies and surveys; however, case and other studies do not provide sufficient information. Furthermore, only a few statistics-based studies and surveys provide sufficient information for applying ISIC. In such cases, as demonstrated in the following chapter, industry classification is advised to be applied first and GLOCS after that.

Using the weighted approach is slightly trickier when converting costs from absolute costs to GDP. As mentioned above, weighting of existing studies is often a difficult task because of inadequate background data. In general, one applicable approach could be using the weight of an industry's turnover in relation to GDP that would allow weighting based on the industry's contribution to GDP. In a Finnish study, the findings of which are analyzed in Chapter 7, weighting was done based on aggregated turnover of industry.

6 APPLYING GLOCS TO PREVIOUS RESEARCH

GLOCS was comprehensively introduced in chapter 5, and the method for applying industry classification along with the problems related to that were discussed. The main purpose of chapter 6 is to apply GLOCS to the results of previous research presented in chapter 5. The chapter also briefly demonstrates the suggested methodology of applying ISIC industry classification in order to point out the problems that emerged.

Chapter 6 has two main sections. As industry classification is suggested to be applied first, chapter 6.1 looks at the suggested methodology for doing so. However, as sufficient data for applying ISIC was not available in the greater share of identified extant research, industry classification should be considered mainly from a methodological and exemplary point of view. The results according to ISIC are given for those studies that did provide sufficient background information. Chapter 6.2 concentrates on re-presenting and systematizing the results of identified extant macro logistics research in accordance with GLOCS. This subchapter takes an explanatory view to previous results, trying to systemize and re-present the results of identified research by applying GLOCS.

6.1 An attempt to re-classify the raw data of identified extant research according to ISIC

Chapters 2 and 3 reviewed 66 identified extant publications related to macro logistics costs. Excluding textbooks and some articles, all of these also indicated the level and/or structure of logistics costs at some level. As explained above, due to insufficient information industry classification can only be applied to some of these. Correspondingly, some pieces of previous research have already given logistics costs in accordance with ISIC. These results and the re-processed results of the few studies that had sufficient information for applying industry classification are presented here. It should be noted that industry classification is applied before GLOCS, meaning that the results presented in this subchapter are not GLOCS compatible.

The principles of classifying industries, ISIC, and calculation of weighted averages were explained and demonstrated in chapter 5.2.2. Thus only one example is comprehensively described here. The results of other studies and more specific information on calculations are given in appendices 7.1–7.4.

6.1.1 Example of applying industry classification to the results of the survey by ELA

Supply-Chain-Excellence in der globalen Wirtschaftskrise (2009) conducted by ELA (see also 3.2.1.3) was selected to demonstrate the industry classification process, since it provides sufficient information with appropriate industry distribution and cost breakdown. The study quotes logistics costs in five industrial sectors: machinery/electronic, process, consumer/media, automotive, and retail.

To make the results commensurable (in respect of industry classification) with the results of other studies, it is necessary to calculate the average logistics costs according to ISIC. The first step is to assign reported logistics costs (reported at the level of five industrial sectors in the ELA study) according to ISIC level one as shown in Table 27.

Table 27 Re-classification of industries according to ISIC

Study	Industry sectors	ISIC division ID	Corresponding ISIC section ID
ELA	**Machinery / electronics**	*28/27*	C - Manufacturing
ELA	**Process**	*16,24*	C - Manufacturing
ELA	**Consumer / media**	*47/58*	G - Wholesale and retail trade
ELA	**Retail**	*47*	G - Wholesale and retail trade
ELA	**Automotive**	*45*	G - Wholesale and retail trade

The letter in the right hand column indicates the ISIC section (level one ISIC classification), which is the accuracy of industry classification used in this study. The original industry sectors of ELA being re-assigned to the main sections C and G, it is now possible to calculate the weighted averages for these groups. This process is demonstrated in the following tables.

Table 28 Computing weighted average costs for trading companies in the ELA study as a % of sales (data source: Supply-Chain-Excellence in der Globalen Wirtschaftskrise 2009)

Sub industry	% of participants	index	Administration	Inventory	Warehousing	Transportation
Consumer	25	0.51	0.10	1.07	1.12	1.99
Automotive	13	0.27	0.13	0.27	0.40	0.80
Retail	11	0.22	0.09	0.07	0.27	0.36
	49		0.32	1.40	1.79	3.14
Weighted average of wholesale and retail trade					6.66	

In Table 28, the logistics costs (administration, inventory carrying, warehousing, and transportation) are weighted by the share of participants in each retail sub-industry (consumer, automotive, retail). By summing the weighted logistics costs in each cost component, the total logistics costs for wholesale and retail trade were 6.66% of sales. In Table 29, the same process is repeated for the results of manufacturing companies.

Table 29 Computing weighted average costs for manufacturing companies in the ELA study as a % of sales (data source: Supply-Chain-Excellence in der globalen Wirtschaftskrise 2009)

Sub industry	% of participants	index	Administration	Inventory	Warehousing	Transportation
Machinery	19	0.56	0.73	0.67	0.61	1.96
Process industry	15	0.44	0.57	0.62	0.53	2.12
	34		1.13	0.88	1.45	3.11
Weighted average of manufacturing					6.57	

Correspondingly, the total weighted logistics costs for manufacturing were 6.57% of sales. The results presented in Table 28 and Table 29 are comparable to all results following the ISIC Rev. 4 classification or similar. As the process of applying ISIC is described here, the next subchapter presents only the industry classified results of identified extant research that provided sufficient information.

6.1.2 Results of applying industry classification to identified extant research

Based on information and data from previous studies, industry classification can be applied (or similar industry classification and methodology is already employed) for the following sources:

- Colombia National Logistics Survey (COL)
- Finland State of Logistics Studies
- Grocery Manufacturers Association (GMA)
- Logistikmarktstudie Schweiz (CHF)
- LogOn Baltic (LB)
- State of Logistics Surveys for South Africa (RSA)
- State of Logistics: The Canadian Report (CAN)
- Studies of European Logistics Association (ELA)
- Studies of Transportbrukernes Fellesorganisasjon (TF)
- Sourcing and Logistics in China (CHI)
- Survey of The Institute of Transport Economics, Norway (TÖI)
- Trends and Strategies in Logistics: Global Networks in an Era of Change (STR)

Only the results are presented here; additional information on calculation is given in Appendices 7.1–7.4. For studies that already quoted costs per industry in the original version, no calculations are presented. The industry classification process itself is comprehensively demonstrated above. The data and results of Finland State of Logistics surveys also provide extensive industry classified cost data, and this is analyzed in chapter 7.

Table 30 Industry classified results of identified extant research as a % of turnover

Manufacturing								
Study	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**
CAN*				7.1		5.8		
CHF****								19.4
CHI						13.5		
COL						13		
ELA							6.57	
GMA*****			6.9			6.9		6.75
LB					15.3			
RSA**		30.6			133			
STR***						7.0		
TF	9.1							
TÖI								13.7
Trading								
Study	**00**	**04**	**05**	**06**	**07**	**08**	**09**	**10**
CAN*				11.5		5.69		
CHF****								6.63
CHI								
COL						4.7		
ELA							6.66	
GMA*****								
LB					13.7			
RSA**		150			141			
STR***						15.9		
TF	9.2							
TÖI								16.7

* % of GDP, Canadian companies only; **bn ZAR; ***% of total costs, ****bn CHF, ***** of sales

The logistics costs in Table 30 are divided into two main industries, manufacturing and trading, according to ISIC. As shown in the table, the data from previous studies show some differences between these two industries in the level of logistics costs. The most significant difference is identified in *Trends and Strategies in Logistics: Global Networks in an Era of Change*, according to which the share of logistics costs as a % of total costs in manufacturing is less than in the trading industry. However, this large difference can be attributed at least partly to the scale of measurement. The results of the State of Logistics Survey for South-Africa and Logistikmarktstudie in Switzerland are automatically converted into a common currency and also presented as a % of GDP.

In addition to insufficient information being provided in most studies for applying industry classification, a further problem after this was the number of respondents in certain industries being too small for reliable results. This was the case especially with questionnaire-based surveys where industry classification cannot even be applied to studies that provided enough information due to problems with sample size. However, this subchapter provides a methodology for applying industry classification to macro logistics costs. This is not further discussed in this study, but it should be noted that the industry classification employed in chapter 6.2 is equivalent to ISIC.

6.2 Processing the cost data of identified extant research through GLOCS

As the operational principles of GLOCS are comprehensively explained in the previous chapter, only the re-processed results of identified extant research are presented here. Since the number of previous studies is relatively high, only the results of the very latest studies are tabulated here. More comprehensive results with respective input attributes (i.e. year of study, currency, and original cost components), historical data and charts are presented in Appendices 8.1–8.28. It should be noted that although the numbers and cost components are converted into a uniform scale with GLOCS, the original data were collected with various methods and it is thus impossible to comprehensively evaluate the relevance of these studies. However, given the lack of data this uncertainty can be tolerated.

The results below are split into three tables based on the scale of measurement. Below each table the level of logistics costs is also illustrated with bar graphs. Table 31 summarizes the GLOCS-processed results of studies that gave their results as a % of sales/turnover. If the study also quotes the results as both % of turnover/sales and as absolute costs, the results are presented in Table 32 (absolute costs) or Table 33 (percentage of GDP). Percentage of GDP is the preferred scale of measurement for putting as many studies as possible in commensurable form.

Table 31 Logistics costs of previous research according to GLOCS as a % of sales or turnover (*scale of measurement is % of total costs)

Study	Applied models*	Industry classify-cation	Year of data	Admin-istration costs	Other costs	Operat-ing costs	Market costs	Corres-pond-ing appen-dix No.
Canada	IG	Manu-fact.	2008	2.7	0	2.1	1.7	8.9
Canada	IG	Trading	2008	1.2	0	0.7	1.5	8.8
Canada (US)	IG	Manu-fact.	2008	1.2	0	3.2	1.4	8.7
Canada (US)	IG	Trading	2008	0.8	0	1	0.8	8.6
Davis	G	All indus-tries	2010	0.7	0	5.8	1.8	8.10
ELA	IG	All indus-tries	2008	0.8	0	5.3	1.2	8.5
ELA	IG	Manufac t.	2008	0.3	0	4.9	1.4	8.4
ELA	IG	Trading	2008	0.3	0	1.8	1.4	8.3
France *	G	All indus-tries	2008	4	0	11.6	0	8.21
GMA	G	All indus-tries	2010	0.3	0,3	4.6	0	8.11
LogOn-Baltic	IG	Manu-fact.	2007	1.7	0.9	7.9	3	8.24
LogOn-Baltic	IG	Trading	2007	1.7	1.2	8.5	3.7	8.24
Straube	IG	Manu-fact.	2008	1	0	16.3	0	8.2
Straube	IG	Trading	2008	4	0	10	0	8.1
TF	IG	Manu-fact.	2001	0.9	0	8.2	0	8.17
TF	IG	Trading	2001	1	0	8.2	0	8.17

* (I – industry classification, G – GLOCS)

The table above presents, where feasible, both industry classified (manufacturing and trading) and general results according to GLOCS. The left side of the table provides the study in question, applied models (GLOCS, industry classification), breakdown of industries, and the year of the data. The level of each GLOCS cost component is indicated in the yellow-headed columns. The rightmost column indicates the number of the corresponding appendix, which provides the complete GLOCS output, data, and charts for historical comparison.

As shown in the table, most of the studies provide relative recent data. Interestingly, there are not many studies that contain “other costs” after applying GLOCS. This in a way indicates that GLOCS is a feasible tool for converting the results into a more general format. In order to discuss the differences and commonalities in the studies, the following figures illustrate the most recent

results. Figure 76 provides the breakdown of logistics costs in accordance with GLOCS in the manufacturing industry as a % of sales or turnover. Also the level of total logistics costs is indicated.

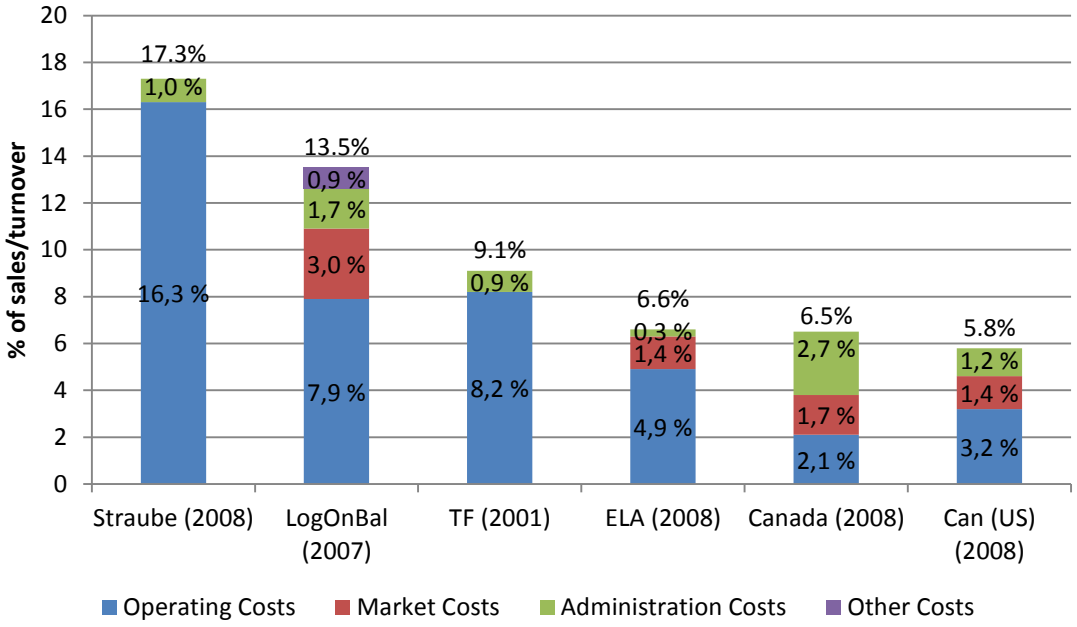


Figure 76 Level of logistics costs in manufacturing industries according to GLOCS as a % of sales/turnover

Figure 76 shows that the level of total logistics costs of manufacturing companies varies quite significantly from one study to another (from 5.8% to 17.3% of sales/turnover). One factor explaining this is the different geographical areas of the studies. According to the majority of studies, the logistics costs in North America are lower compared to e.g. Europe. Furthermore, Canadian studies employed statistics-based methods that usually give lower levels of logistics costs than surveys. On the other hand, the ELA study (see 3.2.1.3) was based on a survey and it indicated almost the same level of logistics costs in Europe and North America. Thus too heavy generalizations should be avoided.

The share of operating costs accounted for more than half of total logistics costs in almost all studies. A relatively high level of logistics costs, indicated by Straube et al., raises questions about the methodology and results of the study, but since the survey was broad (897 German companies and 155 EU companies) methodological issues are not sufficient to explain the discrepancy, nor is it relevant or possible to do so. Interestingly, the results of the LogOn Baltic survey also indicated high figures of logistics costs in Germany. To conclude, the share of German respondents may raise the average in both surveys. Again, this provides a good example of the difficulties of comparing different studies. On the

other hand, the TF study gives logistics costs for manufacturing industries as 9.1% of turnover/sales, which is in line with other studies in the Nordic countries even though the study was conducted at the start of the 21st century.

Other cost components were within a much smaller range. Only the level of administration costs in Canada was somewhat exceptional and based on information available, no specific reason for this can be pointed out. In Figure 77, the level of logistics costs for trading industries is presented according the GLOCS components.

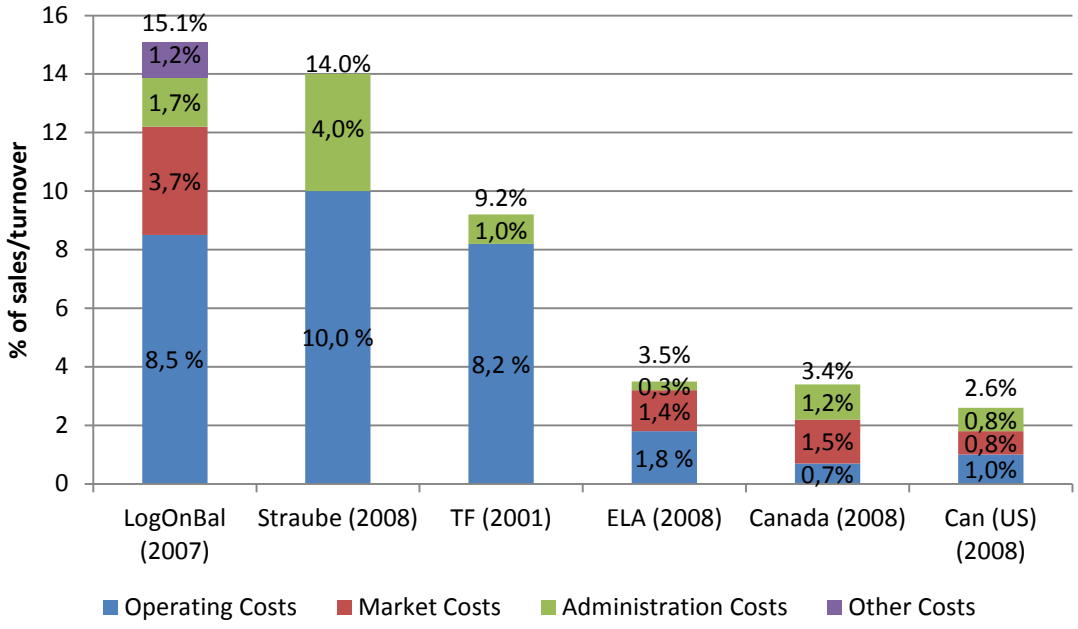


Figure 77 Level of logistics costs in trading industries according to GLOCS as a % of sales/turnover

As shown in the figure above, the distribution of logistics costs is slightly different for trading industries to that for manufacturing (Figure 76). Again the variance between studies is significant (from 15.1% to 2.6%). The logistics costs for trading companies seems to be clearly highest in the BSR, followed by the EU, U.S. and China (Straube et al. 3008) and then Norway (TF). All of these studies employed a survey method and indicate somewhat similar levels with corresponding figures for manufacturing industries. Several studies agree that logistics costs are lower in North America, but surprisingly the gap between the LogOn Baltic and ELA studies is very high even though these employ the same method and were conducted at the same time in relatively the same area. A partial explanation may lie in the difference in sample size (ELA <100, LogOn Baltic >1 200), which can distort the results, and again this shows the prevailing problem of making different studies commensurable. In general, most studies

indicated a lower level of logistics costs for trading than for manufacturing industries.

Excluding Canada, operating costs accounted for around half or more of logistics costs in all reviewed studies. Also the share of market costs and administration costs varied relatively a lot. Finally, the latest logistics costs for all industries as a percentage of sales or turnover are illustrated in Figure 82.

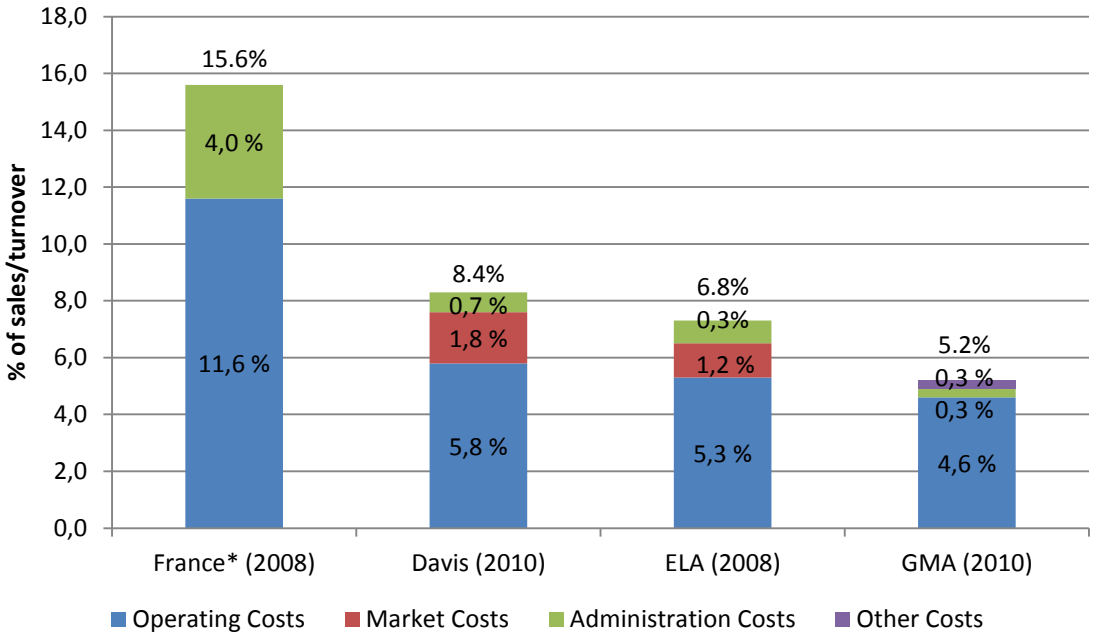


Figure 78 Level of logistics costs according to GLOCS as a % of sales/turnover (*measured as a % of total costs)

Figure 82 shows the latest figures from four studies. One main conclusion can be drawn: the average level of logistics costs is around 7% according to multi-country studies (ELA, Davis, and GMA). The slightly lower level in the GMA study can be attributed to most companies in the survey operating in the grocery industry (whether they were manufacturing or trading companies), with grocery industry-specific issues (e.g. lower warehousing and inventory carrying costs as products cannot be stored for long periods). On the other hand, the results of the French study cannot be directly compared to multi-country studies. However, as the GLOCS results indicate, operating costs form a major part of total logistics costs, while other cost components are smaller.

Table 31 gave the results of studies that indicated logistics costs as a % of turnover or sales; table 32 gives the results of studies that reported logistics costs in absolute costs. As discussed earlier, the original cost data in different currencies is automatically converted into euro by the GLOCS Tool (see 1.4.2 for the methodology of currency conversion). Table 32 shows the latest absolute costs

according to GLOCS. More comprehensive results are provided in the Appendices.

Table 32 Logistics costs of previous research according to GLOCS as absolute costs (bn EUR)

Study	Applied components*	Industry classification	Year of data	Administration costs	Other costs	Operating costs	Market costs	Corresponding appendix No.
China (CFLP)	G	All industries	2010	102	0	703	0	8.18
China (KPMG)	G	All industries	2006	52.4	0	345.8	0	8.26
CSCMP	G	All industries	2010	32.7	0	534.4	275.2	8.16
Japan	G	All industries	2007	0	12	279.6	0	8.28
Klaus	G	All industries	2010	37	0	633	205	8.12
Netherl.	G	All industries	2009	5	0	43	9.7	8.22
S Africa	G	All industries	2009	4.7	0	15.6	4.4	8.15
S Africa	IG	Manufact.	2007	3	0	11.8	1.9	8.13
S Africa	IG	Trading	2007	3.2	0	12.2	1.9	8.14
Switzerland	G	All industries	2009	0	3.5	19.7	0	8.23
Thail.	G	All industries	2008	3.5	0	18.9	16.2	8.20
Sweden	G	All industries	2005	4.3	0	9.7	10.6	8.21

* (I – industry classification, G – GLOCS)

Only studies of logistics costs in Switzerland and Japan reported costs under another category. On the other hand, neither of the logistics studies regarding China (CFLP and KPMG) or Japan indicated any market costs, because the original studies had a cost component of warehousing costs that may cover both storage and inventory-carrying costs. In the majority of studies, inventory-carrying costs comprise their own cost group as the nature of these differs from warehousing/storage costs. In GLOCS, storage and warehousing costs are located under operating costs, as these are directly related to operational activities, while inventory-carrying costs fall under market costs due to the nature of these costs. This is yet another great example of the complexity of measuring macro logistics costs, and justifies the need for using generic cost component taxonomy like GLOCS. Excluding the State of the Logistics Study for South Africa, none of the

studies applied industry classification, nor did they provide sufficient information to apply ISIC. The GLOCS results in absolute costs are illustrated in Figure 79.

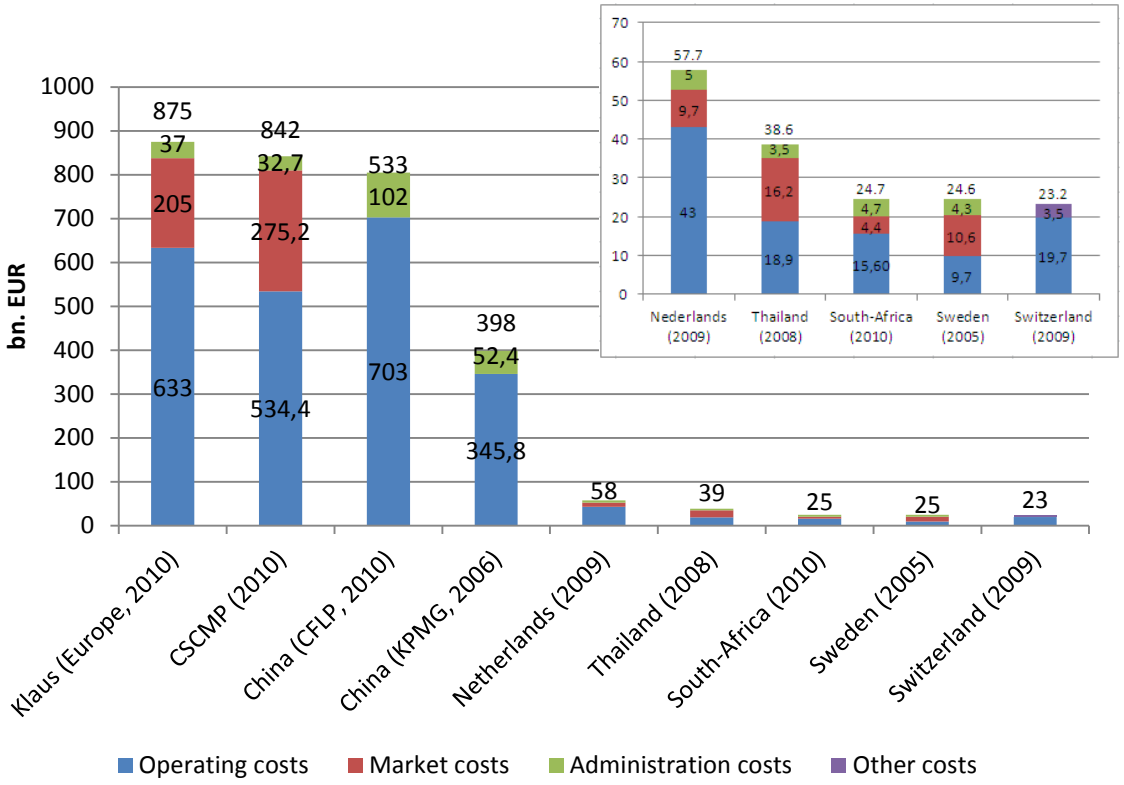


Figure 79 Level of logistics costs according to GLOCS in bn EUR

As shown in the figure, the logistics costs in Europe are at the same level as those in the U.S. and China. The situation is, however, different when comparing costs to GDP, which for the U.S. is around three times larger than for China. Europe's logistics markets are characterized by larger operating costs compared to the U.S., while market costs are higher in the U.S. This could at least partly be attributed to energy (mainly petrol) prices that are lower in the U.S. due to e.g. differences in taxation. The high share of operating and administrative costs in China may indicate inefficiency of logistics networks and administration. Also, as neither study on China included the market costs component, it is possible that some market costs were included in administrative costs. It should also be remembered that studies look at the situation from different years. Especially those reflecting the situation before and after the 2008 recession are affected by the downturn having cut logistics costs.

The logistics costs of individual economies in Europe, Asia, and Africa varies from EUR 58bn to EUR 23bn. These are of course heavily dependent on the size of the country. Switzerland suffered from high logistics costs that can partially be explained by geographical/topographical aspects like the Alps, while market costs were remarkably high in Thailand and Sweden. In Sweden this is mainly

explained by the 25% interest rate on inventory-carrying costs. The share of administration costs was solid in all countries. Industry classified results (in absolute costs) for South Africa are presented in Figure 80.

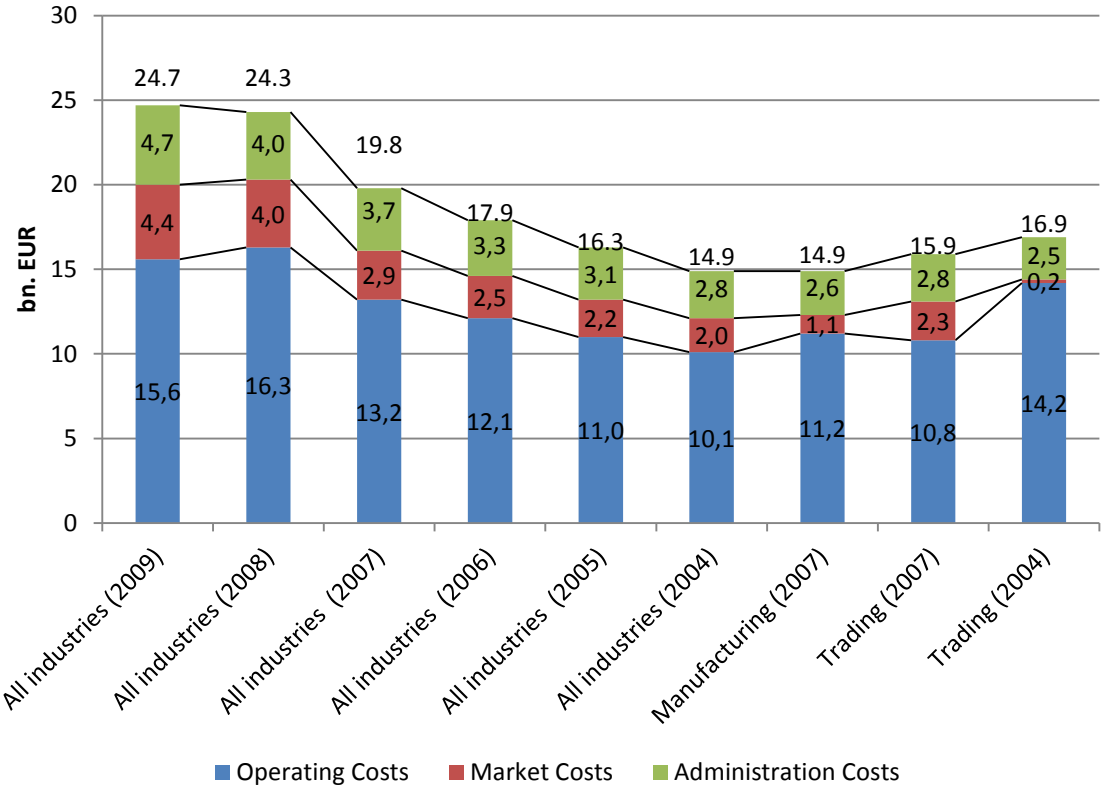


Figure 80 Logistics costs for South Africa according to GLOCS in bn EUR

Figure 80 shows the logistics costs of South African manufacturing companies in 2007 and trading companies in 2007 and 2004. The level of costs was slightly higher for trading companies, even though the trend was downward. From 2004, accumulated costs for all industries are presented on the left. According to the results, logistics expenditures in absolute costs increased from 2004 to 2009 by 10%. However, this figure needs to be compared with economic growth (i.e. GDP) in order to study whether the relative level of costs has also increased.

In order to get more information concerning the ratio of logistics costs to economic growth, the results of previous studies are compared to GDP, which is one of the rare widely-acknowledged indicators of macro-economic activity. The results according to GLOCS are presented as a % of GDP in Table 33.

Table 33 GLOCS output as a % of GDP

Study	Applied compo-nents*	Industry classification	Year of data	Admin-istration costs	Other costs	Operat-ing costs	Market costs	Corres-pond-ing appen-dix no.
China (CFLP)	G	All industries	2010	2.79	0	19.22	0	8.18
China (KPMG)	G	All industries	2006	2.33	0	15.39	0	8.26
CSCMP	G	All industries	2010	0.32	0	5.23	4.09	8.16
Japan	G	All industries	2007	0	0.36	8.47	0	8.28
S Korea	G	All industries	2008	0.4	0	12	0	8.27
Neth-erl.	G	All industries	2009	0.88	0	7.55	1.7	8.22
S Africa	G	All industries	2009	2.33	0	7.81	2.22	8.15
Swit-zerland	G	All industries	2010	0	0.99	5.65	0	8.23
Thail.	G	All industries	2008	1.87	0	10.17	8.72	8.20
Vinno-va	G	All industries	2005	1.59	0	3.57	3.92	8.19

* (I – industry classification, G – GLOCS)

Administration costs were the highest for South Africa and China, where they accounted for over 2% of GDP. In South Africa, logistics administration costs were as high as 4.7% of GDP. Over 10% of GDP operating costs occurred in China (19.22% / 15.39%), South Korea (12%) and Thailand (10.17%). Operational and overall logistics costs were the smallest in the U.S., Switzerland, Sweden, and the Netherlands, all of which are considered developed countries in the field of logistics activities. The results of Table 33 are illustrated in Figure 81 from the largest total logistics costs to the smallest.

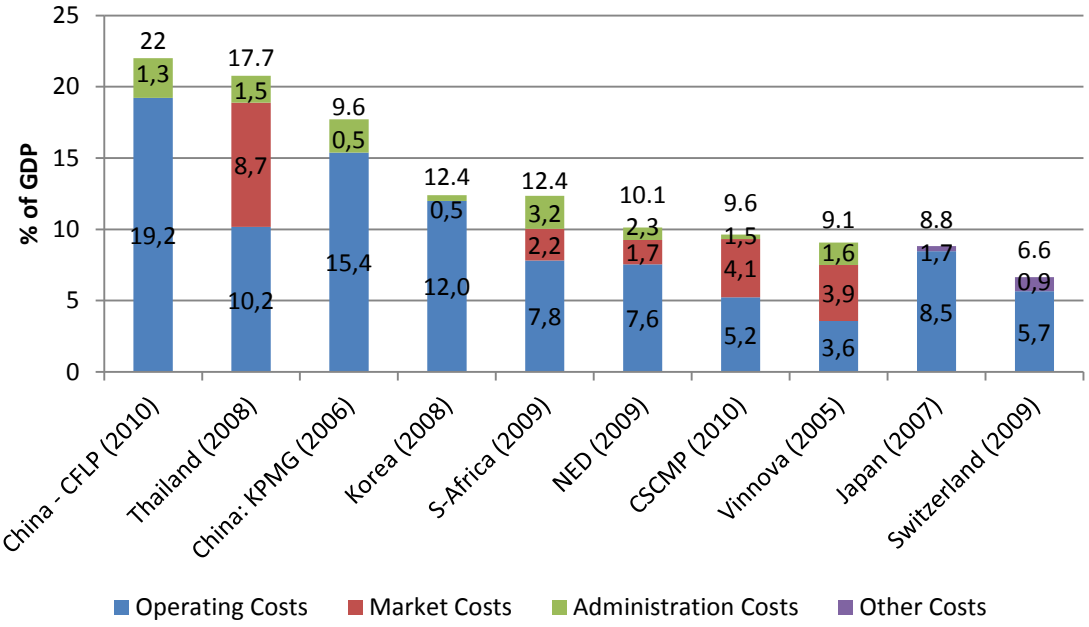


Figure 81 Level of logistics costs per cost component according to GLOCS as a % of GDP

As seen in the figure, the logistics costs were highest in China and Thailand, which partly attributable to the general stage of development in these countries. South Korea and South Africa both hit total logistics costs of 12.4% of GDP, which positions them between developed and developing countries. Logistics costs in European countries, Japan, and the U.S. varied from 6.6% (Switzerland) to 10.1% of GDP (Netherlands). The low level of logistics costs in Switzerland indicates the efficiency of their logistics system and infrastructure, given the challenges posed by the country's topography. However, a partial reason for the low logistics costs/GDP ratio lies Switzerland's high GDP per capita. This shows that investments and policies can increase the efficiency of the logistics network. Thailand and the U.S. seemed to suffer a particularly high share of market costs. This may be because of high interest rates for capital tied in inventory. It does not, however, explain the high level in the U.S. (2010), as interest rates have fallen following the global recession in 2008. The reason may also lie in high inventories caused by an inability to adapt supply to falling demand. In the Swedish case, the high level of market costs is mainly due to the measurement methodology concerning inventory-carrying costs that are calculated as 25% of warehousing costs. Excluding the Swedish study, the operating costs were clearly the largest individual cost component in all studies. Despite the fact that the results of surveys indicated a higher level of logistics costs than statistics-based studies, the difference between developed and developing countries was evident. This is also one of the main outcomes of the chapter. It should again be considered that the studies were conducted in different years, and especially

those describing the situation before and after 2008 most likely reflect the downturn in the economy, causing lower logistics costs.

The complete output from the reclassification process for each study is provided in the appendices, with a more comprehensive comparison of historical cost data and some illustrative figures.

7 ANALYSIS OF LOGISTICS COSTS IN FINNISH MANUFACTURING AND TRADING COMPANIES ACCORDING TO GLOCS

This chapter applies GLOCS to the data of Finland State of Logistics surveys for comprehensive analysis and discussion of industry-specific logistics costs. First, the results of the latest Finland State of Logistics surveys are presented. Next, an extensive analysis of logistics costs in Finnish manufacturing and trading companies is conducted according to GLOCS. This analysis, based on data from Finland State of Logistics Surveys in 2006, 2009, 2010, and 2012, aims to analyze the structure of logistics costs in different industries and to identify the direction of development and the reasons behind it. Analyses are conducted by presenting real life data systematically with historical series. The results are concluded in chapter 8.

7.1 Logistics costs in Finland State of Logistics surveys

This chapter delves into the empirical data of Finland State of Logistics surveys that were first introduced in chapter 3.2.2.2 (overview) and in chapter 4.2 (methodological issues). The chapter is further divided into two sections. The first presents the results of the surveys, while second further analyses the results by applying GLOCS. As the author was a member of the research group, no references are given here.

7.1.1 Results of Finland State of Logistics surveys 2006, 2009, 2010, 2012

Logistics costs are divided into six cost components: transportation, warehousing, inventory carrying, transport packaging, and other logistics costs. This grouping was employed in the surveys from 2006 to 2010. In the latest edition from 2012, transport packaging costs were combined with transportation costs. This follows the example of several other studies, and also in GLOCS these two are presented under the same cost component.

The largest individual cost component is transportation costs, which represented 4.6% of turnover in 2011 (4.4% in 2009, 6.3% in 2008, 5.1% in 2005). Transport packaging costs are included in these figures. The second and third

largest groups were inventory-carrying (3.0%) and warehousing costs (2.6%), followed by the smaller cost groups of logistics administration (1.2%) and other logistics costs (0.7%). All individual cost groups, excluding logistics administration costs, increased from 2005 to 2008 with a 1.1% rise in total logistics costs. The growth was significant especially in transportation costs, which were up by 1.2% of turnover. This development was mainly due to the well-developing global economy, which suffered a major drawback as the recession started at the end of 2008. From 2008 to 2011 the total logistics costs fell by 2.1% to 12.1% of turnover. The most significant decline occurred in transport costs, which ended below the 2005 level with 4.6% of turnover. The development is illustrated in Figure 73.

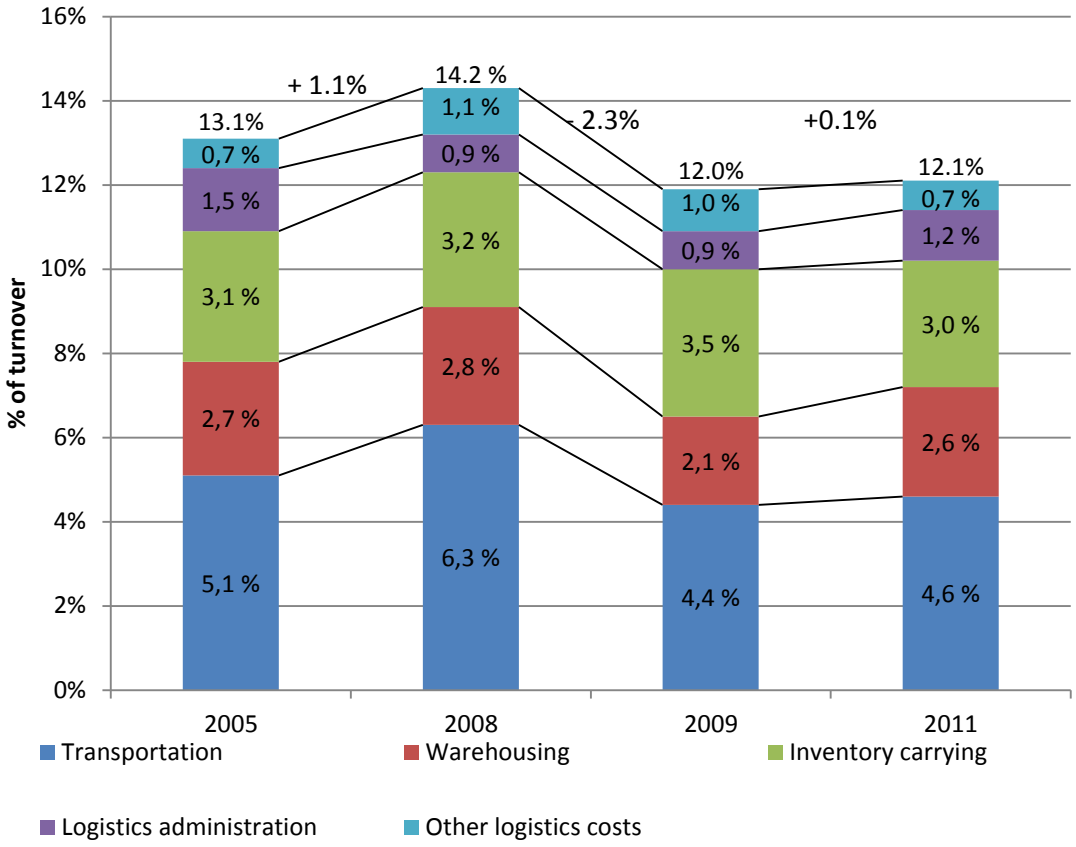


Figure 82 Logistics costs in Finnish manufacturing and trading enterprises as a % of turnover in 2005, 2008, 2009, 2011 (weighted by turnover of respondent and of industries)

The rapid increase in transport costs from 2005 to 2008 seen in the figure was the main factor behind the rise of total logistics costs. Increased transport costs were mainly due to the rise in crude oil price, overheating of the global economy, and the rise of salaries. The rise of crude oil price led to where growing fuel costs of logistics service providers were being transferred to pricing, increasing the

transport costs of users. At the same time, the overheated global economy created a growth in demand, and as the supply could not follow this demand, prices rose. Also salary costs in the field of logistics rose faster than the general development of prices at the time. At the end of 2008, the global economy started a sharp downturn, plunging the world into recession. As the demand for logistics services dropped, a significant volume of free transport capacity resulted in global logistics markets. This further pushed down transport prices, causing a decline in transport costs as companies that wanted to stay in business lowered their prices. It should also be noted that logistics service provision is highly resource-intensive industry, which makes it hard to compensate declining demand with other means than lowering prices. Transport costs fell from 6.3% of turnover in 2008 to 4.6% in 2009.

The second largest logistics cost component for Finnish manufacturing and trading companies is inventory-carrying costs, which have stabilized around 3% of turnover. The relatively high level of inventory-carrying costs can be attributed mainly to long transportation distances both to and within Finland, encouraging companies to increase their inventory levels. Keeping high inventories can also be seen as a way to maintain service level. This naturally increases the capital costs of holding the inventory. This cost component was not affected by the recession.

The third major cost component is warehousing costs, the development of which follows the same trend as transport costs. From 2005 to 2008 there was moderate growth of 0.1%, but from 2008 to 2009 there was a decline of 0.7%. This was followed by rather significant increase from 2.1% to 2.6% from 2009 to 2011. The level of warehousing costs also depends at least somewhat on general economic development. As the economy slows down, companies use less money for logistics activities like warehousing. Of course, in the short term the adjustment of costs is only possible if the company is able to cut warehousing costs (e.g. size of the workforce) rapidly. In practice this is possible if warehousing services are outsourced or the size of the workforce can be otherwise adapted rapidly. Hence, the outsourcing of e.g. warehouse staff is today relatively popular.

The remaining cost components, administration and other logistics costs, seem to be at a relatively stable level in terms of the share of total logistics costs. However, quite large proportional changes have also occurred. These include the fall of logistics administration costs from 1.5% to 0.9% in 2008. A decrease in some the cost components, like in this case administration costs, may indicate that the internal efficiency of logistics processes in Finnish companies has improved. This can in some cases also be explained by outsourcing decisions. Other logistics costs have stabilized at around 1.0% of turnover. The historical development of logistics costs is shown in Table 34.

Table 34 Development of logistics costs in Finland (2011 prices)

Indicator	1990	1995	2000	2005	2008	2009	2011
Logistics costs (bn EUR)	20.7	17.0	21.8	32.4	42.3	35.1	33.1
Logistics costs (% of turnover)	11.0	10.3	10.2	13.1	14.2	11.9	12.1
Transport costs (% of turnover)	4.8	4.7	4.5	5.0	6.3	4.4	4.6

As shown above, the range of logistics in Finland has been 10.2–14.2% of turnover over the past two decades. Absolute logistics costs increased steadily from 1995 to 2008, but have since fallen to EUR 33.1bn. As discussed above, the trend of decreasing costs has been mainly due to the global downturn.

The development of logistics costs as a share of turnover has followed the same track as absolute costs. An increase occurred between 1995 and 2008, after which the ratio fell. This indicates that logistics costs grew faster than turnovers developed. As a result it can be said that the efficiency of logistics should be promoted. The development of the most significant individual cost component, transportation costs, followed the development of total logistics costs with certain exceptions. Between 2000 and 2005, the development of transport costs was relatively slower than total logistics costs.

A broad set of background variables was emphasized in Finland State of Logistics surveys. This makes it possible to further explore the impact of company size (Figure 83) and manufacturing mode (Figure 85) on the level and structure of logistics costs.

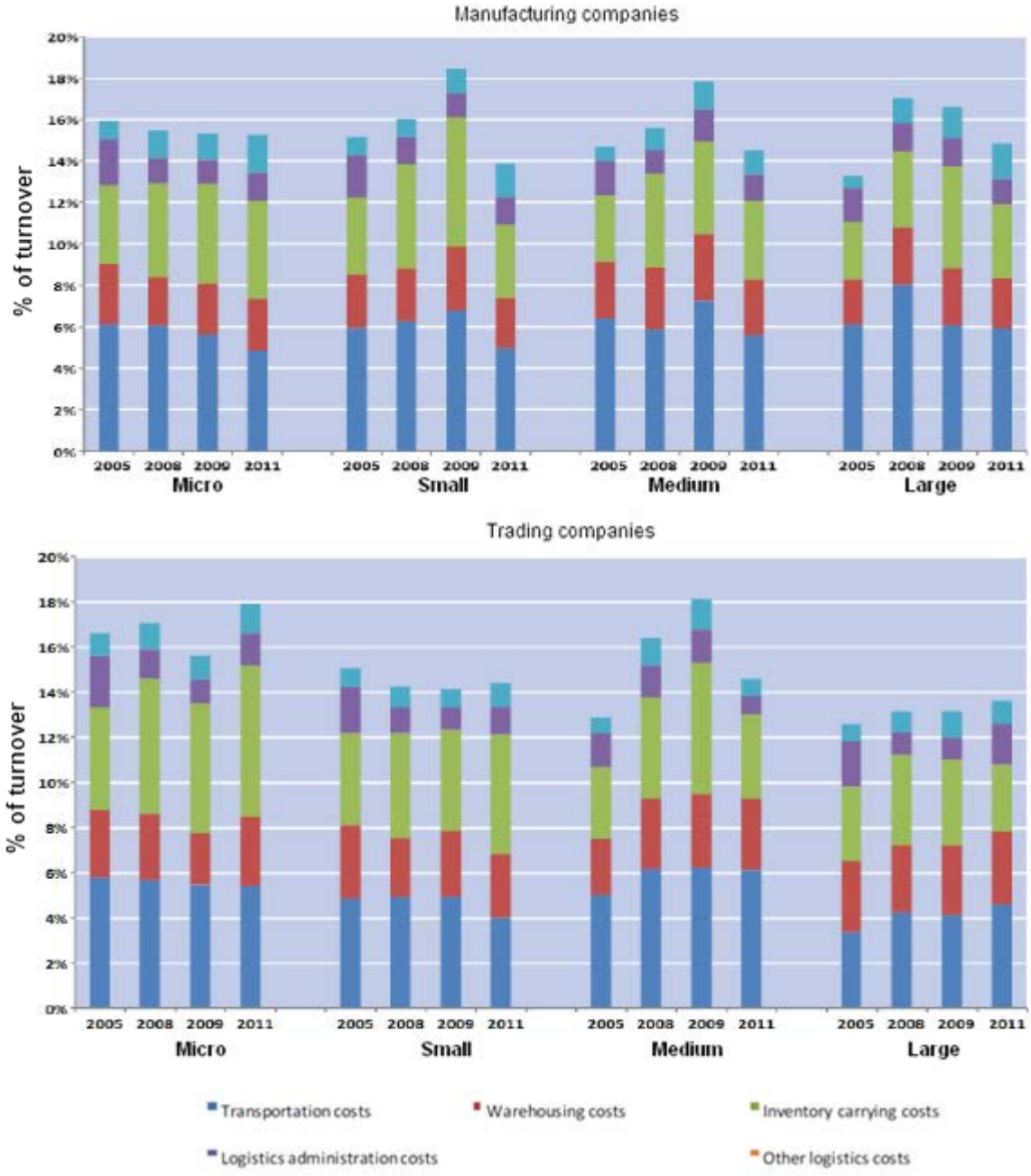


Figure 83 Logistics costs of Finnish manufacturing and trading companies in accordance with company size as a % of turnover

Several interesting issues arise from the results. In the case of small, medium-sized, and large manufacturing companies, logistics costs rose from 2005 to 2009, but among micro companies they dropped. The costs decreased in all company sizes in the last survey. In 2011, the total logistics costs were highest for micro companies, and smallest for small companies. Interestingly, transportation costs were not the largest component for micro companies.

According to the results of trading companies, it seems that micro and small companies succeeded in lowering their logistics costs between 2005 and 2009 but

these subsequently grew. The reverse happened for medium-sized retailers. Large companies enjoyed a stable level of logistics costs during the surveys. In the case of trading industries, economies of scale seem to exist, as total costs of logistics were smallest for large companies and highest for micro companies. In all company sizes, the inventory-carrying, warehousing, and transportation costs are largest individual cost components. This is typical for companies operating in consumer markets where shelf availability is important.

In addition to results classified by company size, the Finland State of Logistics surveys (excluding 2012) also disclosed some interesting results regarding the level of logistics costs in various geographical areas in Finland (Figure 84).

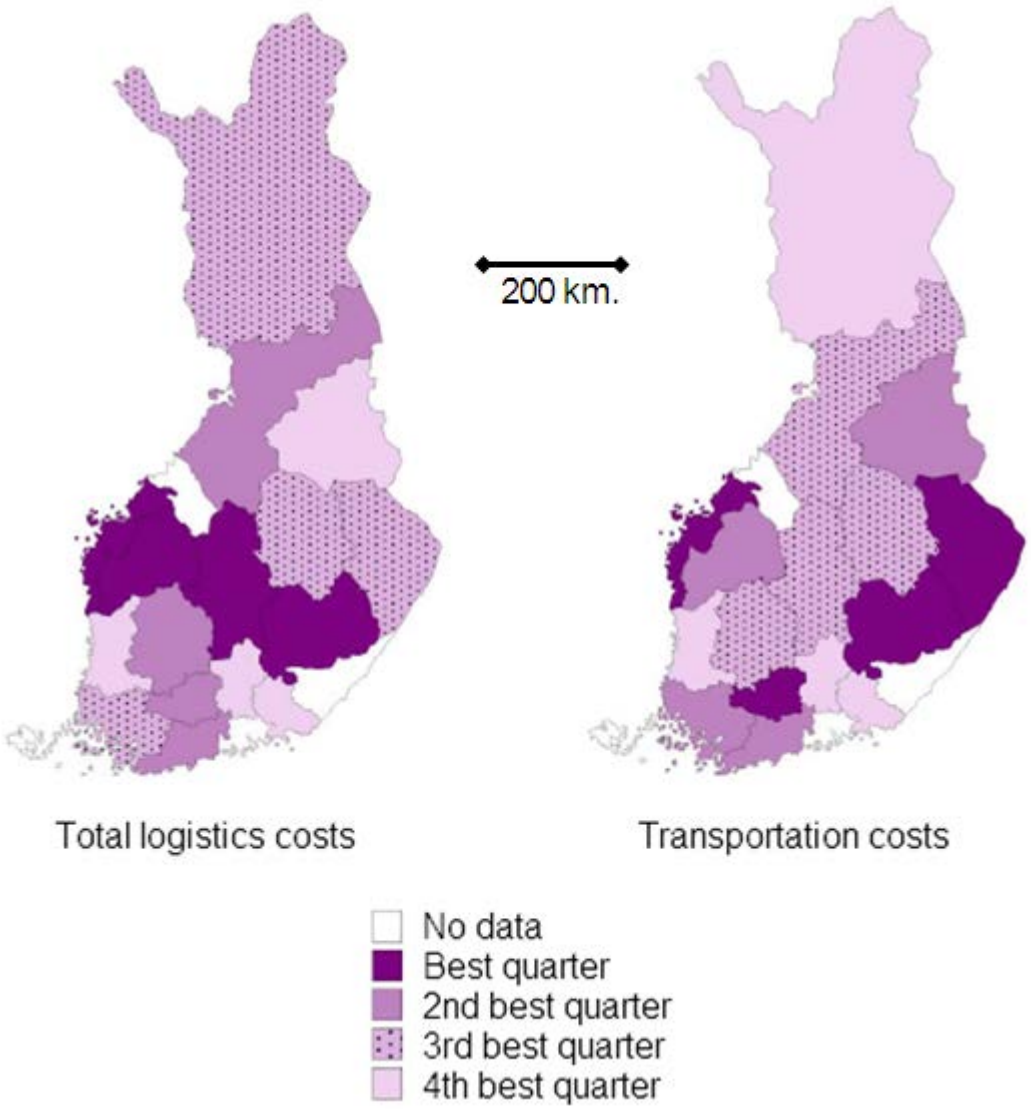


Figure 84 Comparison of areal logistics costs in Finland in 2009 (total logistics costs consist of transportation, warehousing, inventory-carrying, logistics administration, and other logistics costs).

Generally, logistics costs are lowest in central Finland, with the highest costs (4th best quarter) occurring in different parts of the country. The level of transport costs does not follow that of total logistics costs, as areas with the best overall logistics costs suffer from high transport costs. It is possible that these areas have been able to streamline their other logistics activities.

The study also compares the impact of the level of internationalization and production mode on logistics costs (Figure 78). Between 2005 and 2009, the total logistics costs rose in exporting and international companies, while domestic companies enjoyed more stable logistics costs. This kind of development is mainly due to increasing prices of global logistics services. In 2011 logistics costs decreased in all companies, which followed the general development of logistics costs.

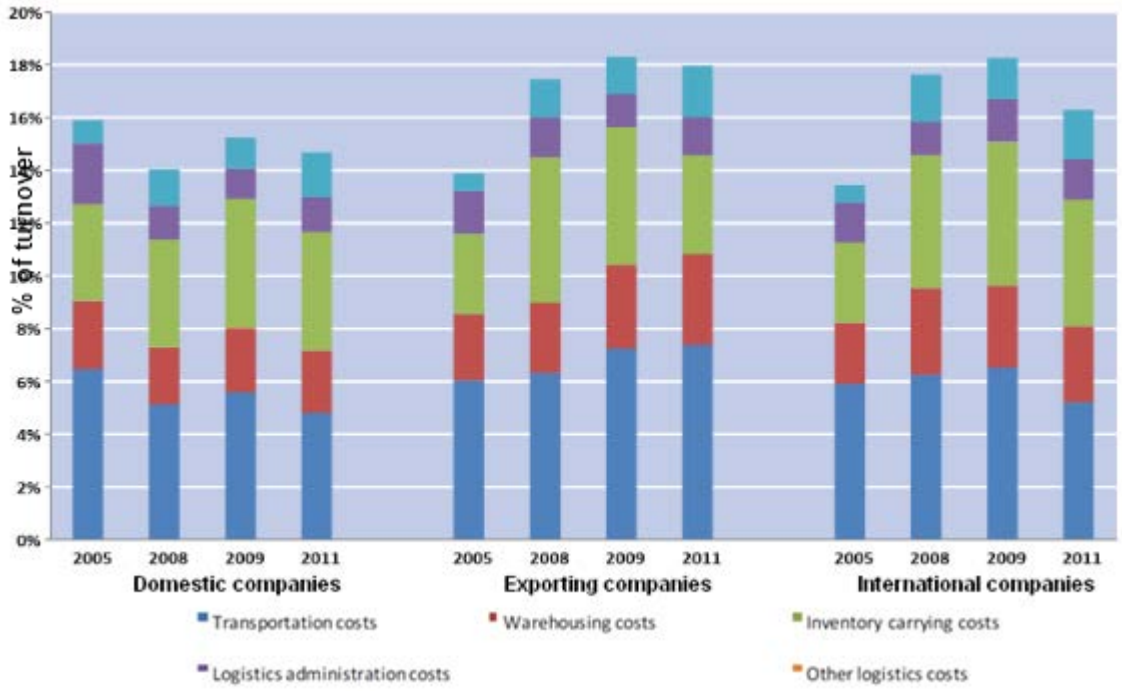


Figure 85 Logistics costs of Finnish domestic, export, and international companies

Finally, logistics costs can be scrutinized from a production mode perspective. This is presented in Figure 86.

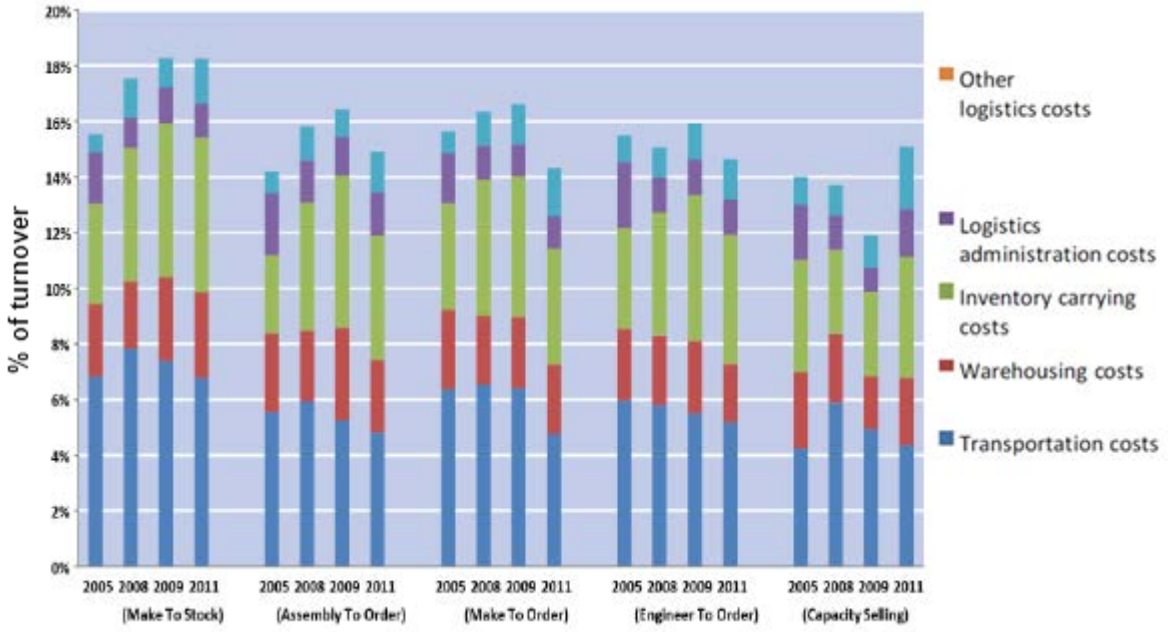


Figure 86 Impact of production mode (manufacturing industries) on total logistics costs of Finnish companies as a % of turnover in 2005, 2008, 2009, 2011

Production mode is one factor explaining the differences in logistics costs (Figure 86). The logistics costs seemed to be highest (above 18% on average of turnover) among MTS (make-to-stock) companies, who face high inventory carrying costs caused by the production mode. Also for MTO (make-to-order), ETO (engineer-to-order), and ATO (assembly-to-order) companies, logistics costs rose from 2005 to 2009. In 2011, logistics costs fell in all production modes excluding CS (capacity selling) companies, which showed a rise of over 2%. The costs of MTO companies were a little over 14%, while ATO and ETO companies hit the 15% line. The share of logistics costs for CS companies dropped rather significantly between 2005 and 2009, and it seemed that these companies were able to adapt their logistics activities to the economic situation. This is probably partly because of their production model that allows a rapid response to changes in the operational environment. However, in 2011, a significant increase occurred.

7.1.2 Applying GLOCS to Finland State of Logistics surveys 2006, 2009, 2010, and 2012

Applying the GLOCS Model should not significantly change the results or the information given by original studies but make the results more comparable. Since the methodology of forming cost components is explained in chapter 5.1, only the results after applying GLOCS are presented here. Comparison of the

results before and after applying GLOCS is illustrated in Figure 87. Data from 2005 and 2008 surveys are employed since the last survey used six cost components instead of five. This provides a better example of how the structure combines different components under four GLOCS components.

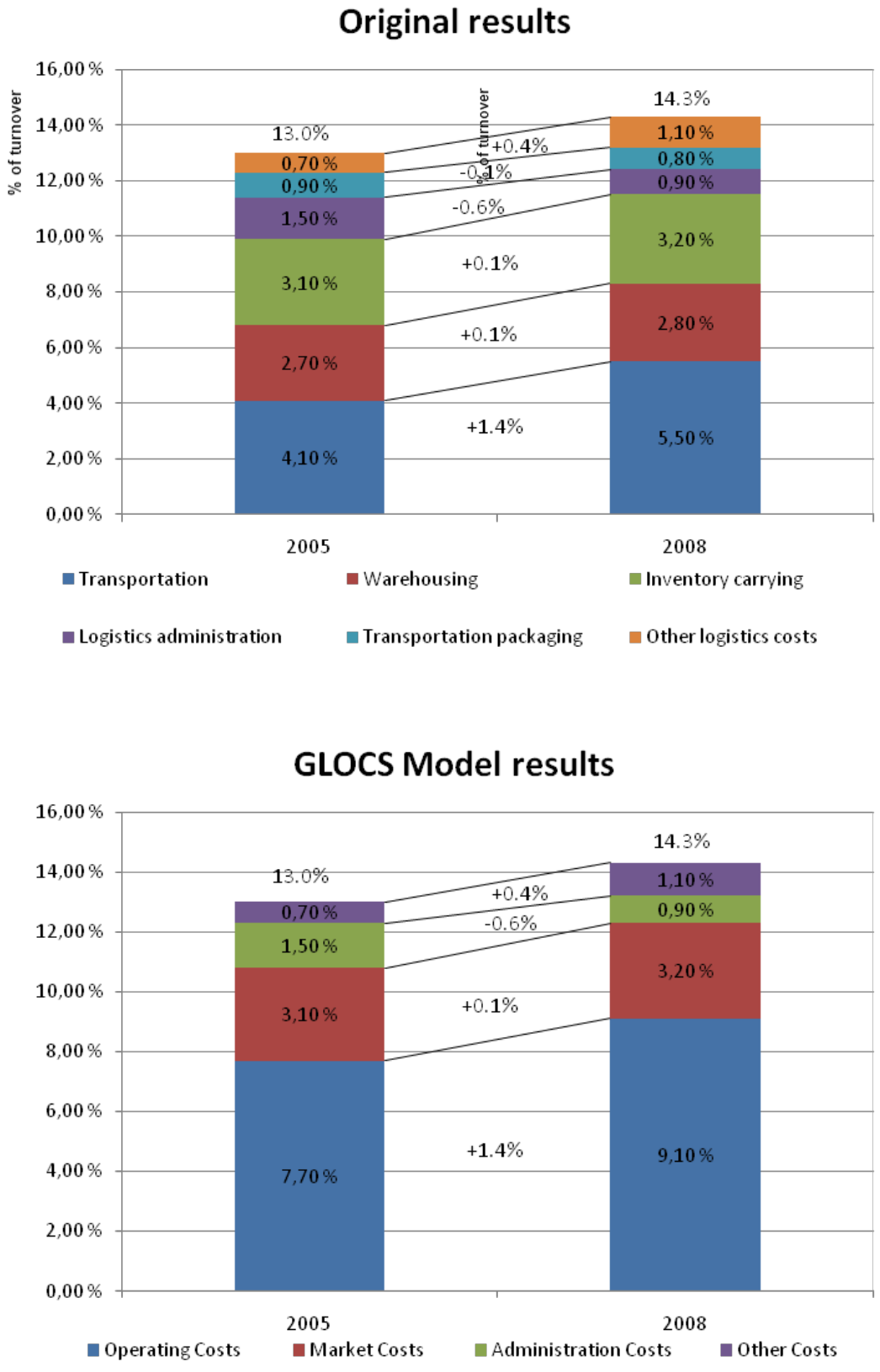


Figure 87 Impact of applying GLOCS to the data of Finland State of Logistics surveys

The main impact of applying GLOCS to 2005, 2008, and 2010 data is that three cost components, transportation, transportation packaging and warehousing, are presented as one component, operating costs. In other words, GLOCS bundles these subcomponents into one. This is justified by the fact that all of these are direct and operative (see also Figure 69 and Table 24). In the latest Finland State of Logistics survey, transportation packaging and transportation are already combined in the original data.

The impact of applying GLOCS can also be scrutinized by comparing cost components in different industries before and after applying GLOCS. Figure 88 shows the logistics costs in Finnish industries in 2008 with both GLOCS and original cost components.

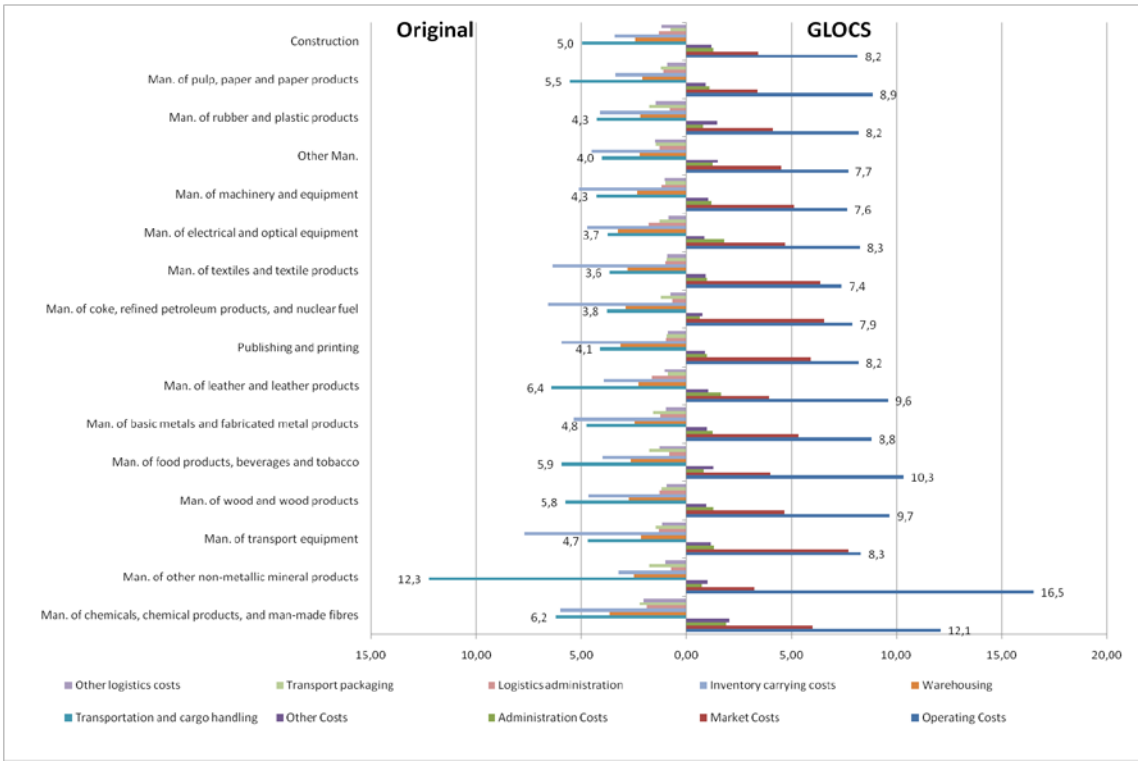


Figure 88 Comparison of GLOCS output with original results (Finland State of Logistics survey 2009)

As shown in the figure above, operating costs are the only cost component that varies significantly compared to original cost allocation. Otherwise the dimensions of the figures remain unchanged. GLOCS addresses the portion of operating costs, which after all are caused by functions that are the most significant drivers of logistics costs.

Both pros and cons can be found of applying the GLOCS Model. In this particular case, some may claim that the original results give a more detailed picture of the structure of logistics costs in Finland. The lack of detailed information is a trade-off to making several studies comparable, which is one of

the key advantages of GLOCS. In addition, it should be noted that also GLOCS components provide a significant amount of information. Considering these facts, GLOCS can be seen as a valid tool for comparing logistics costs based on different studies.

7.2 Logistics costs of different industries in Finland

This chapter consists of two main sections, the first of which (7.2.1) further analyzes the level and structure of logistics costs in different manufacturing industries in Finland. The second (7.2.2) concentrates on the same subject in the context of Finnish trading industries. GLOCS is applied to all logistics cost data collected for Finland State of Logistics surveys 2006, 2009, 2010, and 2012.

7.2.1 Manufacturing industries

This chapter concentrates on the level and structure of logistics costs of Finnish manufacturing companies in four consecutive surveys (2006, 2009, 2010, and 2012). Each survey is presented as its own subchapter. All figures give GLOCS as unweighted averages.

7.2.1.1 Finland State of Logistics 2006

Totally 1 458 valid responses related to logistics costs were collected in 2006. The largest individual group of respondents was manufacturers of wood and wooden products with 233 responses. Correspondingly, the smallest representation was received from manufacturers of coke, refined petroleum products and nuclear fuel (seven valid answers). This is not a surprise, given the number of companies operating in this sector in Finland. The comprehensive distribution of respondents is summarized in Table 21.

Unweighted logistics costs were highest in the manufacturing of pulp, paper and paper products, where logistics costs represented 22.1% of turnover on average. Correspondingly, machinery and equipment manufacturers achieved the lowest logistics costs with 10.7% of turnover (Figure 89).

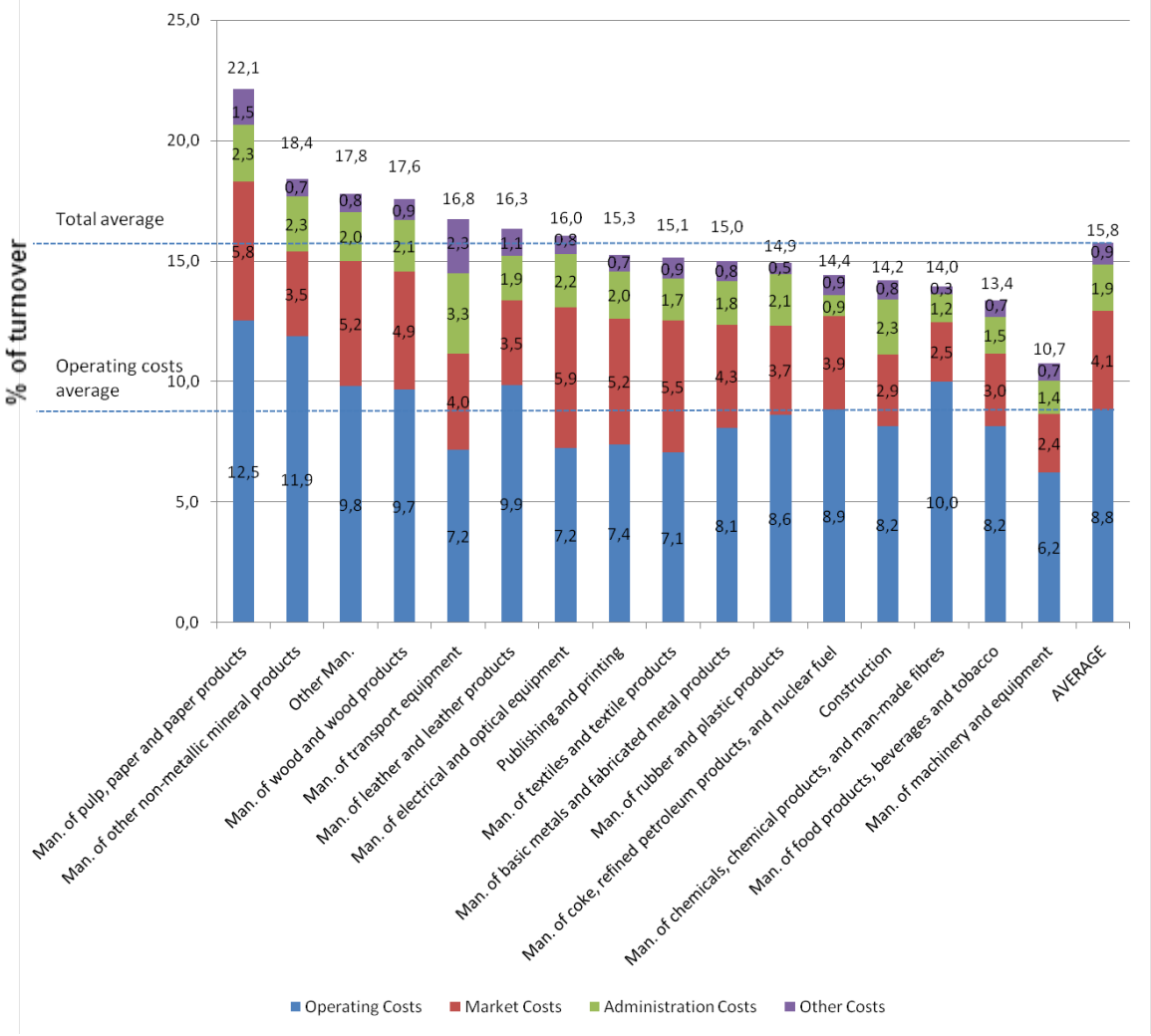


Figure 89 Logistics costs as a % of turnover in Finnish manufacturing companies according to GLOCS (data from 2005)

The rightmost bar illustrates the unweighted average costs of each individual cost component for all manufacturing industries. The level of total logistics costs was 15.8% of turnover, of which operating costs was the largest individual component (8.8%), followed by market costs (4.1%), administration costs (1.9%) and other costs (0.9%).

In 2005, seven out of 16 manufacturing industries hit above average operating costs. The highest logistics costs were experienced by pulp, paper and paper product manufacturers, with 3.7% above average higher operating costs. Manufacturing of machinery and equipment had the lowest operating costs, with 6.2% of turnover, which is 2.6% below average. The broad variance of operating costs is mainly due to the different transport costs in different industries. For example, paper and mining industries operate in global markets with high transport volumes that naturally increase the operating costs. These are also bulk products that have a low value/volume ratio, affecting the share of operating costs. On the other hand, the transportation volumes in the manufacturing of

machinery and equipment industry are lower compared to the high value of products transported.

Correspondingly to operating costs, 7/16 industries suffered above average market costs. The unweighted average of market costs were 4.1% of turnover, topped by the manufacturing of electrical and optical equipment industry (5.9%) and pulp, paper and paper product manufacturers (5.8%). The lowest market costs were declared by manufacturers of machinery and equipment, and manufacturers of chemical products. The low costs can be attributed to the production modes applied by these industries, which allow light inventory levels that further decrease inventory-carrying costs.

The variance of administration costs was relatively larger than that of operational and marker costs with a range from 0.9 % to 3.3 %. Concerning this cost component, 10/16 industries suffered above average costs. Administration costs were highest in manufacturing of transportation equipment, with 3.3% of turnover. There are several factors that contribute to this, but one could be the complexity of logistics activities related to the nature of the industry. It should further be noted that the number of respondents in this industry was considerably low (n=12). The logistics administration costs were lowest for companies refining coal, petroleum, and nuclear fuel. One reason may lie in the relatively well-established logistics processes that promote the decrease in administration costs.

The average level of other logistics costs for all industries was 0.9% of turnover. Other costs were highest among manufacturers of transportation equipment (average 2.3% of turnover), while the lowest figure was reported for manufacturing of chemicals, chemical products, and man-made fibers (average 0.3% of turnover). There may be several reasons for this, but in general but it could be agreed that some industries tend to have more indirect logistics costs. This leads to where where assigning these is unclear, which increases the level of other logistics costs.

7.2.1.2 Finland State of Logistics 2009

In the 2009 study, the number of valid responses for the question set related to logistics costs was 1 394. As was the case in 2006, the fewest answers were received from coke and petrol manufacturers, manufacturers of non-metallic mineral products, and transport equipment manufacturers (see Table 21 for complete information).

In the 2009 study, the unweighted average logistics costs were highest for manufacturing of chemicals, chemical products and man-made fibers (22% of turnover). The corresponding figure in the 2006 study was 14.0%. The construction industry reported the lowest logistics costs, with an average of 14.1% of

turnover. Twelve out of 16 industries had above average logistics costs, which indicates the broad variance of results (Figure 90).

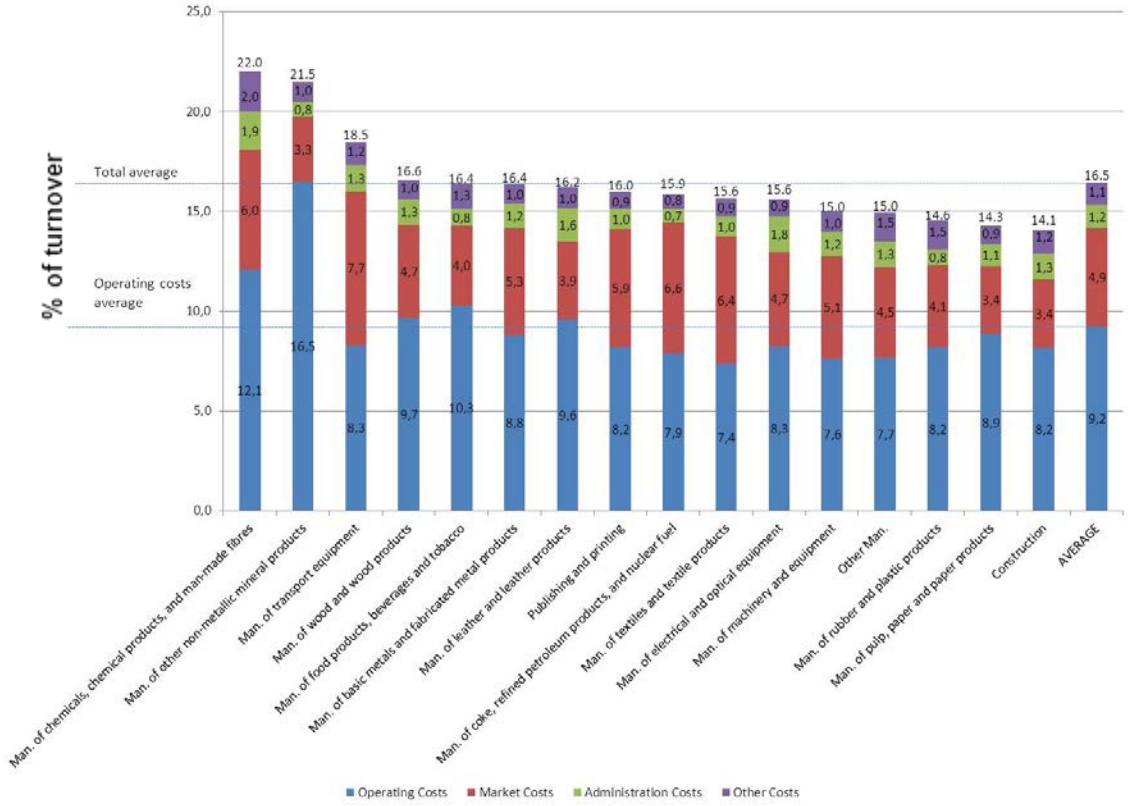


Figure 90 Logistics costs as a % of turnover in Finnish manufacturing companies according to GLOCS (data from 2008)

The level of average logistics costs (16.5%) is illustrated on the far right. Operating costs remained the largest individual component (average 9.2% of turnover), followed by market costs (4.9%), administration costs (1.2%), and other costs (1.1%). Excluding administration costs, the average level of each individual cost component was higher compared to the 2006 study.

In 2009 study, only 5/16 industries suffered above average operating costs. Manufacturing of other non-metallic mineral products hit 16.5% operating costs, which was the same as average total logistics costs for all manufacturing industries. Although it could be agreed that logistics processes in the respective industry advocate high operating costs, in view of the small sample size the reliability of this figure is somewhat questionable. As in 2006, textile manufacturers reported low operating costs, which is typical for the industry.

In the context of market costs, 6/16 industries hit an above-average cost level (un-weighted average 4.9% of turnover). Market costs above 6% of turnover were experienced by industries manufacturing chemicals (6.6.%) and transport equipment (7.7. %), and refiners of coke and petroleum (6.6%). The below-

average market costs can be attributed to the redundancy of keeping large inventories, as demand is easily predicted.

Administration costs were at a lower level compared to the 2006 survey. Over half (9/16) of industries had average or above-average administration costs. The costs were highest for companies manufacturing chemicals, chemical products and man-made fibers (average 1.9% of turnover), which also had the highest total logistics costs. The second highest administration costs were reported among manufacturers of electrical and optical equipment (1.8%). Correspondingly, the lowest administration costs (0.7%) were again reported by companies refining coal, petroleum, and nuclear fuel.

The average level of other logistics costs increased from 0.9% to 1.1%. By far the highest level of other logistics costs was reported again by manufacturers of chemicals, chemical products, and man-made fibers (2.0%). In all, only 5/16 industries had above-average other logistics costs.

7.2.1.3 Finland State of Logistics 2010

The number of valid responses for the question set related to logistics costs in the 2010 survey was 458. In this edition, the fewest answers were received from companies in the manufacturing of leather and leather products (2), manufacturing of pulp, paper and paper products (4), publishing and printing (4), and manufacturing of other non-metallic mineral products (2). This diminishes the reliability of the results for these industries. No answers were received from manufacturers of coke, refined petroleum products, and nuclear fuel (refer to Table 21 for complete information).

According to the 2010 data, the unweighted average logistics costs were highest for manufacturing of other non-metallic mineral products (23.5% of turnover). Although this does not indicate a major increase compared to 2008 (21.5%), it should be noted that only two answers were received for this industry. Publishers and manufacturers of printed products reported the lowest logistics costs, averaging 11.5% of turnover. Almost half of the industries (7/15) reported above-average logistics costs. On the other hand, only four industries had above-average operational costs (Figure 91).

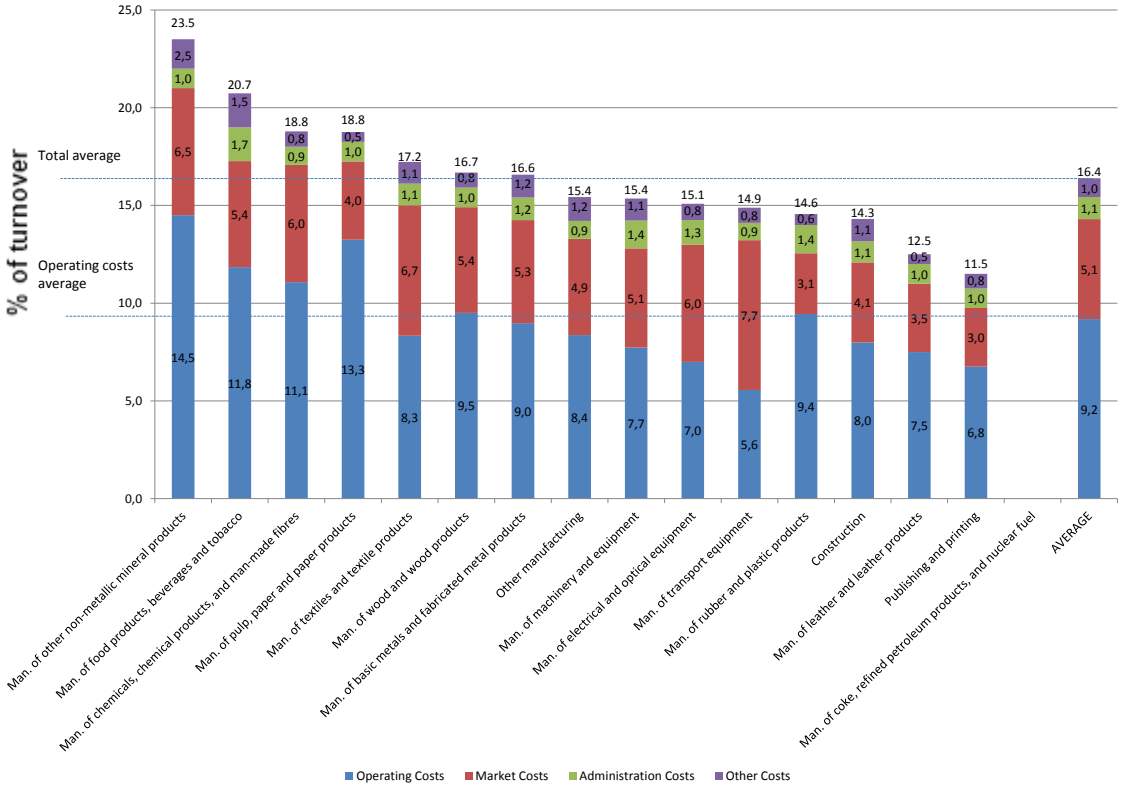


Figure 91 Logistics costs as a % of turnover in Finnish manufacturing companies according to GLOCS (data from 2009)

The level of average costs (16.4%; 16.5% in 2008) and average operational costs (9.2%; 9.2% in 2008) are indicated with dashed blue lines. The largest individual component, operating costs, is followed by market costs (5.2%), administration costs (1.1%) and other costs (1.0%). Comparison with the 2008 results shows that no major change has occurred in the level of individual cost components.

In the 2009 study, only 5/16 industries suffered above-average operating costs. Manufacturing of other non-metallic mineral products hit 14.5% operating costs (16.5% in 2008), which was clearly the highest figure. It can be agreed that the nature of logistics processes in the respective industry advocates high operating costs, but as mentioned above, due to the small sample size the reliability of this figure is somewhat questionable. Incidentally, manufacturers of transport equipment reported low operating costs.

Over half of industries (9/15) experienced above-average (5.1%) market costs. The highest costs in this component were identified by manufacturers of transport equipment (7.7%; 7.7 % in 2008), and the lowest by companies operating in publishing and printing (3.0%; 5.9% in 2008) The reason for the low market costs of publishers and printers may lie in the somewhat easily predicted demand.

Average administration costs and other costs were 0.1% lower compared to 2008. Seven industries had average or above-average administration costs. Administrative costs were highest for manufacturers of food products, beverages and tobacco (average 1.7% of turnover), which also had the second highest total logistics costs. Correspondingly, the lowest administration costs (0.9%) were reported by other manufacturers and manufacturers of transport equipment. By far the highest level of other logistics costs was reported by manufacturers of other non-metallic mineral products (2.5%), and totally six industries had above-average other logistics costs.

7.2.1.4 Finland State of Logistics 2012

The number of valid responses was 636, which is higher than in the 2010 survey. No answers were received from coke, refined petroleum products or nuclear fuel manufacturers, and only four responses were received from manufacturers of leather and leather products. As mentioned earlier, this may diminish the reliability of the results for these industries (see Table 21 for complete information).

According to the 2011 data, the unweighted average logistics costs were highest for manufacturing of leather and leather products, at 20.9% of turnover (12.5% in 2009). As mentioned above, only four respondents represented this industry, which together with the large increase compared to the earlier study raises questions as to the reliability of the results. The lowest average logistics costs were reported by manufacturers of basic metal products, with an average of 13.8% of turnover (16.6% in 2009). One third of industries (5/15) had above-average logistics costs and one third above-average operational costs (Figure 92).

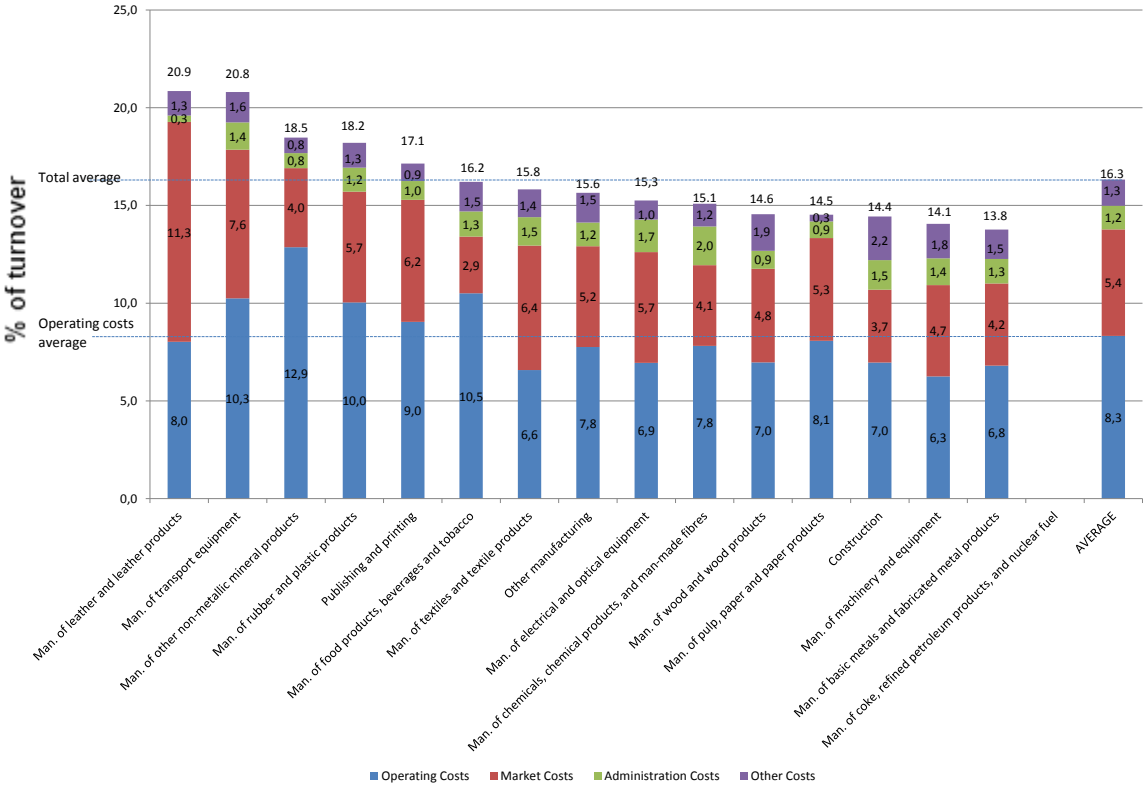


Figure 92 Logistics costs as a % of turnover in Finnish manufacturing companies according to GLOCS (data from 2011)

The level of average costs (16.3%; 16.4% in 2009) and average operational costs (8.3%; 9.2% in 2009) are illustrated with blue dashed lines. The level of market costs (5.4%) was slightly higher than in 2009 (5.2%). Administration costs (1.2%; 1.1% in 2009) and other costs (1.1%; 1.0% in 2009) remained at roughly the same level. Comparison with the 2008 results shows that no major change occurred in the level of individual cost components.

Manufacturing of other non-metallic mineral products had the highest operational costs, at 12.9%, although there was some decrease compared to previous years (14.5% in 2009; 16.5% in 2008). Correspondingly, the lowest operational costs were identified by manufacturers of machinery and equipment (6.3% of turnover).

Market costs were remarkable high for manufacturers of leather and leather products (11.3%), although the sample was small. The overall average of market costs remained, however, at 5.4%. The lowest market costs were reported by companies operating in the manufacturing of food, beverages, and tobacco (2.9%). One reason could be that these companies were able to passing their market costs onto retailers (see Figure 96).

Only four industries had below-average (1.2% of turnover) administration costs. Administrative costs were highest for manufacturers of chemical products (average 2.0% of turnover). Excluding manufacturers of leather, with only a few

respondents, the lowest administration costs (0.9%) were reported by manufacturers of non-metallic, mineral products (0.8% of turnover). Clearly the highest level of other logistics costs was reported by construction companies (2.2%), while the lowest other costs were experienced by respondents representing manufacturers of pulp and paper (0.3%).

7.2.2 Trading industries

This chapter concentrates on the level and structure of logistics costs of Finnish trading companies in 2006, 2009, 2010, and 2012, under their respective subchapters. The results follow GLOCS, and all figures are unweighted averages.

7.2.2.1 Finland State of Logistics 2006

Totally 761 trading companies responded to the 2006 survey. Most responses were received from companies operating in industries of other retailing (292 respondents) and other wholesaling (246 respondents). The complete numbers of respondents in different industries are shown in Table 22. Figure 93 illustrates the levels of logistics costs in seven trading industries in the 2006 survey according to GLOCS.

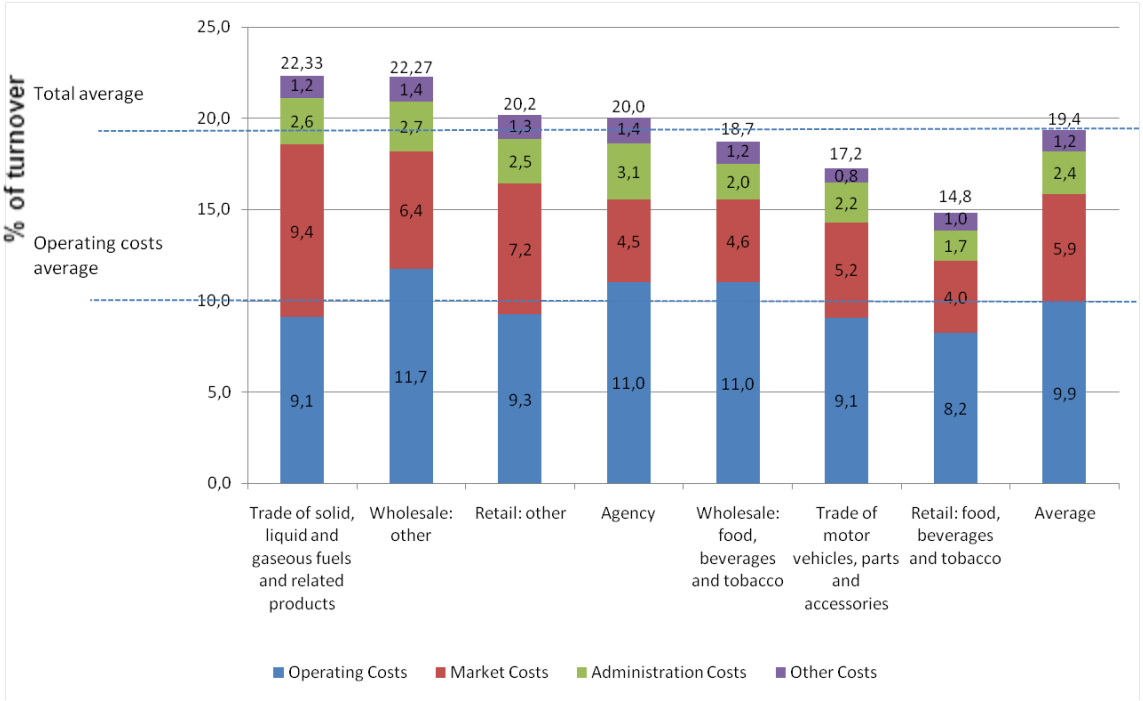


Figure 93 Logistics costs in Finnish trading companies as a % of turnover according to GLOCS (data from 2005)

Unweighted average logistics costs of trading industries in the 2006 survey were 19.4% of turnover, which was higher than for manufacturing industries. In 2005, the total logistics costs were highest in the fuel trade (22.33%), followed by other wholesale at 22.7%. This is interesting, given that logistics costs of refiners of coke and petroleum were among the highest for manufacturing industries. This indicates that in the petroleum trade, manufacturers have succeeded in passing their market costs onto distributors (market costs were the highest individual cost component for the industry). The lowest total logistics costs were declared by food, beverage and tobacco retailers (average 14.8% of turnover). In addition, the level of costs in each individual cost component was below average in this industry (Figure 93). Compared to manufacturing industries, the variance between industries in accordance with different GLOCS components was smaller.

Average operating costs were 9.9%, and above-average operating costs were reported by food, beverage and tobacco wholesalers (11.0%), agencies (11.0%), and other wholesalers (11.7%). This indicates that wholesalers use more cost-intensive logistics operating processes. The industries with the lowest operating costs included trading of liquid gas and related products (9.1%), which suffer from high market costs, trading of motor vehicles and parts (9.1%), and retail of food and beverages (8.3%). It seems that retailers are able to reap economies of scale and lower their operating costs. It should also be noted that the competitive setting in food and beverage retail is quite unique in view of their oligopoly, and this may allow cutting of operating costs.

Market costs for trading companies were 5.9% on average. As mentioned above, the figure was highest for trading of liquid gas and related products (9.4%), while the lowest costs were identified by retailers of food and beverages (4.0%). The reasons for this may lie partly in the state of the market.

Logistics administration costs for trading companies were 2.4% of turnover on average. Above-average costs were reported by companies that also incurred high total logistics costs. This indicates that for trading industries the level of administration costs follow the level of total logistics costs. Other costs accounted for 1.2% of turnover on average within a 0.8% to 1.4%.

7.2.2.2 Finland State of Logistics 2009

In the 2009 study, the number of valid responses from trading companies was 761, which is slightly higher than in the 2006 survey. As in 2006, the fewest responses were collected from the fuel-trading sector, totaling 12 (see Table 22 for complete information).

The average total logistics costs for trading companies in Finland in 2008 were 20.0% of turnover (Figure 94). The costs rose from 19.4% to 20.0% and five out of seven industries reached below average total logistics costs. Trade of fuel and related products sustained its place as an industry with the highest logistics costs, which totaled 30.9% of turnover in the 2009 survey (22.3% in 2006). However, it should be noted that the relatively small sample (12 respondents) may cause distortion. Agencies reported the lowest total logistics in the 2009 survey (14.7% of turnover). The most significant changes in costs occurred among the motor vehicle trade (17.2% in 2006; 22.2% in 2009) and agencies (20.0% in 2006; 14.7% in 2009).

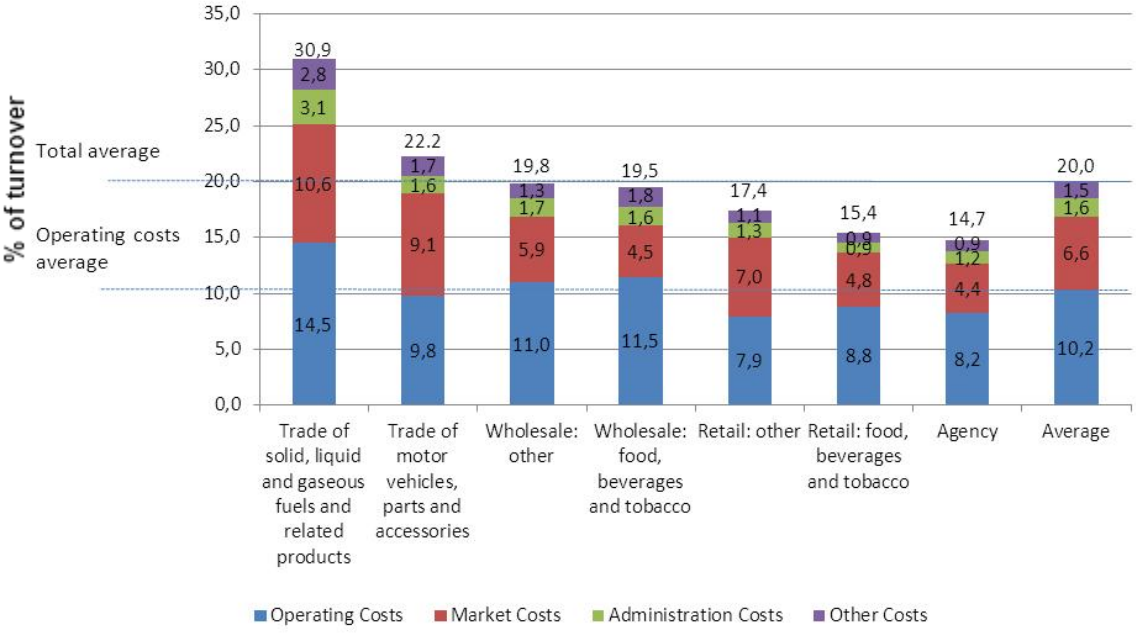


Figure 94 Logistics costs in Finnish trading companies as a % of turnover according to GLOCS (data from 2008)

Excluding administration costs, the level of all other individual GLOCS components increased from the 2006 study. The highest logistics operating costs were reported by fuel trading companies (14.5% of turnover on average). This should, however, be considered with caution as the sample size was small. The lowest operation costs were identified by other retail for the reasons discussed above. Fuel trading companies also hit the highest market and logistics administration costs, as well as other costs. Also these figures should be considered with caution. Agencies had the lowest market costs, attributable to the nature of their business, which does not usually include holding large inventories. Administration costs were the lowest for retail of food, tobacco, and beverages, while the lowest other costs were reported by agencies and retail of food and beverages.

7.2.2.3 Finland State of Logistics 2010

In the 2010 study, the number of valid responses from trading companies was 331, which is lower than in the 2009 survey. No cost data were received from fuel trading companies. Refer Table 22 for complete distribution of respondents.

The average total logistics costs for trading companies in 2009 were 13.7% of turnover (Figure 94). This was significantly lower than in 2008, which is mainly due to the high average costs reported by a few companies trading fuels and related products. As no answers were received from these respondents in the 2010 survey, this had a lowering impact on total average logistics costs. The range of average total logistics costs is broad, from 17.1% (trade of motor vehicles etc.) to 10.2% (agencies). These industries had the highest (excluding trading of fuel) and lowest logistics costs in the 2008 data as well. Costs decreased in all industries from 2008.

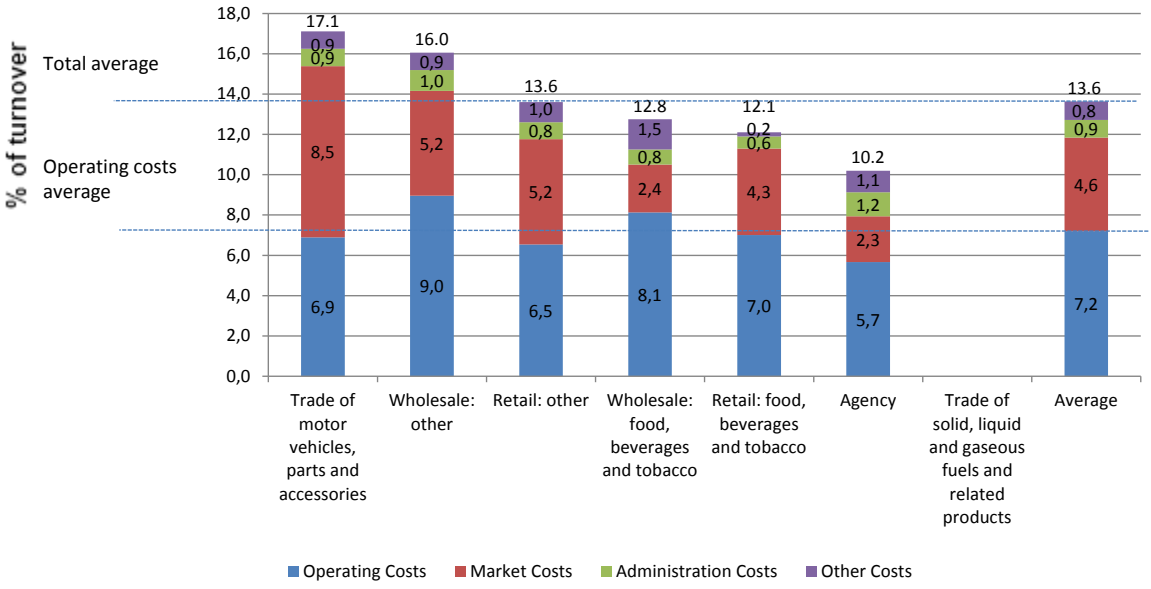


Figure 95 Logistics costs in Finnish trading companies as a % of turnover according to GLOCS (data from 2011)

The highest operating costs were reported by other wholesalers (9.0% of turnover on average), which is somewhat surprising as these should be able to reap economies of scale in operational processes. One reason could be that in the trading business most operational costs are paid by wholesalers (see also Figure 7). The lowest operational costs, market costs, and also total costs, were identified by agencies. This is attributable the nature of their business, which does not usually include holding large inventories or other operational logistics services. Again, the lowest administration costs and other logistics costs were identified by retailers of food, tobacco, and beverages.

7.2.2.4 Finland State of Logistics 2012

In total 503 valid answers were received from Finnish trading companies in the 2012 edition of the survey. This was nearly double compared to the 2010 survey. The fewest answers were received from fuel trading companies (4) (see Table 22 for the comprehensive distribution of respondents).

The average total logistics costs for trading companies in 2011 were 17.4% (13.7% in 2009) of turnover (Figure 96). Excluding the fuel traders with four valid answers, the average total logistics costs between industries varied from 18.5% (trade of motor vehicles) to 12.3% (retail of food, beverages, and tobacco).

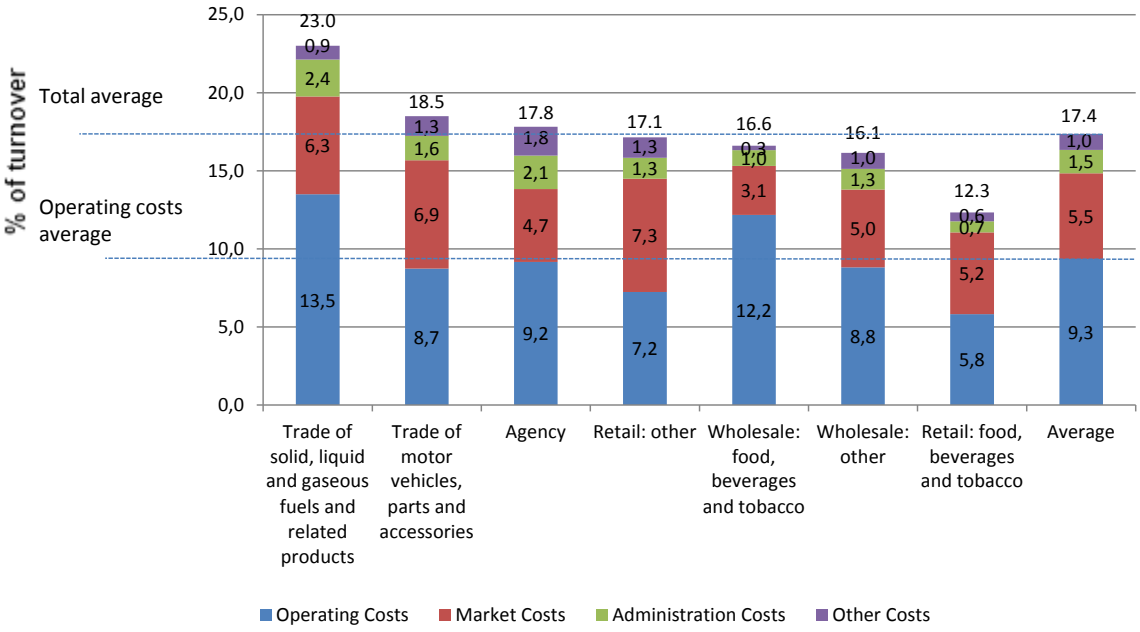


Figure 96 Logistics costs in Finnish trading companies as a % of turnover according GLOCS (data from 2011)

The highest operating costs were identified by fuel traders (13.5% of turnover on average). However, the sample from this industry was relatively small, with only four respondents subject the result to some skepticism. The lowest operational costs were identified among food, beverage, and tobacco retailers (5.8% of turnover).

7.3 Development and structure of logistics costs

In this chapter, the analysis of logistics cost development is extended to two counter-dimensions of GLOCS: administrative-operative and indirect-direct (see

e.g. Figure 69). Based on these dimensions and data from Finland State of Logistics surveys, industries are positioned in "logistics families" — groups of industries with a similar cost structure. Also the development of logistics families over the years is studied. As mentioned in the methodology, industry classification follows the Finnish TOL2002 system, which is equivalent to the main international industry classifications (like ISIC).

In practice, the logistics costs of different industries are first plotted into two tables with a counter-dimension of indirect-direct costs (see e.g. Figure 97) and administrative-operative costs (see e.g. Figure 98). As mentioned earlier, market costs and other costs are considered as indirect costs, while operating and administration costs are direct costs. The positioning is based on data regarding the industry's cost level and average cost levels of manufacturing or trading industries (direct averages, not weighted). In the second phase these tables are combined into one aggregate table (see e.g. Figure 99). Finally, the development is discussed in chapters 7.3.1.5 (manufacturing industries) and 7.3.2.5 (trading industries). It should be noted that the sample size of some industries was relatively small, which may have some impact on the results (see chapter 4.2.2 for comprehensive description of the data).

7.3.1 Logistics families of manufacturing industries

In this chapter, GLOCS is employed to position manufacturing industries and identify logistics families. This allows some distinctive characteristics of logistics costs to be identified in different industries. The GLOCS type, a letter-number combination that helps distinguish the structure of logistics costs between industries, is assigned to each industry.

7.3.1.1 Logistics families in the 2006 survey

In Figure 97, costs are plotted in respect of indirect and direct costs, with averages for the whole manufacturing sector. The average level of indirect logistics costs of manufacturing companies in 2005 was 5.0% of turnover and that of direct costs 10.7% (average level indicated with a dashed line). Based on the level of indirect and direct logistics costs in a given industry, it is positioned in one of the boxes in Figure 97. The level of logistics costs is indicated next to the pointer on the chart with the industry number (underlined). The numbering corresponds to that in the previous tables in chapter 7.

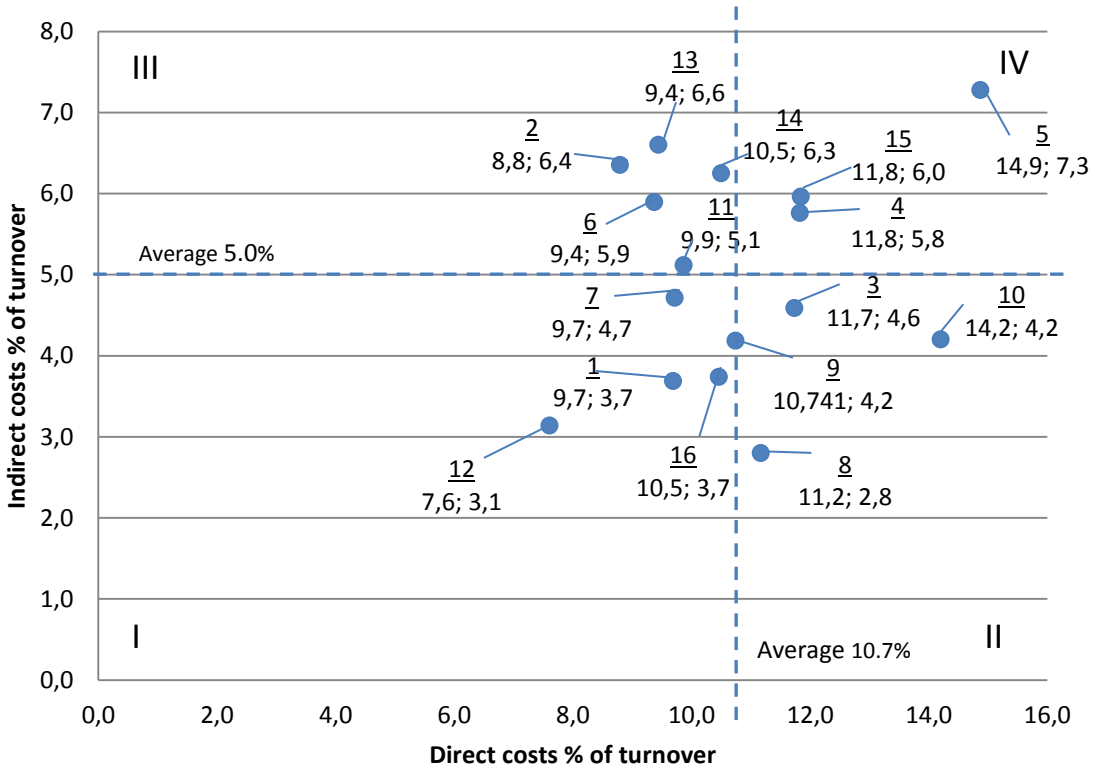


Figure 97 Positioning of Finnish manufacturing industries in respect of the level of direct and indirect logistics costs as a % of turnover (data from 2005)

Figure 97 is split into four sections. Section I represents industries that have below-average costs in both dimensions, direct and indirect logistics costs. Four industries are located here: 1) manufacturing of food, beverages and tobacco, 7) manufacturing of coke, refined petroleum products and nuclear fuel, 12) manufacturing machinery and equipment, and 16) construction.

The industries in section II have above-average (>10.739%) direct logistics costs, but below-average indirect costs. Again there are four industries: 3) manufacturing of leather and leather products, 8) manufacturing of chemicals, chemical products and man-made fibers, 9) manufacturing of rubber and plastic products, and 10) manufacturing of non-metallic mineral products.

Section III is the opposite to section II. The five industries located here have above-average (>5.0%) indirect logistics costs but below-average direct costs. They are: 2) manufacturing of textiles and textile products, 6) publishing and printing, 11) manufacturing of basic metals and fabricated metal products, 13) manufacturing of electrical and optical equipment, and 14) manufacturing of transportation equipment.

The industries in section IV have above-average indirect and direct costs. They are: 4) manufacturing of wood and wood products, 5) manufacturing of pulp, paper and paper products, and 15) other manufacturing. Below, the industries are positioned in respect of the level of operative and administrative costs

(Figure 98). Average levels of all manufacturing industries are illustrated with dashed lines.

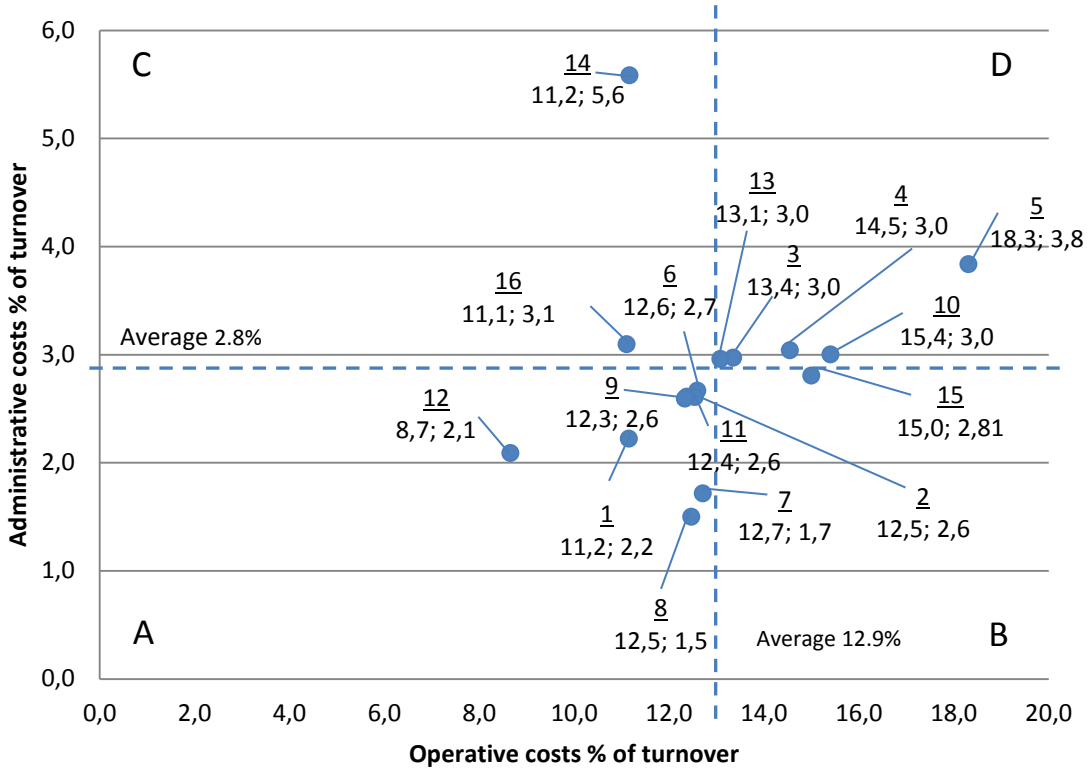


Figure 98 Positioning of Finnish manufacturing industries in respect of the level of operative and administrative costs (data from 2005)

The logic of Figure 98 is similar to that of Figure 97, but the cost dimensions here are administrative costs and operative costs. Average levels of these dimensions in 2005 were 2.8% of turnover (administrative costs) and 12.9% of turnover (operative costs). The sections are now assigned letters A-D in order to distinguish them from the previous figure.

Below-average operative and administrative costs (section A) were achieved in seven industries: 1) manufacturing of food, beverages and tobacco, 2) manufacturing of textiles and textile products, 6) publishing and printing, 7) manufacturing of coke, refined petroleum products and nuclear fuel, 8) manufacturing of chemicals, chemical products and man-made fibers, 9) manufacturing of rubber and plastic products, 11) manufacturing of basic metals and fabricated metal products, and 12) manufacturing of machinery.

Section B shows that only one industry had above-average operative costs (>12.9%) and below-average administrative costs: 15) other manufacturing. This means that all other industries that had above-average operative costs also had above-average administrative costs.

There are also only two industries in the opposite section, C. These are: 14) manufacturing of transportation equipment and 16) construction, and they have above-average administrative costs (>2.83%) but below-average operative costs.

The remaining five industries are located in section D, with above-average costs in both dimensions. They are: 3) manufacturing of leather and leather products, 4) manufacturing of wood and wood products, 5) manufacturing of pulp, paper and paper products, 10) manufacturing of non-metallic mineral products, and 13) manufacturing of electrical and optical equipment.

As illustrated in Figure 98, most industries fall into sections I and IV. In Figure 97 they are spread more evenly between all four sections (A-D). Next, the information is combined into one table that allows typical attributes of cost structure to be identified for a given industry (Figure 99).

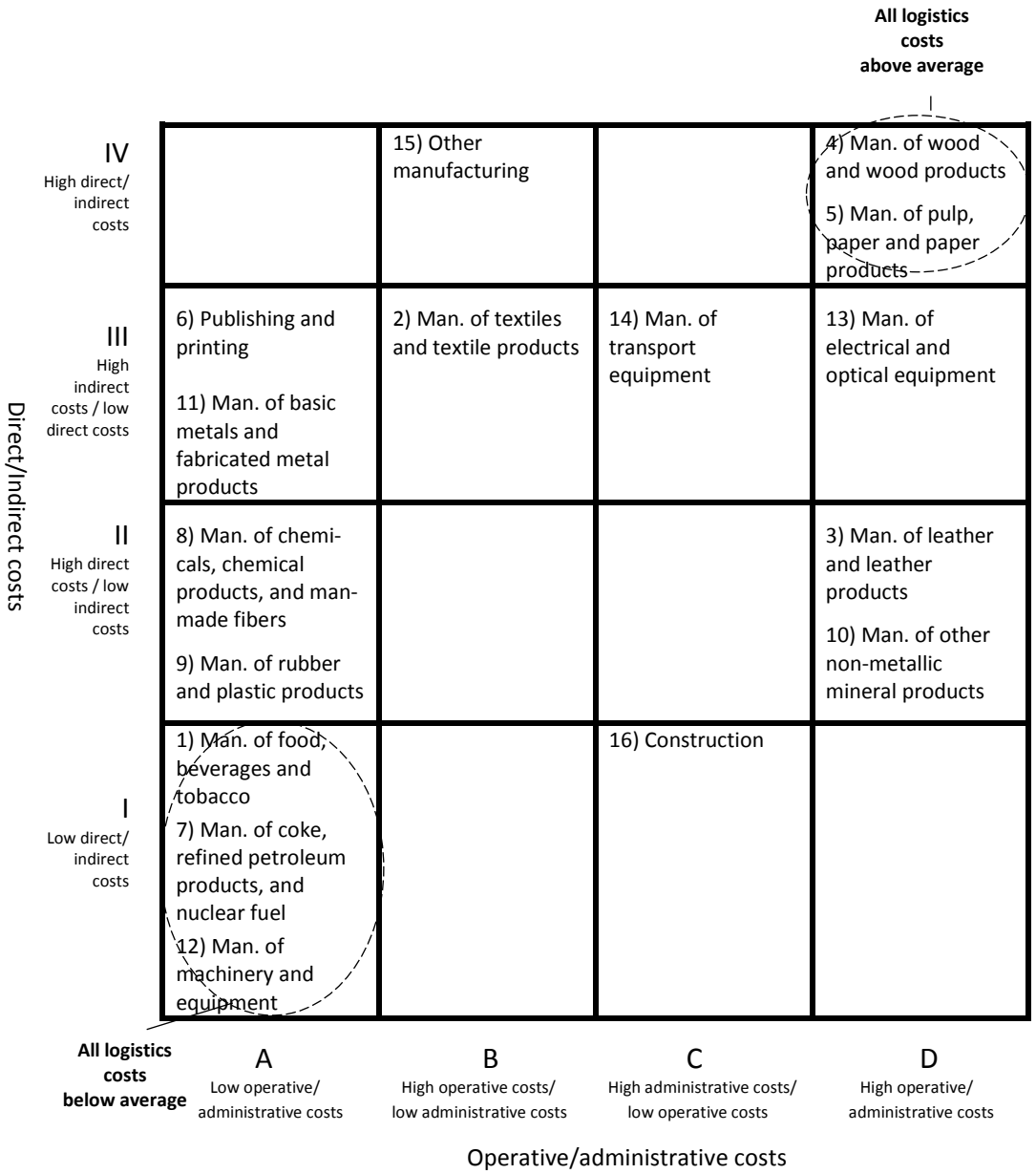


Figure 99 Combining the results of Finnish manufacturing industries positioning (data from 2005)

Figure 99 gives a quick and summarized snapshot of the level of logistics costs in 16 manufacturing industries in Finland according to GLOCS. In the figure, high or low costs are defined based on whether they were above or below average.

Starting from the bottom left corner of the grid, three industries with low logistics costs in all dimensions can be identified: 1) manufacturing of food products, beverages and tobacco, 7) manufacturing of coke, refined petroleum products and nuclear fuel, and 12) manufacturing of machinery and equipment. Moving up, two industries with high direct costs but otherwise low logistics cost can be identified: 8) manufacturing of chemicals, chemical products and

man-made fibers and 9) manufacturing of rubber and plastic products. Further up, the grid shows two industries with high indirect costs but low costs in all other dimensions: 6) publishing and printing and 11) manufacturing of basic metals and fabricated metal products.

Operative costs are high in the other manufacturing industry (15), in which also direct and indirect costs are high. Administrative costs of this industry, on the other hand, are low. In the manufacturing of textiles and textile products (2), operative and indirect costs are high but administrative and direct costs are low, which is more or less contradictory.

The construction industry (16) has high administrative costs but all other dimensions indicate low costs. Manufacturers of transport equipment (14) have high indirect and administrative costs, while operative and direct costs are at a low level.

According to the results, five industries have above-average operative and administrative costs. Two of these, 3) manufacturing of leather and leather products and 10) manufacturing of other non-metallic mineral products, also have high direct costs but low indirect costs. The opposite is true for 13) manufacturing of electrical and optical equipment, where indirect costs were high. In the upper right corner are industries with above-average logistics costs in all dimensions. These are: 4) manufacturing of wood and wood products and 5) manufacturing of pulp, paper and paper products. This is realistic considering the cost structures and similarities between them. The table below shows the results from 7.3.1.1 in respect of industry and introduces the GLOCS types.

Table 35 Level of logistics costs in Finnish manufacturing industries (data from 2005)

No.	Industry	Direct	Indirect	Operative	Administrative	GLOCS type
1	Manufacturing of food products, beverages and tobacco	●	●	●	●	A I
2	Manufacturing of textiles and textile products	●	●	●	●	B III
3	Manufacturing of leather and leather products	●	●	●	●	D II
4	Manufacturing of wood and wood products	●	●	●	●	D IV
5	Manufacturing of pulp, paper and paper products	●	●	●	●	D IV
6	Publishing and printing	●	●	●	●	A III
7	Manufacturing of coke, refined petroleum products, and nuclear fuel	●	●	●	●	A I
8	Manufacturing of chemicals, chemical products, and man-made fibers	●	●	●	●	A II
9	Manufacturing of rubber and plastic products	●	●	●	●	A II
10	Manufacturing of other non-metallic mineral products	●	●	●	●	D II
11	Manufacturing of basic metals and fabricated metal products	●	●	●	●	A III
12	Manufacturing of machinery and equipment	●	●	●	●	A I
13	Manufacturing of electrical and optical equipment	●	●	●	●	D III
14	Manufacturing of transport equipment	●	●	●	●	C III
15	Other manufacturing	●	●	●	●	B IV
16	Construction	●	●	●	●	C I

● Below-average costs ● Above-average costs

The following chapters examine the same aspects with respect to the datasets from 2009, 2010, and 2012.

7.3.1.2 Logistics families in the 2009 survey

As for 2006, the industries are positioned below based on their level of indirect and direct logistics costs for 2009 (Figure 100).

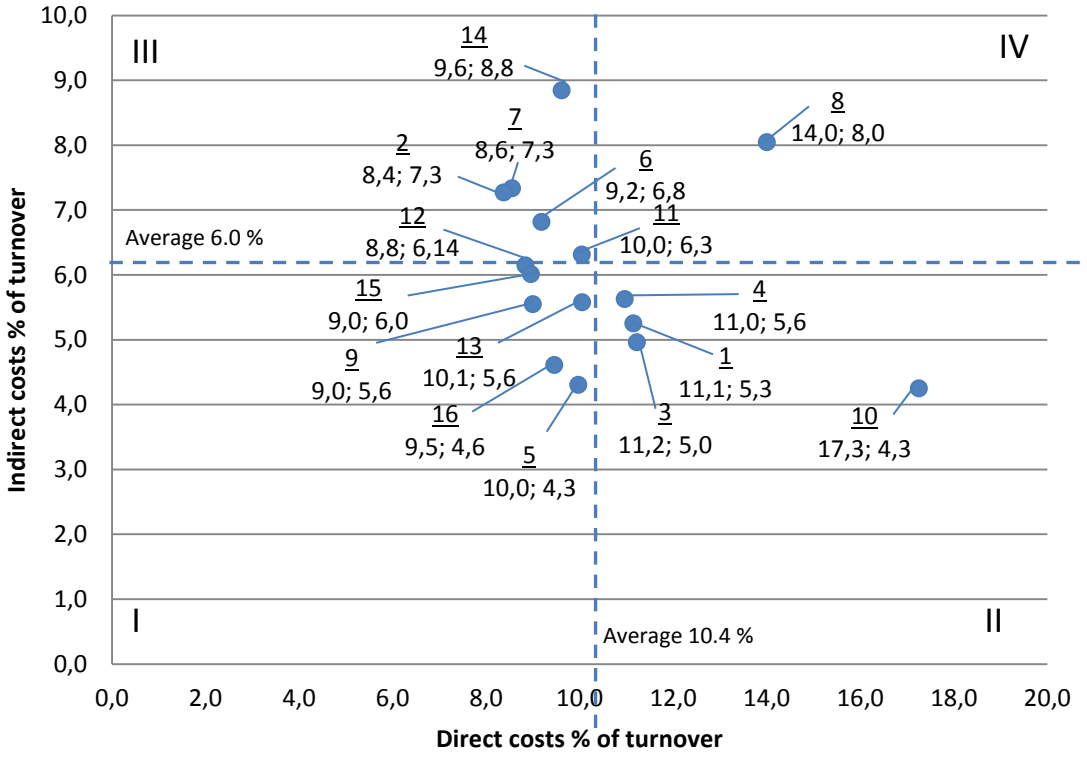


Figure 100 Positioning of Finnish manufacturing industries in respect of the level of direct and indirect logistics costs as a % of turnover (data from 2008)

Figure 100 follows the same pattern as in the chapter above. Section I accommodates five industries with below-average costs in both dimensions of direct and indirect logistics costs: 5) manufacturing of pulp, paper and paper products, 9) manufacturing of rubber and plastic products, 13) manufacturing of electrical and optical equipment, 15) other manufacturing, and 16) construction.

The four industries in section II had above-average direct logistics costs and below-average indirect logistics costs: 1) manufacturing of food, beverages and tobacco, 3) manufacturing of leather and leather products, 4) manufacturing of wood and wood products, and 10) manufacturing of non-metallic mineral products.

Section III, which represents below-average direct costs and above-average indirect logistics costs, includes six industries: 2) manufacturing of textiles and textile products, 6) publishing and printing, 7) manufacturing of coke, refined petroleum products and nuclear fuel, 11) manufacturing of basic metals and fabricated metal products, 12) manufacturing machinery and equipment, and 14) manufacturing of transportation equipment.

Only one industry, 8) manufacturing of chemicals, chemical products and man-made fibers, had above-average logistics costs in both dimensions (section IV). Indirect logistics costs of this industry were 8.0% of turnover and direct logistics costs 14.0%. However, in this case the number of respondents was relatively small.

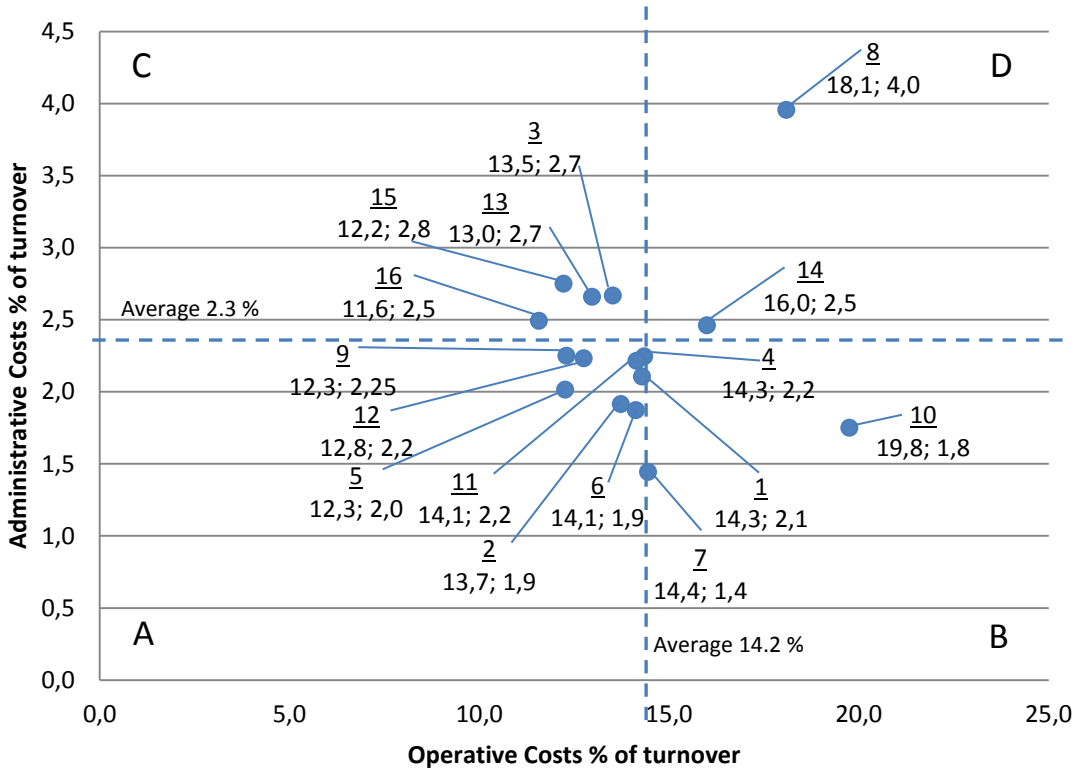


Figure 101 Positioning of Finnish manufacturing industries in respect of the level of operative and administrative costs (data from 2008)

Figure 101 illustrates the positioning of industries in respect of administrative and operative costs. The average logistics costs of manufacturing industries in 2008 were 2.3% of turnover (administrative costs) and 14.2% of turnover (operative costs). Compared to 2005, administrative costs fell slightly but operative costs rose by 1.3%.

The following industries managed to reach below-average costs in both dimensions, operative and administrative (section A): 2) manufacturing of textiles and textile products, 5) manufacturing of pulp, paper and paper products, 6) publishing and printing, 9) manufacturing of rubber and plastic products, 11) manufacturing of basic metals and fabricated metal products, and 12) manufacturing of machinery.

Four industries had above-average operative costs but below-average administrative costs (section B): 1) manufacturing of food, beverages and tobacco, 4) manufacturing of wood and wood products, 7) manufacturing of coke, refined petroleum products and nuclear fuel and 10) manufacturing of non-metallic mineral products.

Section C, above-average administration costs and below-average operative costs, houses four industries: 3) manufacturing of leather and leather products, 13) manufacturing of electrical and optical equipment, 15) other manufacturing, and 16) construction. Only two industries are located in section D, which represents industries with above-average costs in both dimensions: 8) manufacturing

of chemicals, chemical products and man-made fibers, and 14) manufacturing of transportation equipment. The latter also had the highest aggregated costs at 22.1% of turnover. Figure 102 combines the information from the two figures above in the same way asFigure 99, which shows the 2006 survey results.

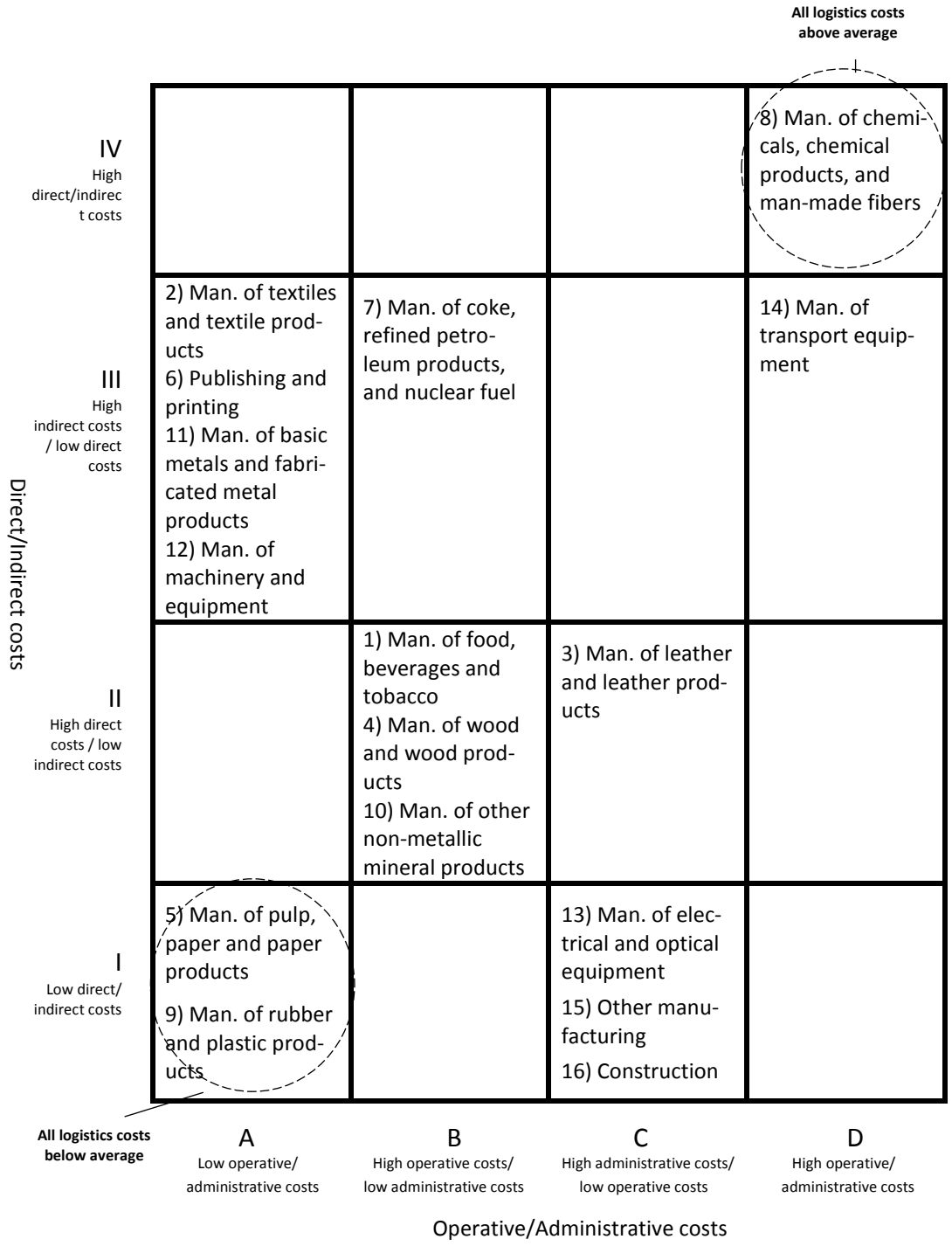


Figure 102 Combining the results of Finnish manufacturing industries positioning (data from 2008)

Compared to the 2005 data, industries occupied fewer slots (eight compared to 10 in Figure 99). In 2008 two industries, 5) pulp and paper manufacturing and 9) rubber and plastic manufacturing, had low (below-average) logistics costs in all dimensions. Compared to 2005, the pulping and paper manufacturing industry had shifted from the top right to the bottom left corner of the chart. Correspondingly, rubber and plastic manufacturers had also managed to cut their direct costs to below average.

Two industries with high indirect costs, 6) publishing and printing and 11) manufacturing of basic metals, maintained their cost structure and position from 2006. Two other industries moved into the slot with high indirect costs and low operative/administrative logistics costs: 2) manufacturing of textiles and 12) manufacturing of machinery. In 2005, the former had high indirect and operative costs and the latter had all logistics costs below average.

Three industries were positioned in the slot of high operative and indirect costs: 1) manufacturing of food, beverages and tobacco, 4) manufacturing of wood and wood products, and 10) manufacturing of non-metallic mineral products. In the 2005 data manufacturing of food products, beverages and tobacco had low logistics costs in all dimensions; manufacturing of wood and wood products had high logistics costs in all dimensions, and manufacturing of non-metallic mineral products had high operative, administrative and direct costs. Manufacturing of coke, refined petroleum products and nuclear fuel (7) landed in the slot for high indirect and operative costs (all low in 2005).

Three industries settled in the slot for high administrative costs but low costs in other dimensions: 13) manufacturing of electrical and optical equipment, 15) other manufacturing, and 16) construction. Construction was already positioned here in 2005 but the two other industries were slotted elsewhere (13 with high indirect costs, administration and operative costs, and 15 with high operative, direct and indirect costs). Manufacturing of leather and leather products managed to cut its average operative costs and moved to the slot for high administrative and direct costs in 2008.

Two industries had high operative and administrative costs: 14) manufacturing of transportation equipment industry, which had above-average indirect costs, and 8) chemical manufacturers, which also had high direct costs, making it the only industry with all logistics costs above average. It should be noted that in 2005 chemical manufacturers had high direct costs, but other cost dimensions were below average. Table 36 follows the same pattern as Table 35.

Table 36 Level of logistics costs in Finnish manufacturing industries (data from 2009)

No.	Industry	Direct	Indirect	Operative	Adminis-trative	GLOCS type
1	Manufacturing of food products, beverages and tobacco	●	○	●	○	B II
2	Manufacturing of textiles and textile products	○	●	○	○	A III
3	Manufacturing of leather and leather products	●	○	○	●	C II
4	Manufacturing of wood and wood products	●	○	●	○	B II
5	Manufacturing of pulp, paper and paper products	○	○	○	○	A I
6	Publishing and printing	○	●	○	○	A III
7	Manufacturing of coke, refined petroleum products, and nuclear fuel	○	●	●	○	B III
8	Manufacturing of chemicals, chemical products, and man-made fibers	●	●	●	●	D IV
9	Manufacturing of rubber and plastic products	○	○	○	○	A I
10	Manufacturing of other non-metallic mineral products	●	○	●	○	B II
11	Manufacturing of basic metals and fabricated metal products	○	●	○	○	A III
12	Manufacturing of machinery and equipment	○	●	○	○	A III
13	Manufacturing of electrical and optical equipment	○	○	○	●	C I
14	Manufacturing of transport equipment	○	●	●	●	D III
15	Other manufacturing	○	○	○	●	C I
16	Construction	○	○	○	●	C I

○ Below-average costs ● Above-average costs

Table 36 presents the information elaborated in paragraph 7.3.1.2 in the same table. Table is constructed similarly to Table 35 but by using year's 2008 data.

7.3.1.3 Logistics families in the 2010 survey

Figure 110 positions industries based on their level of indirect and direct logistics costs compared to average levels of all manufacturing industries. No data were received from representatives of manufacturing of coke, refined petroleum products and nuclear fuel.

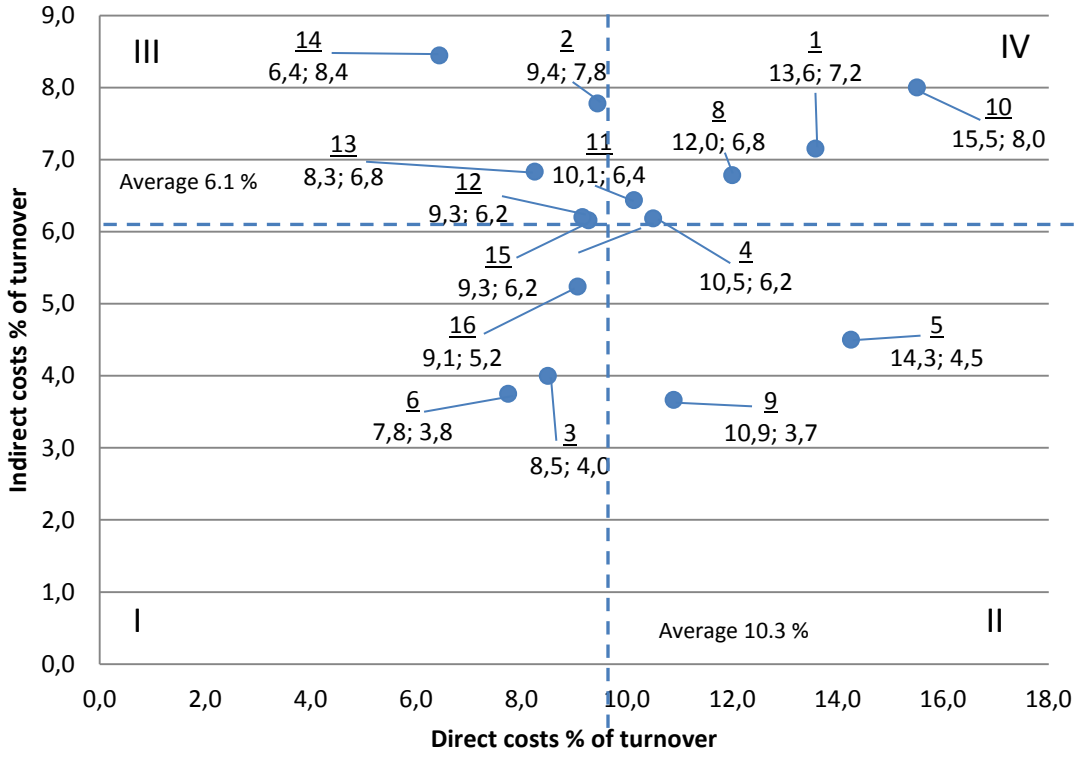


Figure 103 Positioning of Finnish manufacturing industries in respect of the level of direct and indirect logistics costs as a % of turnover (data from 2009)

Three industries had below-average costs in both dimensions: 3) manufacturing of leather and leather products (section I in 2008), 6) publishing and printing (section III in 2008), and 16) construction (section I in 2008).

Two industries are located in section II, above-average direct logistics costs and below-average indirect logistics costs: 5) manufacturing of pulp, paper and paper products, and 9) manufacturing of rubber and plastic products. In 2008 both of these were located in section I.

Section III, representing below-average direct costs and above-average logistics costs, includes five industries: 2) manufacturing of textiles and textile products, 12) manufacturing machinery and equipment, 13) manufacturing of electrical and optical equipment, 14) manufacturing of transportation equipment, and 15) other manufacturing. Excluding manufacturing of electrical and optical equipment, and other manufacturing (section I in 2008), all other industries were in the same section in 2008.

Five industries are located in section IV as no data from manufacturers of coke, refined petroleum products and nuclear fuel were available that year: 1) manufacturing of food, beverages and tobacco, 4) manufacturing of wood and wood products, 8) manufacturing of chemicals, chemical products and man-made fibers, 10) manufacturing of non-metallic mineral products, and 11) manufacturing of basic metals and fabricated metal products. Three of these (industries 1, 4,

10) moved to section IV from section II, while two others were in same section earlier. Industries are positioned in respect of administrative and operative costs in Figure 111.

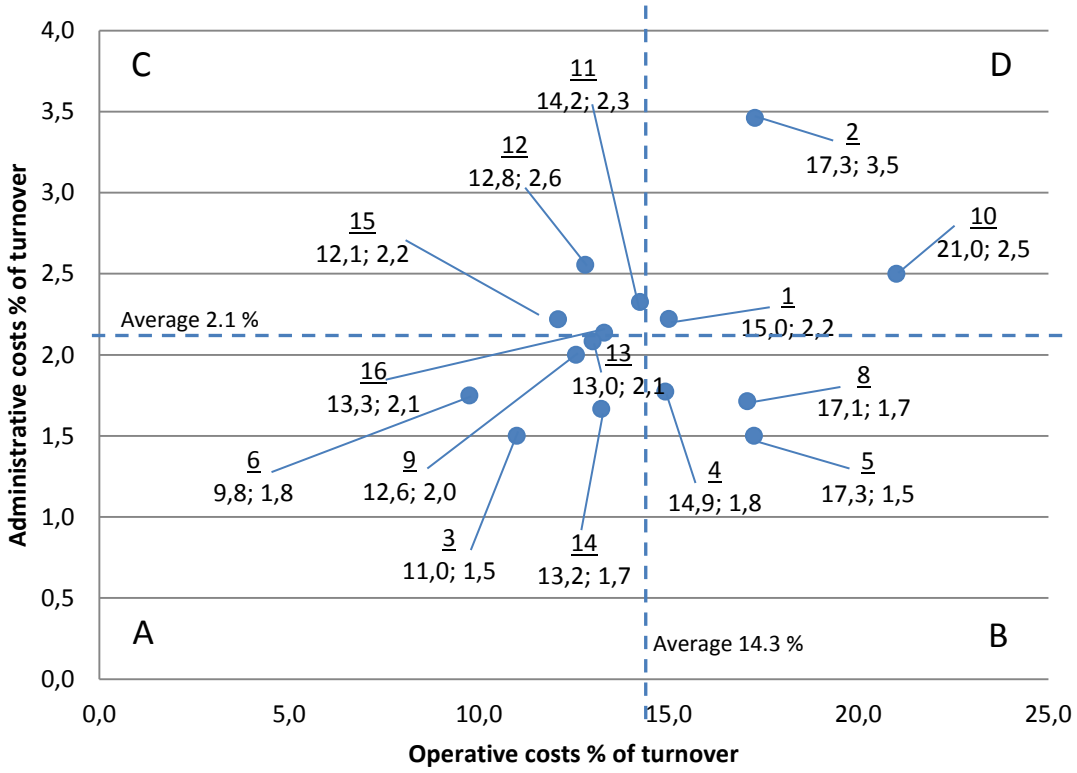


Figure 104 Positioning of Finnish manufacturing industries in respect of the level of operative and administrative costs (data from 2009)

Average administrative costs were 2.1% (2.3% in 2008) of turnover (administrative costs) and operative costs 14.2% (14.2% in 2008) of turnover.

As in 2008, six industries reached below-average costs in both dimensions (section A): 3) manufacturing of leather and leather products (C in 2008), 6) publishing and printing, 9) manufacturing of rubber and plastic products, 13) manufacturing of electrical and optical equipment, 14) manufacturing of transportation equipment (D in 2008), and 16) construction (C in 2008). There were several additional industries in A in 2008.

Three industries had above-average operative costs but below-average administrative costs (section B): 4) manufacturing of wood and wood products (also B in 2008), 5) manufacturing of pulp, paper and paper products (A in 2008), and 8) manufacturing of chemicals, chemical products and man-made fibers (D in 2008).

Section C, above-average administration costs and below-average operative costs, included three industries: 11) manufacturing of basic metals and fabricated metal products, 12) manufacturing of machinery (both A in 2008), and 15) other

manufacturing (C in 2008). Three industries were located in section D, with above-average costs in both dimensions: 1) manufacturing of food, beverages and tobacco (B in 2008), 2) manufacturing of textiles and textile products (A in 2008), and 10) manufacturing of non-metallic mineral products (B in 2008). Figure 102 combines the information of these two tables. The layout of the table is similar to Figure 99, presenting 2006 survey results.

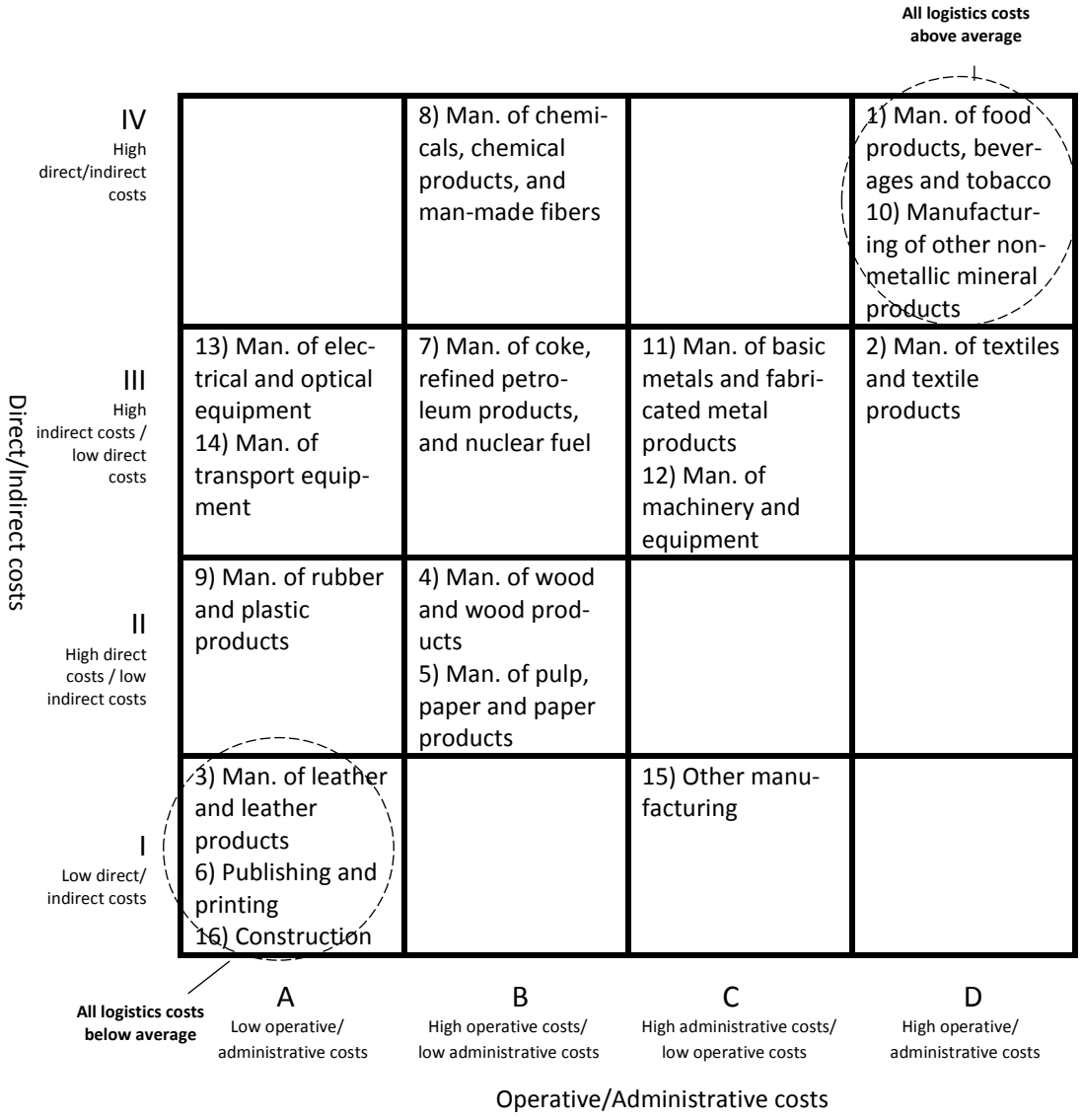


Figure 105 Combining the results of Finnish manufacturing industries positioning (data from 2009)

Compared to previous data, industries were more spread out and occupied 10 slots. In 2008 two industries, 5) pulp and paper manufacturing and 9) rubber and plastic manufacturing, had low (below-average) logistics costs in all cost dimensions, and they also had one of the lowest costs in 2009. However, three industries, 3) manufacturing of leather and leather products, 6) publishing and print-

ing, and 16) construction, had the lowest costs. The development of costs was favorable especially for the publishing and printing industry, which had high indirect costs in 2008. Industry 15 kept its place with high administrative costs, but low its costs in other dimensions.

Machine manufacturers (12) stayed in place with high indirect costs and low operative/administrative logistics costs, while manufacturers of textiles and textile produces (2) also faced high operative/administrative logistics costs. Other industries with high indirect logistics costs were 13) manufacturing of electrical and optical equipment, 14) manufacturing of transport equipment, 7) manufacturing of coke, refined petroleum products, and nuclear fuel, 11) manufacturing of basic metals and fabricated metal products, 12) manufacturing of machinery and equipment, and 2) manufacturing of textiles and textile products.

Three industries landed in slots indicating high direct costs: 9) manufacturing of rubber and plastic products, 4) manufacturing of wood and wood products, and 5) manufacturing of pulp, paper and paper products. The latter two also had high operative logistics costs.

Manufacturers of food products (1) and manufacturers of non-metallic mineral products (10) had high operative and indirect costs in 2008. In 2009 the costs continued rising, landing these industries in the slot for high logistics costs in all dimensions. Table 37 tabulates the results with the respective GLOCS types.

Table 37 Level of logistics costs in Finnish manufacturing industries (data from 2009)

No.	Industry	Direct	Indirect	Operative	Adminis-trative	GLOCS type
1	Manufacturing of food products, beverages and tobacco	●	●	●	●	D IV
2	Manufacturing of textiles and textile products	○	●	●	●	D III
3	Manufacturing of leather and leather products	○	○	○	○	A I
4	Manufacturing of wood and wood products	●	○	●	○	B II
5	Manufacturing of pulp, paper and paper products	●	○	●	○	B II
6	Publishing and printing	○	○	○	○	A I
7	Manufacturing of coke, refined petroleum products, and nuclear fuel	○	●	●	○	B III
8	Manufacturing of chemicals, chemical products, and man-made fibers	●	●	●	○	B IV
9	Manufacturing of rubber and plastic products	●	○	○	○	B II
10	Manufacturing of other non-metallic mineral products	●	●	●	●	D IV
11	Manufacturing of basic metals and fabricated metal products	○	●	○	●	C III
12	Manufacturing of machinery and equipment	○	●	○	●	C III
13	Manufacturing of electrical and optical equipment	○	●	○	○	A III
14	Manufacturing of transport equipment	○	●	○	○	A III
15	Other manufacturing	○	○	○	●	C I
16	Construction	○	○	○	○	A I

7.3.1.4 Logistics families in the 2012 survey

Manufacturing industries are positioned in this chapter based on data from the 2012 Finland State of Logistics survey. Again, industries are first positioned based on their level of indirect and direct logistics costs compared to average levels of all manufacturing industries (Figure 106). As in the 2010 survey, no data were available from the manufacturing of coke, refined petroleum products and nuclear fuel.

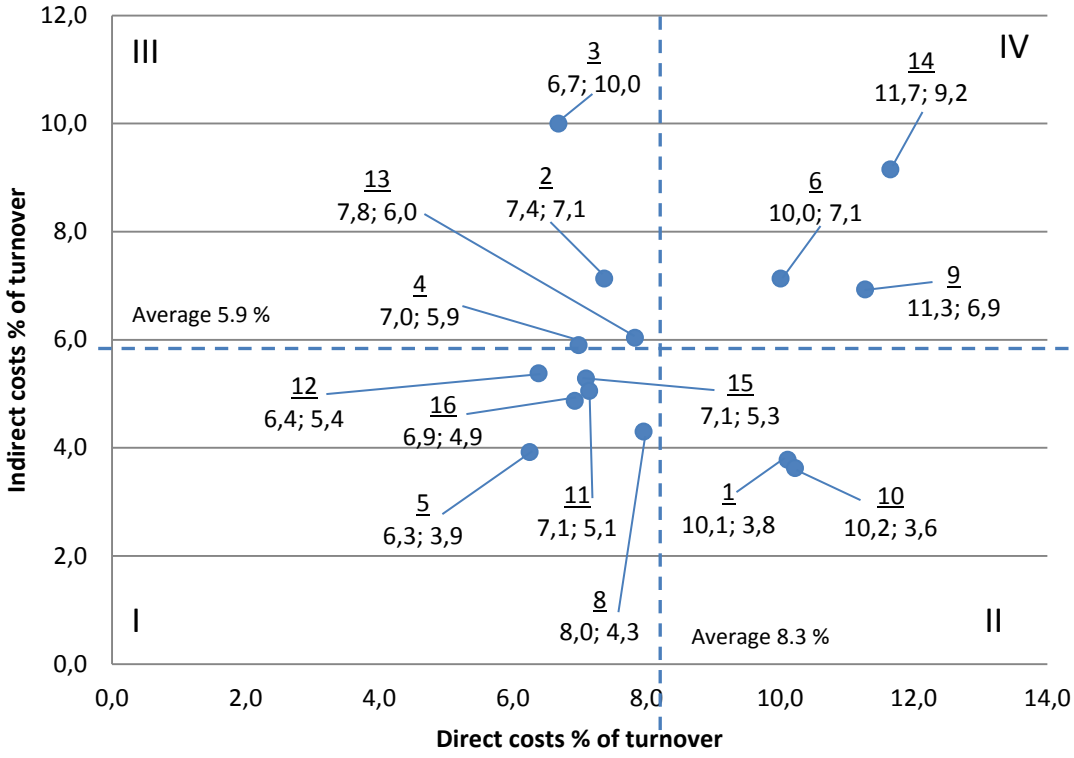


Figure 106 Positioning of Finnish manufacturing industries in respect of the level of direct and indirect logistics costs as a % of turnover (data from 2011)

According to the 2011 data, six industries had below-average costs in both dimensions, direct and indirect logistics costs: 5) manufacturing of pulp, paper and paper products (earlier in slot II), 8) manufacturing of chemicals, chemical products and man-made fibers, 11) manufacturing of basic metals and fabricated metal products (both earlier in IV), 12) manufacturing machinery and equipment (earlier in II), 15) other manufacturing (earlier in III), and 16) construction (earlier also in I).

Based on the 2011 data, only two industries had above-average direct costs and below-average indirect costs (section II): 1) manufacturing of food, beverages and tobacco and 10) manufacturing of non-metallic mineral products (both earlier in IV).

Four industries were positioned in section III: 2) manufacturing of textiles and textile products (III in 2009), 3) manufacturing of leather and leather products (I in 2009), 4) manufacturing of wood and wood products (IV in 2009), and 13) manufacturing of electrical and optical equipment (also III in 2009).

Hence three industries had above-average costs in both dimensions (section IV): 6) publishing and printing (I in 2009), 9) manufacturing of rubber and plastic products (III in 2009), and 14) manufacturing of transportation equipment (III in 2009). The positioning of industries in respect of administrative and operative costs is shown in Figure 111.

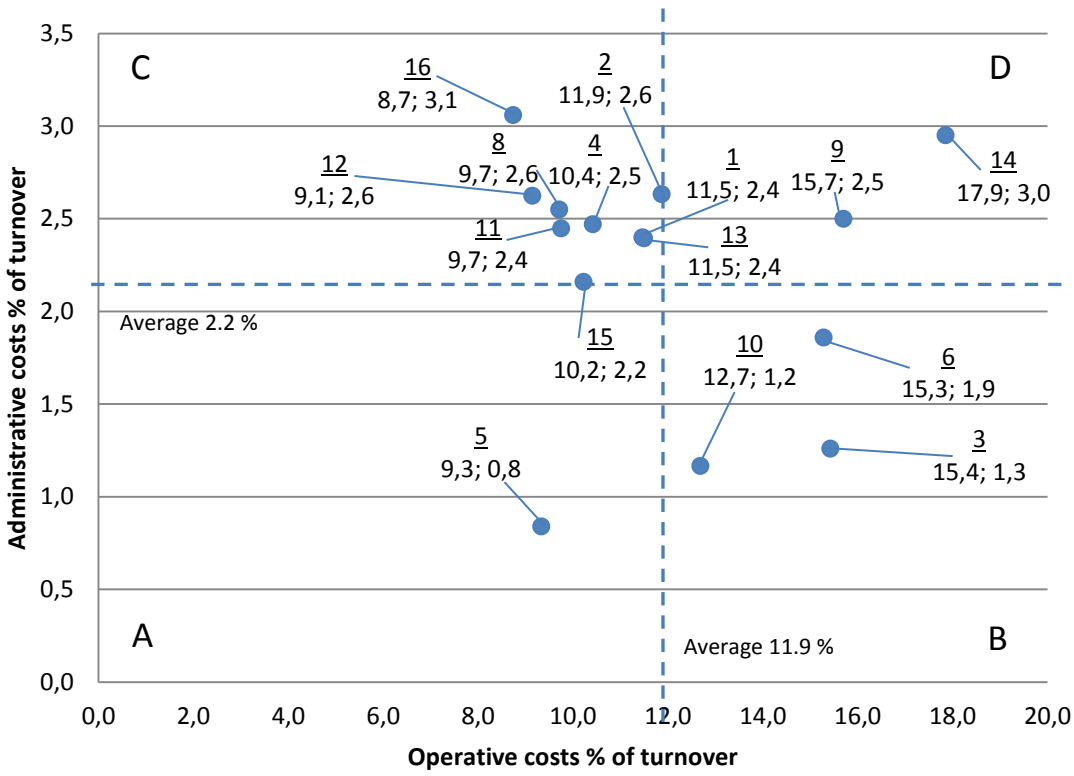


Figure 107 Positioning of Finnish manufacturing industries in respect of the level of operative and administrative costs (data from 2011)

In the figure above, average administrative costs were 2.2% (2.1% in 2009) of turnover, while operative costs dropped to 11.9% of turnover (14.2% in 2009).

In the 2011 data, only two industries landed in section A with below-average operative and administrative logistics costs: 5) manufacturing of pulp, paper and paper products (B in 2009) and 15) other manufacturing (C in 2009). Especially the change in costs was significant in the manufacturing of pulp and paper. The changes in cost sections are more comprehensively discussed in chapter 7.3.1.5.

Three industries had above-average operative costs and below-average administrative costs: 3) manufacturing of leather and leather products, 6) publishing and printing (both A in 2009), and 10) manufacturing of non-metallic mineral products, which returned to B from D.

Over half of industries (nine) were located in section C, above-average administration costs and below-average operative costs: 1) manufacturing of food, beverages and tobacco (formerly C), 2) manufacturing of textiles and textile products (D in 2009), 4) manufacturing of wood and wood products, 8) manufacturing of chemicals, chemical products and man-made fibers (both B in 2009), 11) manufacturing of basic metals and fabricated metal products, 12) manufacturing of machinery (both C in 2009), 13) manufacturing of electrical and optical equipment (formerly A), and 16) construction (A in 2008).

Finally, the two industries in section D were 9) manufacturing of rubber and plastic products and 14) manufacturing of transportation equipment (both A in 2009). Figure 108 presents the combined information from the two previous tables.

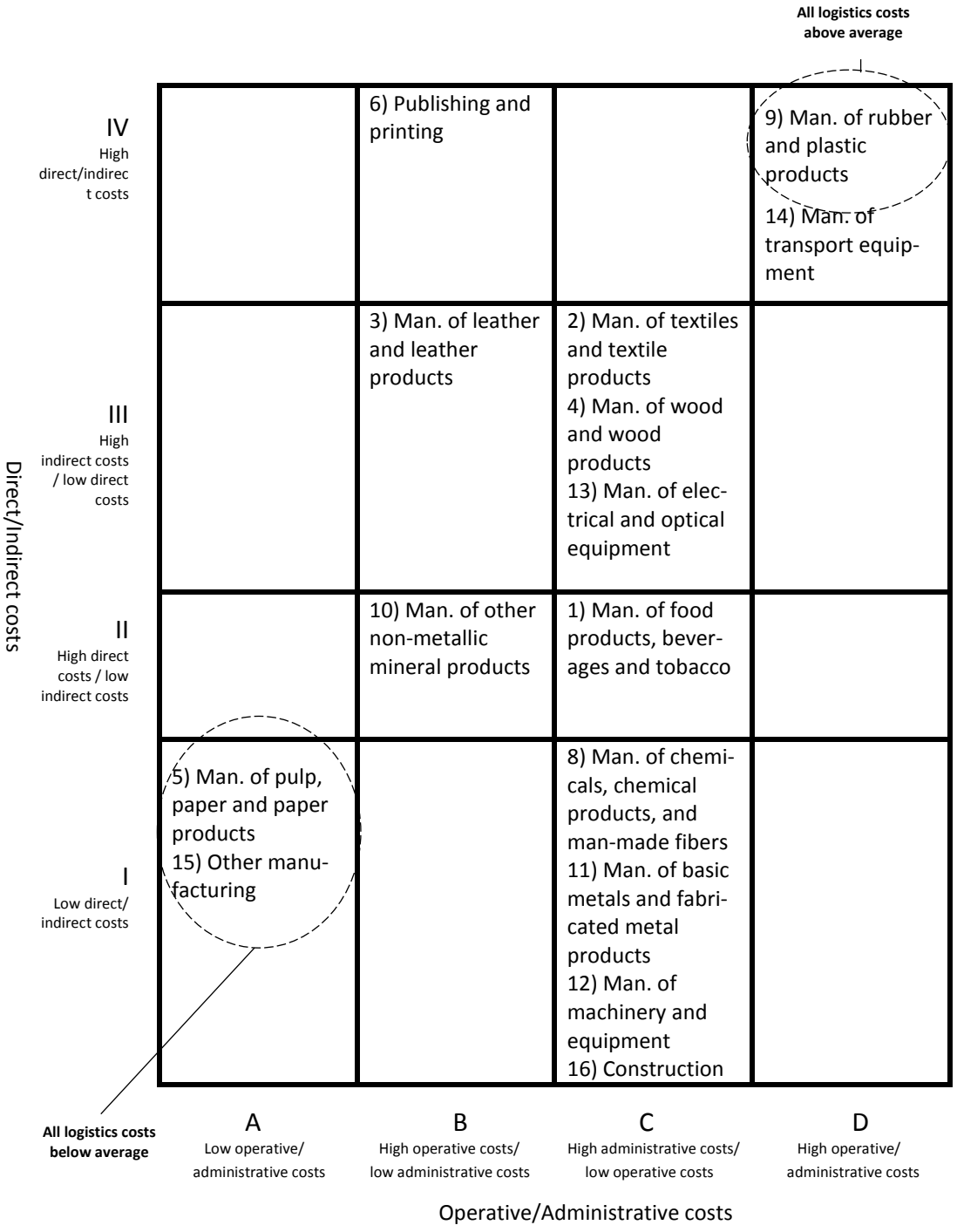


Figure 108 Combining the results of Finnish manufacturing industries positioning (data from 2011)

Compared to 2009, the positioning of industries was more concentrated. Again two industries, 5) pulp and paper manufacturing and 15) other manufacturing, had low (below-average) logistics costs in all dimensions. Pulp and paper manufacturers reported low costs in earlier studies as well, which indicates efficient logistics processes in this industry.

Totally four industries had high administrative costs, but low logistics costs in the other three dimensions: 8) manufacturing of chemicals, 11) manufacturing of basic metals, 12) manufacturing of machinery, and 16) construction. Companies in publishing and printing (6) had high operational, direct and indirect costs, while manufacturers of leather (3) and manufacturers of non-metallic mineral products (10) had either high direct or indirect costs.

Manufacturers of food and beverages reported high administrative and indirect logistics costs. Three industries were slotted in the high administrative and high indirect logistics costs: 2) manufacturing of textiles and textile products, 4) manufacturing of wood and wood products, and 13) manufacturing of electrical and optical equipment.

Finally, two industries hit above average in all cost dimensions: 9) rubber and plastic manufacturing and 14) manufacturing of transportation equipment. No data were received from manufacturers of coke or petrol. The results are summarized with the respective GLOCS types in Table 38.

Table 38 Level of logistics costs in Finnish manufacturing industries (data from 2012)

No.	Industry	Direct	Indirect	Operative	Adminis-trative	GLOCS type
1	Manufacturing of food products, beverages and tobacco	●	●	●	●	C II
2	Manufacturing of textiles and textile products	●	●	●	●	C III
3	Manufacturing of leather and leather products	●	●	●	●	B III
4	Manufacturing of wood and wood products	●	●	●	●	C III
5	Manufacturing of pulp, paper and paper products	●	●	●	●	A I
6	Publishing and printing	●	●	●	●	B IV
7	Manufacturing of coke, refined petroleum products, and nuclear fuel	NA	NA	NA	NA	
8	Manufacturing of chemicals, chemical products, and man-made fibers	●	●	●	●	C I
9	Manufacturing of rubber and plastic products	●	●	●	●	D IV
10	Manufacturing of other non-metallic mineral products	●	●	●	●	B II
11	Manufacturing of basic metals and fabricated metal products	●	●	●	●	C I
12	Manufacturing of machinery and equipment	●	●	●	●	C I
13	Manufacturing of electrical and optical equipment	●	●	●	●	C III
14	Manufacturing of transport equipment	●	●	●	●	D IV
15	Other manufacturing	●	●	●	●	A I
16	Construction	●	●	●	●	C I

The information in the table above is commensurable with earlier tables.

7.3.1.5 Changes in GLOCS type for manufacturing industries

As presented above, the positions of industries have changed according to the surveys published in 2006, 2009, 2010, and 2012. Comparison of GLOCS types between these years offers useful information on the development of logistics costs and their structure in different industries. The changes in positions of industries are illustrated in Figure 109. Each industry has its respective table and some potential reasons for changes are discussed. The similarities between industries are concluded in chapter 8.

1. Man. of food etc.

	A	B	C	D
IV				***2009***
III				
II		***2008***	***2011***	
I	***2005***			

2. Man. of textiles

	A	B	C	D
IV				
III	***2009***	***2005***	***2011***	***2008***
II				
I				

3. Man. of leather products

	A	B	C	D
IV				
III		***2011***		
II			***2008***	***2005***
I	***2009***			

4. Man. of wood products

	A	B	C	D
IV				***2005***
III			***2011***	
II		***2008 2009***		
I				

5. Man. of pulp and paper

	A	B	C	D
IV				***2005***
III				
II		*2009*		
I	***2008 2011***			

6. Publishing and printing

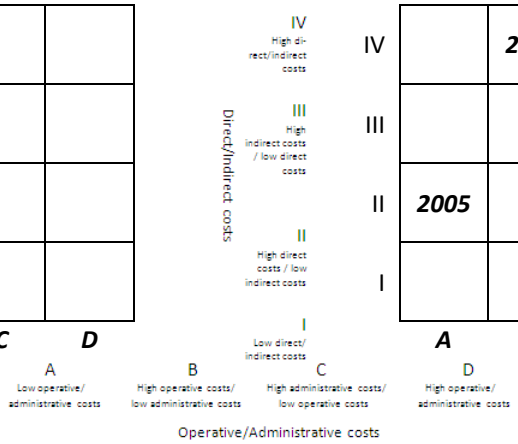
	A	B	C	D
IV		***2011***		
III	***2005 2008***			
II				
I	***2009***			

7. Man. of coke and petrol*

	A	B	C	D
IV				
III		***2008 2009***		
II				
I	***2005***			

8. Man. of chemicals

	A	B	C	D
IV		***2009***		***2008***
III				
II	***2005***			
I			***2011***	



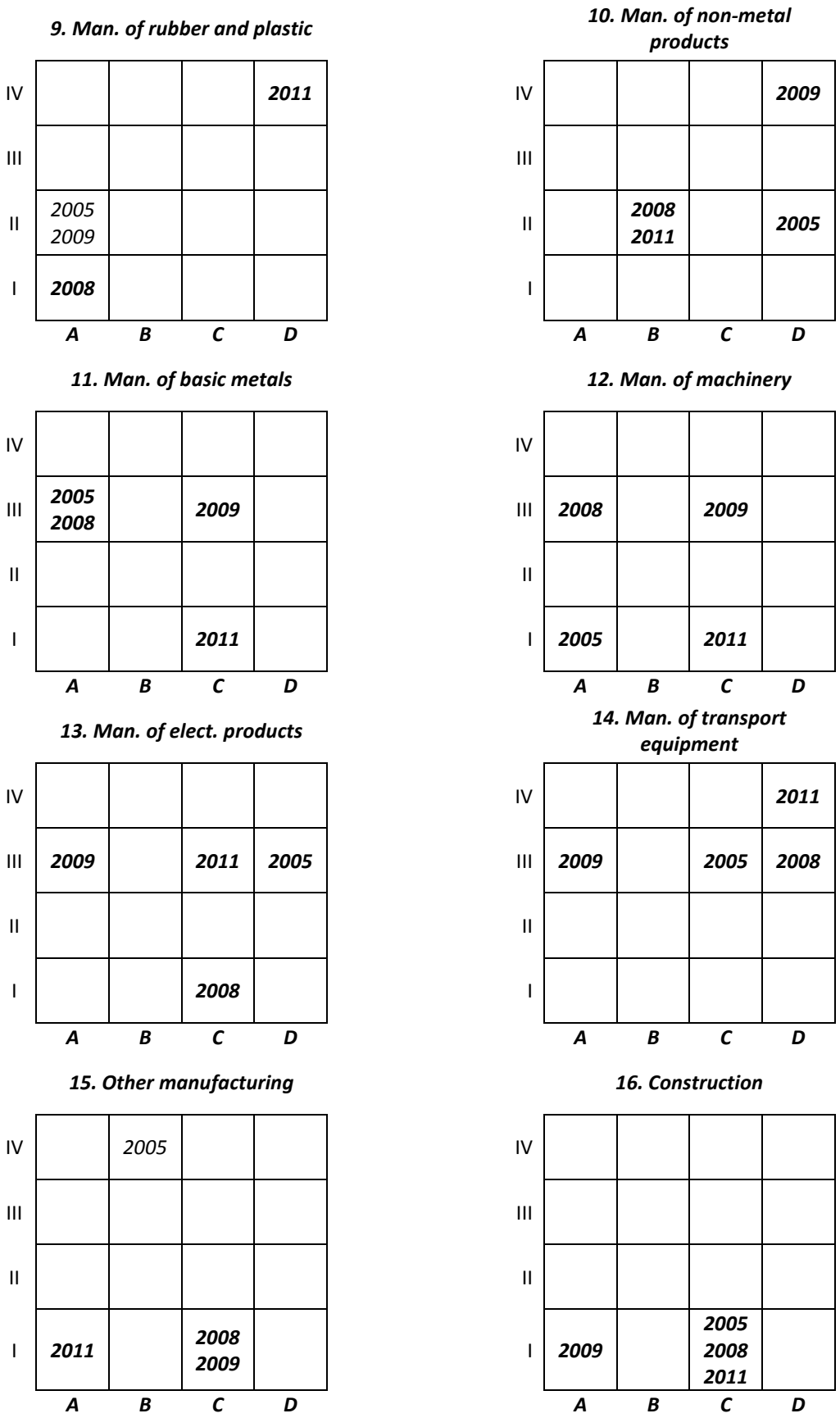


Figure 109 Changes in positions of Finnish manufacturing industries (year of data indicated) *No data available for 2011

The logistics costs for manufacturers of food, beverages, and tobacco increased from type A I to D IV between 2005 and 2009. In 2011, costs fell to C I. No single explanation for this can be provided within this research but the output confirms that logistics costs of industries vary significantly in relation to the average for all manufacturing. It also seems that food and beverage manufacturers are relatively vulnerable to changes in logistics costs compared to other industries. One reason may be that logistics plays an important role for an industry dealing with perishable goods. This is also related to regulation issues, as logistics processes in certain industries may be strictly regulated, which may in turn further increase costs.

The logistics costs of textile manufacturers have varied significantly in respect of operative/administrative costs, but according to the findings indirect costs have been above average in all surveys. Correspondingly, direct costs have been below average for all industries. Some high indirect costs may be attributed to the complexity of global logistics processes, characteristic for the textile industry, which may require major resources for managing processes not directly related to logistics. These may include e.g. preparing documents, negotiations, and processes relating to the import and export of raw materials and such. This is supported by the logistics costs of manufacturing of leather and leather products, which had above-average indirect logistics only in 2011. One reason lies in the complexity of logistics processes, as manufacturers of leather are usually able to use domestic raw material suppliers, facilitating the logistics processes and indirect work related to these.

Another interesting correlation is that between wood and paper manufacturers. Whereas manufacturing of wood and wood products suffered above-average logistics costs in at least in two of four cost dimensions in all surveys, pulp and paper manufacturers had below-average costs in at least two dimensions in 2008, 2009, and 2011. Especially in 2008 and 2011, the GLOCS type of manufacturing of pulp and paper was A I, which indicates that logistics costs were covered by raw material producers, namely wood manufacturers. Furthermore, the next industry on the value chain, publishing and printing, had low administrative and operative logistics costs. To conclude, it seems that in forest-related industries, logistics costs are carried mainly by companies operating upstream of the chain. This is confirmed by e.g. the incoterms used by companies (see Figure 7). The significant decrease in the logistics costs of paper and pulp manufacturers from 2005 is attributable to the nature of the industry itself: As the demand for paper has fallen especially in Europe and North America, manufacturers have been forced to move their capacity to low-cost countries, where demand is still growing.

Manufacturing of coke and petrol and manufacturing of chemicals are fairly marginal industries in Finland, which explains the small samples resulting in

scattered results. The results for manufacturing of rubber and plastic show that operative costs were at a low level throughout the empirical measurement period. This indicates that the industry has succeeded in building up an efficient logistics network, which is probably facilitated by the concentrated retail and wholesaling sector in Finland. On the other hand, operative and direct costs were high for manufacturing of non-metallic products.

A similar correlation between added value and logistics costs to that experienced in the wood-related industries was not detected in the case of metallic products. In fact the results were somewhat opposite, as manufacturers of basic metals (raw material suppliers) reported lower logistics costs in general than manufacturers of machinery/electrical products/transport equipment (assembly etc.). These two value chains cannot be directly compared, as the logic of these industries is different. Whereas wood producers, the pulp and paper industry and publishing are dominated only by large players, the value chain of metal refineries and machine manufacturers also consists of smaller players. In this sense they do not possess similar bargaining power towards raw material suppliers as for example paper companies do. This explains why basic metal providers are able to have lower logistics costs than refiners. These may also take advantage of economies of scale, as volumes are large.

The logistics costs of other manufacturing industries were high before the onset of the global recession in 2008. Since then logistics costs have fallen relative to the average of all manufacturing industries. In 2008 and 2009, administrative costs were still high, but in 2011 the GLOCS type was AI. Finally, construction, which differs quite a lot from other manufacturing industries, reported high administrative costs but below-average costs in other dimensions. This could be due to the project nature of the industry, which allows cutting logistics costs as processes can be planned beforehand.

In general, explaining the factors behind changes in GLOCS type is beyond the scope of this study, but some potential reasons are discussed above. In addition, some transitions may be caused by changes in statistical background factors like heterogeneous population or geographical coverage of respondents' location. It is also likely that some transitions are due to the changes in an industry's business environment or other macro-economic factors. For example, the world economy fell into recession during data collection in 2008, and in some industries the economic downturn might have caused a fall in demand for logistics services, ultimately leading to lower logistics costs. Table 39 re-presents the information illustrated in Figure 109.

Table 39 Differences in GLOCS types of manufacturing industries in Finland

No.	Industry	GLOCS type 2005	GLOCS type 2008	GLOCS type 2009	GLOCS type 2011
1	Manufacturing of food products, beverages and tobacco	A I	B II	D IV	C II
2	Manufacturing of textiles and textile products	B III	A III	D III	C III
3	Manufacturing of leather and leather products	D II	C II	A I	B III
4	Manufacturing of wood and wood products	D IV	B II	B II	C III
5	Manufacturing of pulp, paper and paper products	D IV	A I	B II	A I
6	Publishing and printing	A III	A III	A I	B IV
7	Manufacturing of coke, refined petroleum products, and nuclear fuel	A I	B III	B III	N/A
8	Manufacturing of chemicals, chemical products, and man-made fibers	A II	D IV	B IV	C I
9	Manufacturing of rubber and plastic products	A II	A I	B II	D IV
10	Manufacturing of other non-metallic mineral products	D II	B II	D IV	B II
11	Manufacturing of basic metals and fabricated metal products	A III	A III	C III	C I
12	Manufacturing of machinery and equipment	A I	A III	C III	C I
13	Manufacturing of electrical and optical equipment	D III	C I	A III	C III
14	Manufacturing of transport equipment	C III	D III	A III	D IV
15	Other manufacturing	B IV	C I	C I	A I
16	Construction	C I	C I	A I	C I

Table 39 summarizes the changes in position of industries respective to the GLOCS types.

7.3.2 Logistics families of trading industries

In this chapter, trading industries are positioned in the GLOCS fourfold table, which together with GLOCS typing allows one to identify some distinctive characteristics of logistics costs for different industries. Since the positioning of industries and GLOCS are both comprehensively explained in the previous chapters, only the results are provided here.

7.3.2.1 Logistics families in the 2006 survey

Industries are first positioned according to the level of indirect and direct costs. The average of indirect logistics costs in 2006 was 4.3% of turnover (8.9% for direct costs). The average level is indicated in the figure by a dashed line. (Figure 110)

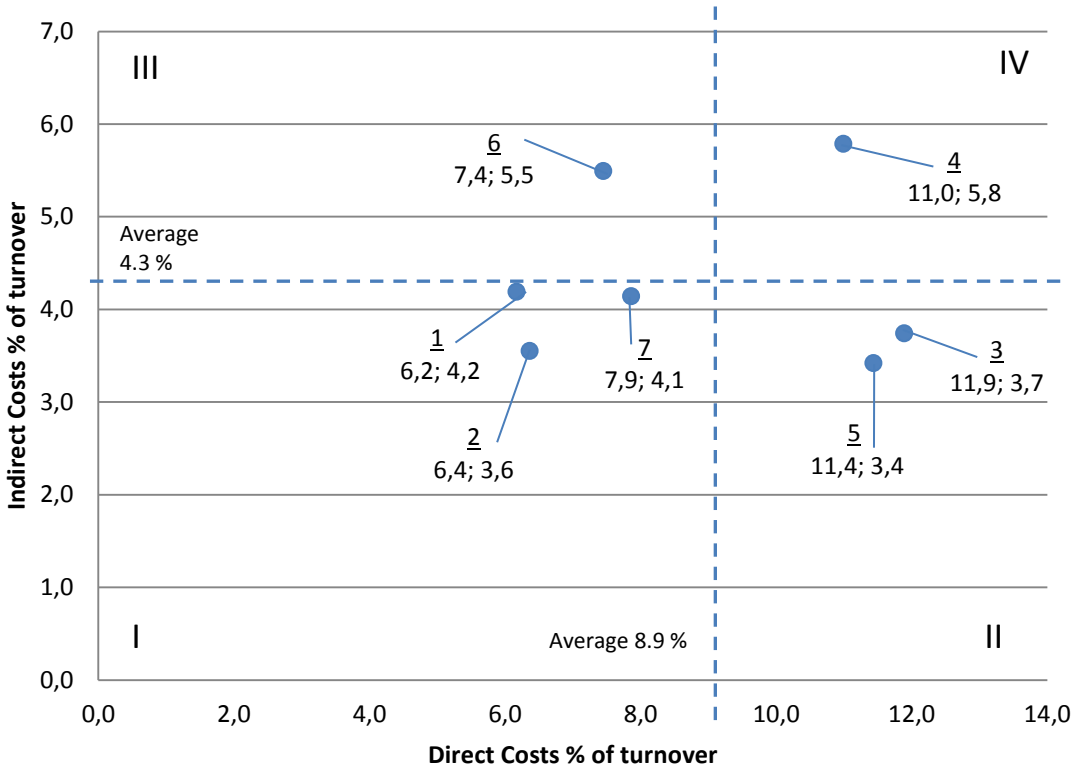


Figure 110 Positioning of Finnish trading industries in respect of the level of direct and indirect logistics costs as a % of turnover (data from 2005)

Retail of food, beverages and tobacco (1), other retailing (2), and trade of fuel (7) are located in Section I, below-average direct and indirect costs. Wholesalers of food, beverages and tobacco (3) and agencies (5) had above-average direct costs but below-average indirect costs. The opposite is true for traders of motor vehicles (6), who reported above-average indirect logistics costs but below-average direct costs. Wholesale: other (4) was the only industry that had above average costs in both dimensions. Figure 111 shows a similar taxonomy of administrative and operative cost dimensions.

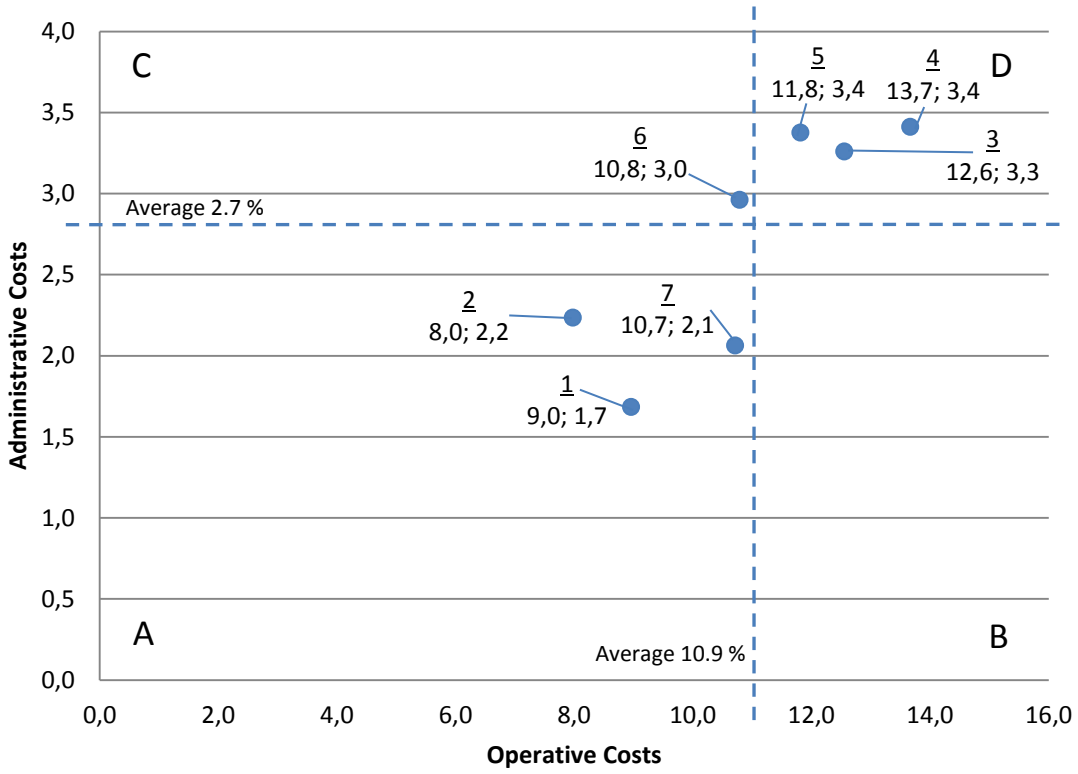


Figure 111 Positioning of Finnish trading industries in respect of the level of operative and administrative costs (data from 2005)

The average level of operative costs in 2005 was 10.9% of turnover (average level of administrative costs 2.7%). Industries are mainly placed in one of two sectors, both dimensions below average (A) or both dimensions above average (D). Industries with high operative and administrative costs were wholesale (3), other wholesale (4) and agency (5). Food retailers (1), other retailers (2), and traders of fuel (7) had below-average operative and administrative costs. Only one industry, traders of motor vehicles (6), was positioned in section C, above-average administrative and below-average operative costs. Figure 112 combines the data presented above.

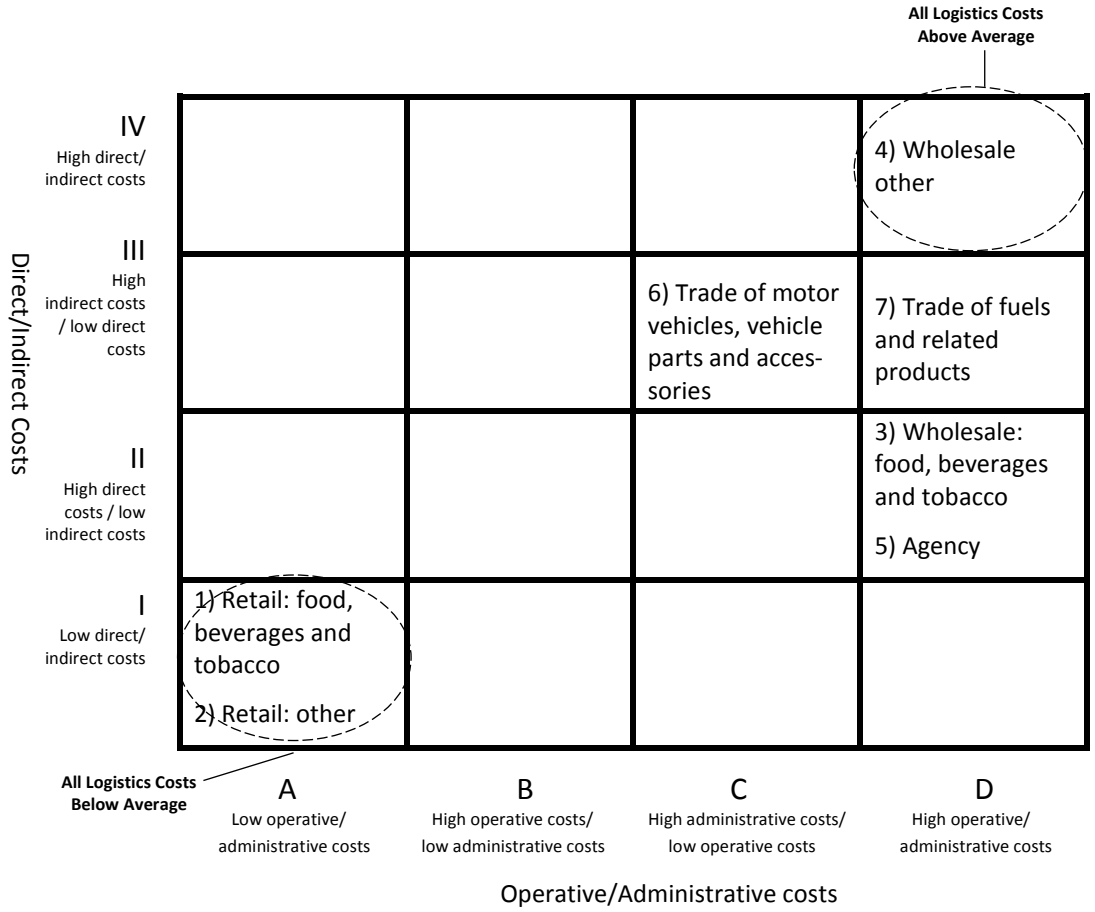


Figure 112 Combining the results of Finnish trading industries positioning (data from 2005)

As seen in Figure 112, two industries, 1) retail of food, etc. and 2) other retail had all logistics costs below average in 2005. The gap between retailers and other trading industries was significant; wholesalers of food (3), etc. and agencies (5) had high administrative and operative as well as direct costs, while traders of motor vehicles (6) reported high indirect and administrative costs. At the upper end of cost level were such industries as 4) other wholesale and 7) trade of fuels. The other wholesale industry (4) had above average logistics costs in all dimensions. Table 40 represents the logistics costs per industry and corresponding GLOCS type.

Table 40 Level of logistics costs in Finnish trading industries (data from 2005)

No.	Industry	Direct	Indirect	Operative	Adminis-trative	GLOCS Type
1	Retail: food, beverages and tobacco	●	●	●	●	A I
2	Retail: other	●	●	●	●	A I
3	Wholesale: food, beverages and tobacco	●	●	●	●	D II
4	Wholesale: other	●	●	●	●	D IV
5	Agency	●	●	●	●	D II
6	Trade of motor vehicles, vehicle parts and accessories	●	●	●	●	C III
7	Trade of solid, liquid and gaseous fuels and related products	●	●	●	●	D III

● Below-average costs ● Above-average costs

In the next chapter a similar process is performed with the 2009 dataset.

7.3.2.2 Logistics families in the 2009 survey

This section replicates the process described in chapter 7.3 but with the 2009 survey dataset. The structure also follows that above. First, trading industries are positioned according to their level of direct and indirect logistics costs (Figure 113).

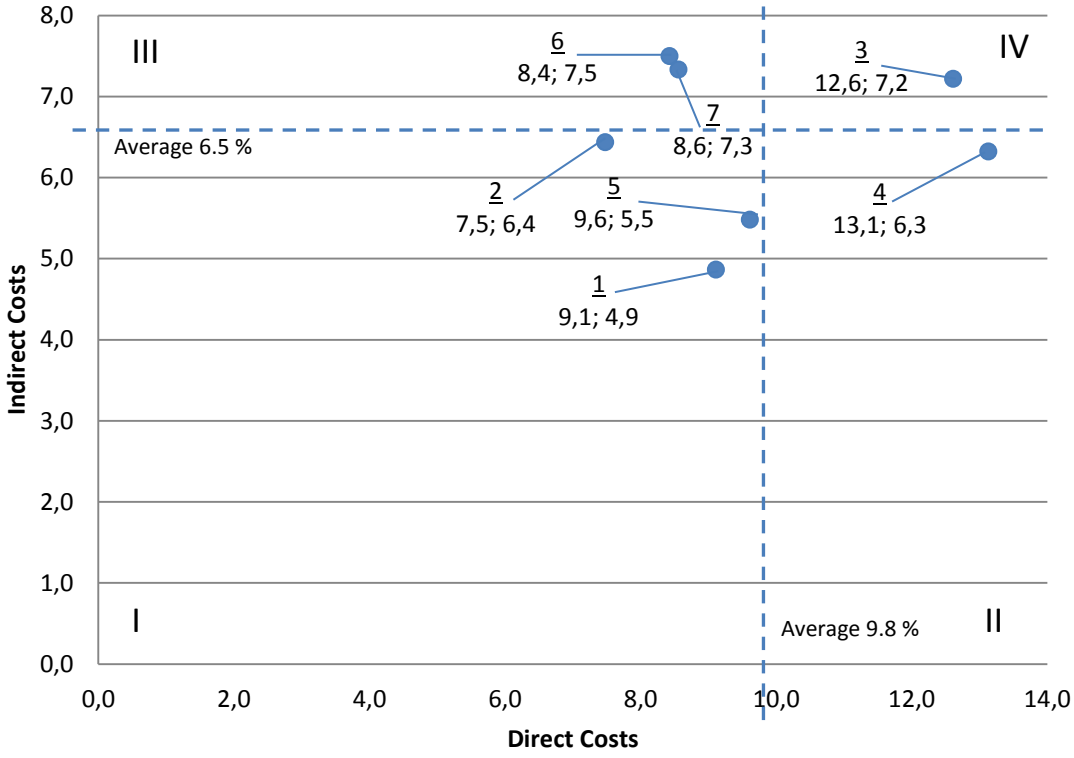


Figure 113 Positioning of Finnish trading industries in respect of the level of direct and indirect logistics costs as a % of turnover (data from 2008)

The three industries located in section I, 1) food retailing, 2) other retailing and 5) agency, had below-average costs in both cost dimensions. Other wholesaling (4), alone in section II, had above-average direct costs and below-average indirect costs. Trade of motor vehicles (6) and trade of solid, liquid and gaseous fuels and related products (7) had below-average direct costs and above-average indirect costs. This leaves only one trading industry in section IV with both direct and indirect logistics costs above average, i.e. wholesale of food and beverages (3). In Figure 114, the positioning is carried out in respect of operative and administrative costs.

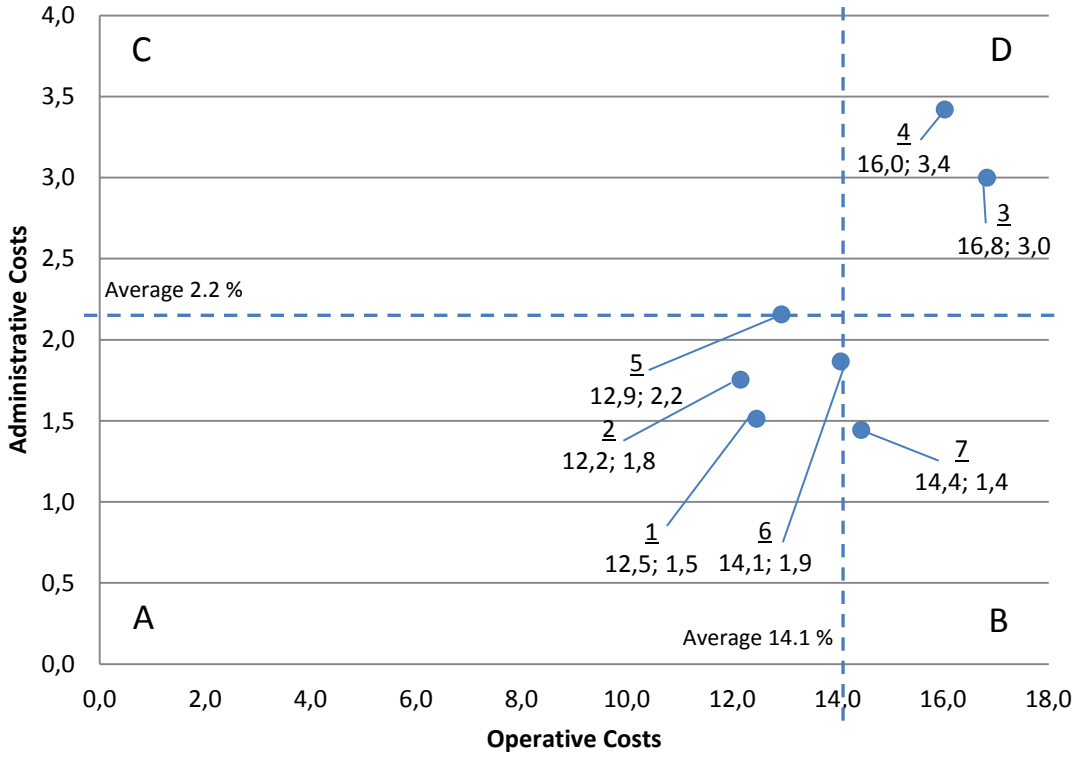


Figure 114 Positioning of Finnish trading industries in respect of the level of operative and administrative costs as a % of turnover (data from 2008)

The figure shows that average administrative costs were 2.16% of turnover and operative costs 14.14% of turnover. Four industries managed to reach below-average costs in both cost dimensions (A): 1) retail: food, beverages and tobacco, 2) retail: other, 5) agency, and 6) trade of motor vehicles. Only one industry, trade of fuel and related products (7), had operative costs above average and administrative costs below average (B). Two industries, wholesale of food and beverages (3) and wholesale: other (4), suffered above-average operative and administrative costs (D). The combined position of the trading industries is illustrated in Figure 115.

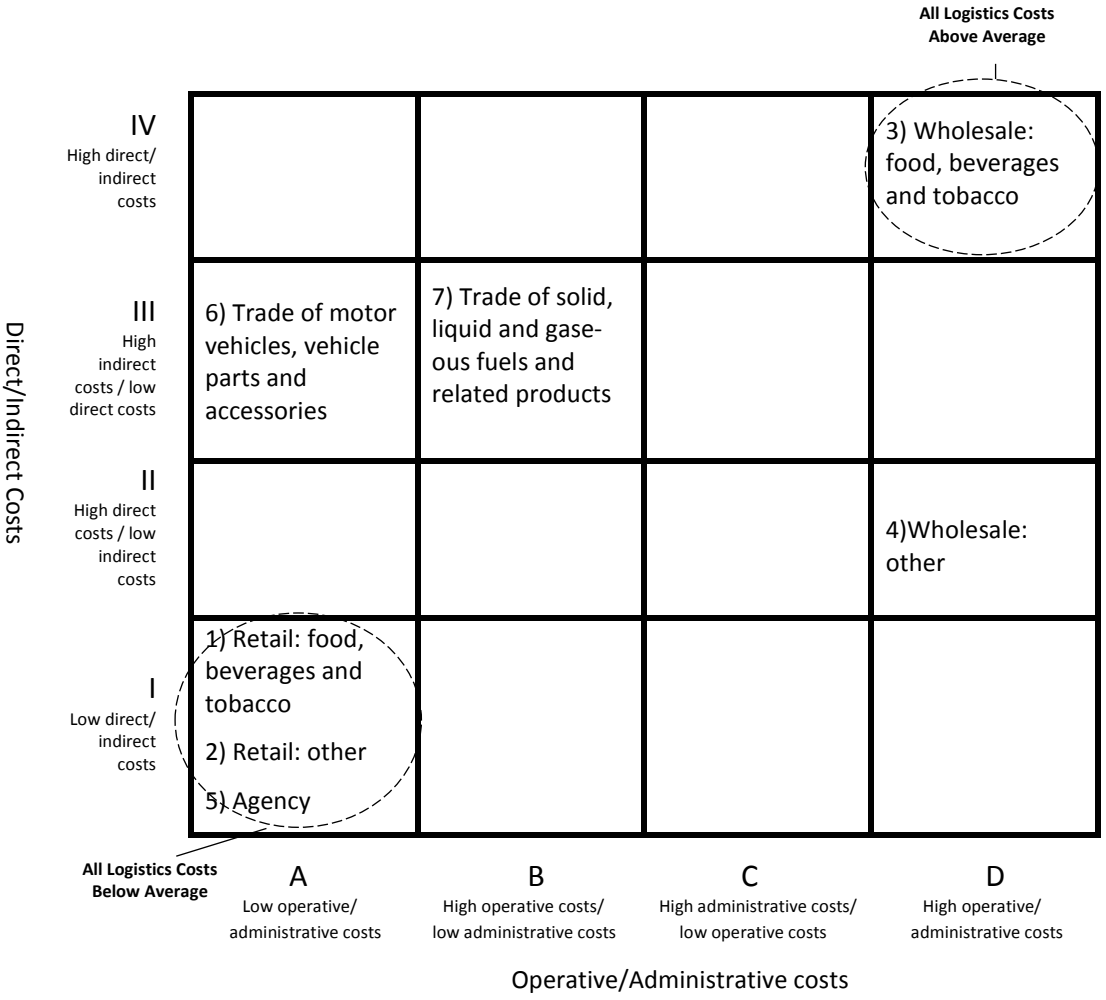


Figure 115 Combining the results of Finnish trading industries positioning (data from 2009)

According to the data, three trading industries, retail of food and beverages (1), other retail (2) and agencies (5), had low logistics costs in all dimensions. Other wholesaling (4) had high direct costs, as well as high costs in operative and administrative cost dimensions. Wholesalers of food and beverages had high costs in all cost dimensions, while traders of motor vehicles (6) had high indirect logistics costs but low operative/administrative costs. Finally, traders of fuel reported high operative and indirect costs. The same data are also presented in Table 41 with GLOCS typing.

Table 41 Level of logistics costs in Finnish trading industries (data from 2008)

No.	Industry	Direct	Indirect	Operative	Adminis-trative	GLOCS type
1	Retail: food, beverages and tobacco	●	●	●	●	A I
2	Retail: other	●	●	●	●	A I
3	Wholesale: food, beverages and tobacco	●	●	●	●	D IV
4	Wholesale: other	●	●	●	●	D II
5	Agency	●	●	●	●	A I
6	Trade of motor vehicles, vehicle parts and accessories	●	●	●	●	A III
7	Trade of solid, liquid and gaseous fuels and related products	●	●	●	●	B III

● Below average costs ● Above average costs

Table 41 gathers the information elaborated in the chapter. Following chapter presents data of 2010 survey.

7.3.2.3 Logistics families in the 2010 survey

This chapter follows the same pattern as the 2009 data. Trading industries are first positioned according the level of direct and indirect logistics costs (Figure 116).

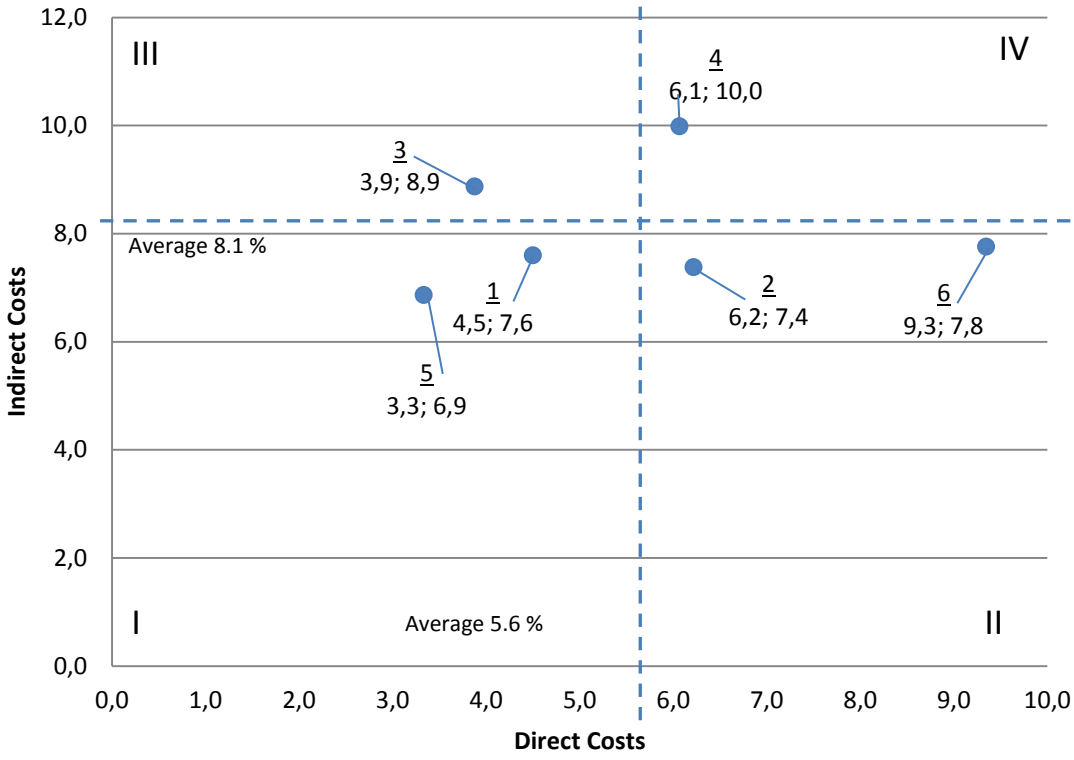


Figure 116 Positioning of Finnish trading industries in respect of the level of direct and indirect logistics costs as a % of turnover (year of the data 2008)

In section I, there are two industries located: 1) retail of food and 5) agencies. These have below average cost in both cost dimensions, direct and indirect logistics costs. Two industries, 2) retail: other and 6) trade of motor vehicles had below average indirect costs and above average direct costs. Wholesaler of food etc. had high indirect yet low direct costs. One industry, wholesale: other (4) was located in section III, direct and indirect logistics costs above average. No data was available from traders of solid, liquid and gaseous fuels and related products. In Figure 114, positioning is carried out in respect of operative and administrative costs.

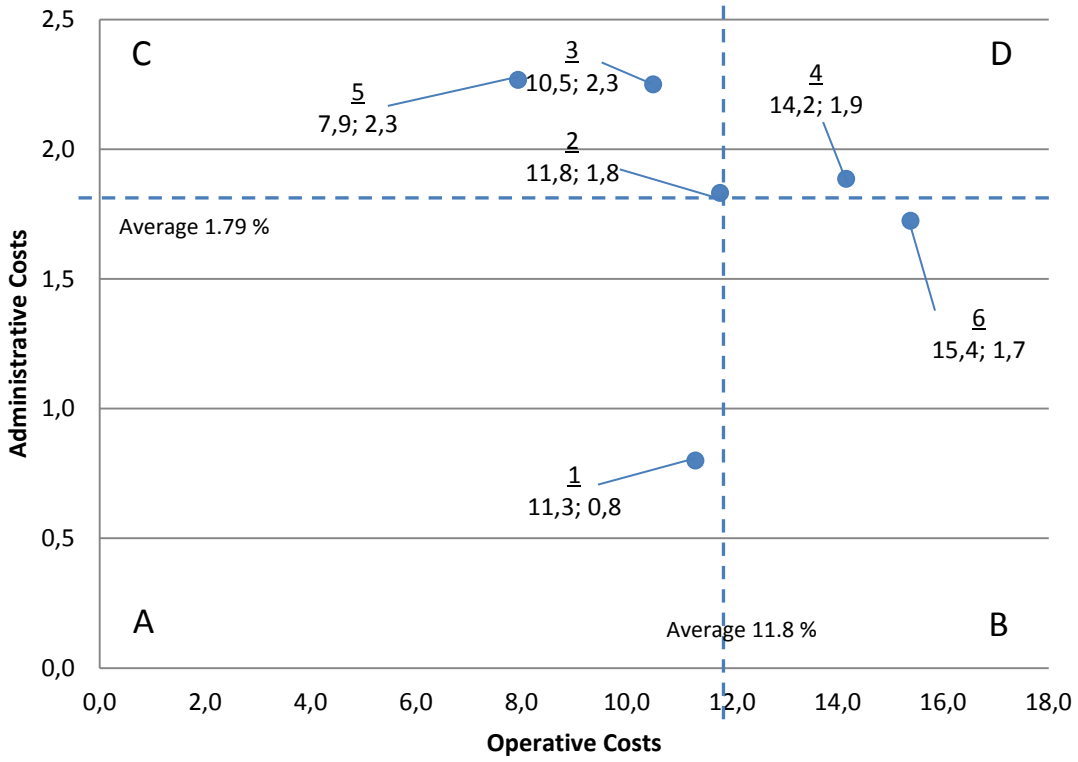


Figure 117 Positioning of Finnish trading industries in respect of the level of operative and administrative costs as a % of turnover (year of the data 2008)

Figure 114 illustrates the positioning of trading industries in respect of administrative and operative costs. Average administrative costs were 1.79 % of turnover and operative costs 11.8 % turnover. Retailing of food etc. managed to reach below average costs in both cost dimensions (section A). Other retail (2), wholesale of food, etc. (3), and 5) agencies had above average administrative costs and below average operative cost. Other wholesale hit above average in both dimensions, while 6) trade of motor vehicles had below average operative costs and above average administrative costs. The combined position of trading industries is illustrated in Figure 115.

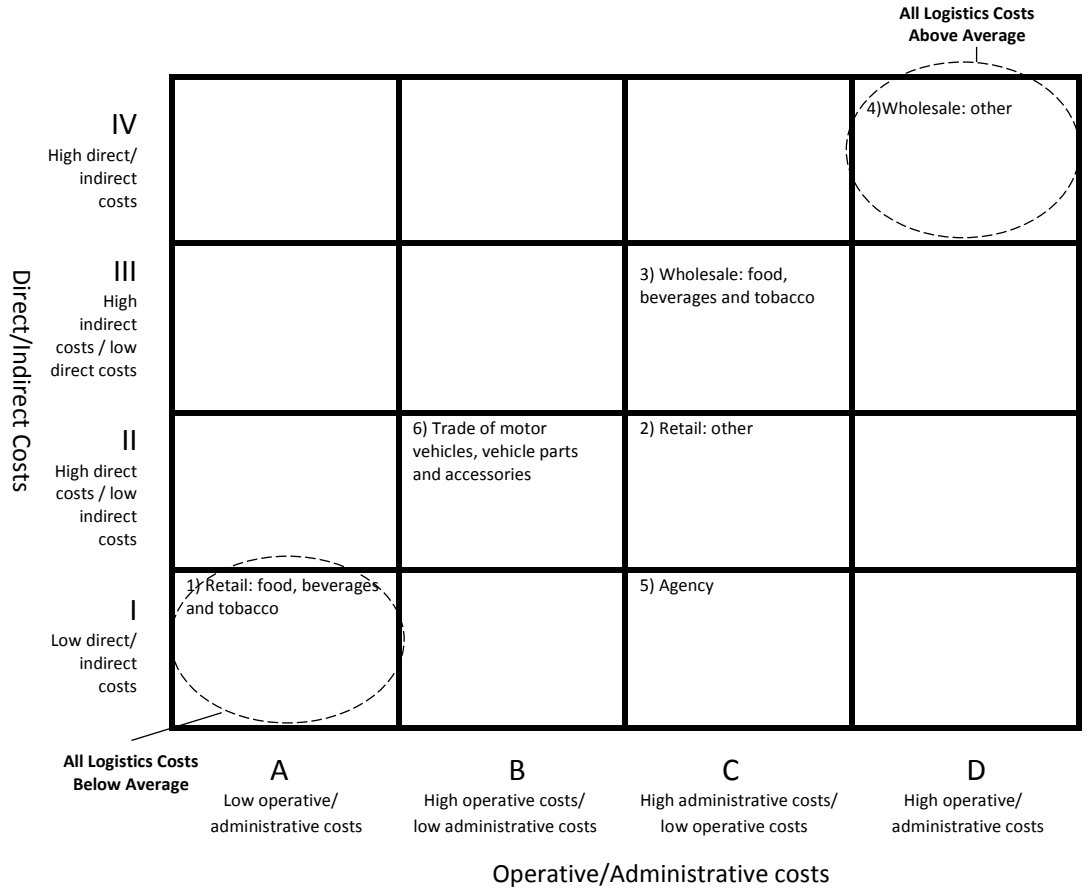


Figure 118 Combining the results of Finnish trading industries positioning (year of the data 2008)

According 2009 data, one trading industry, 1) retail of food etc. had low logistics costs in all dimensions. Trade of motor vehicles (6) had high logistics costs in two cost dimensions, operative and direct. Other retail (2) had high direct and administrative costs, while agencies (5) had only high administrative costs. Other wholesaling (4) had high indirect costs and administrative costs but wholesalers of food etc. reported high costs in all GLOCS dimensions. No data was available on traders of fuel. The same data is also presented in the table below with GLOCS typing.

Table 42 The level of logistics costs in Finnish trading industries (year of the data 2008)

No.	Industry	Direct	Indirect	Operative	Adminis-trative	GLOCS type
1	Retail: food, beverages and tobacco	●	●	●	●	A I
2	Retail: other	●	●	●	●	C II
3	Wholesale: food, beverages and tobacco	●	●	●	●	C III
4	Wholesale: other	●	●	●	●	D IV
5	Agency	●	●	●	●	C I
6	Trade of motor vehicles, vehicle parts and accessories	●	●	●	●	B II
7	Trade of solid, liquid and gaseous fuels and related products	NA	NA	NA	NA	

● Below average costs ● Above average costs

Table gathered the information elaborated in the chapter in the same table. Next chapter identifies logistics families in 2011 data.

7.3.2.4 Logistics families in 2012 survey

Here the logistics families are identified from the 2011 dataset and the data are presented similarly to the previous three subchapters. First, the trading industries are positioned according to their level of direct and indirect logistics costs.

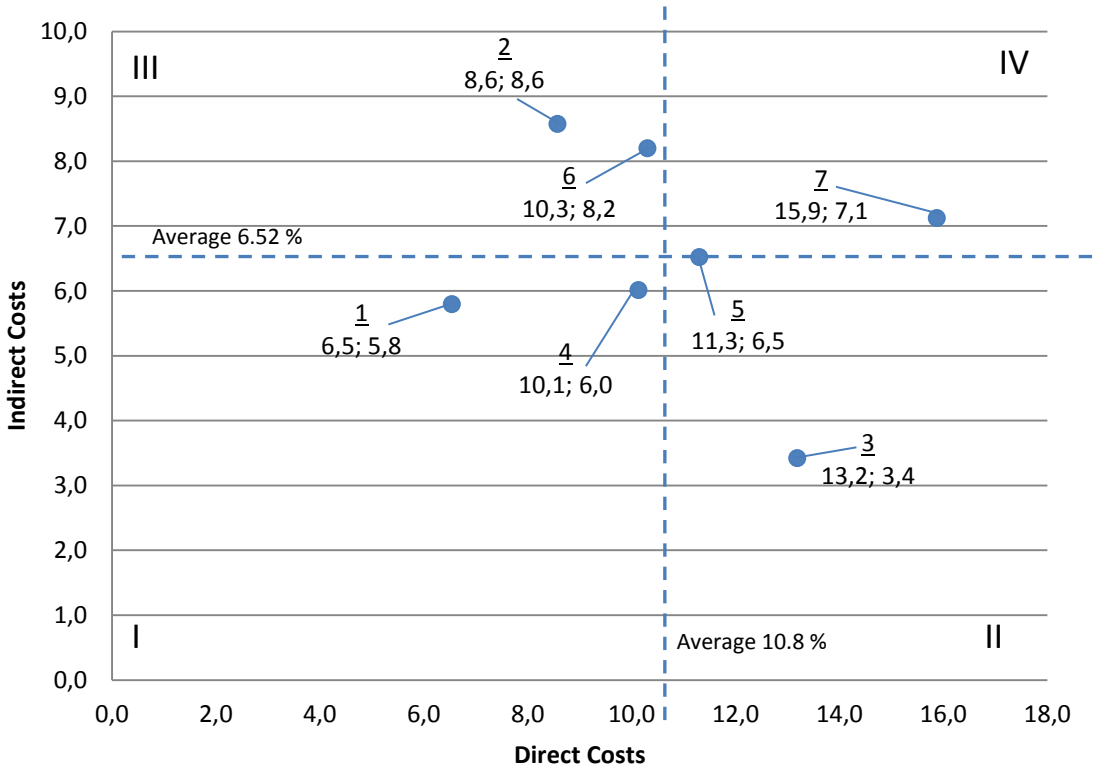


Figure 119 Positioning of Finnish trading industries in respect of the level of direct and indirect logistics costs as a % of turnover (data from 2011)

Section I houses two industries: 1) retail of food and 4) wholesale: other. Wholesale of food (3) and agencies (5) had below-average indirect costs but above-average direct costs (II). Two industries are located in section III: 2) retail: other and 6) trade of motor vehicles. This leaves only one trading industry in section IV: 7) trade of solid, liquid and gaseous fuels and related products, which had above-average direct and indirect logistics costs. The positioning of industries in respect of their operative and administrative costs is illustrated below.

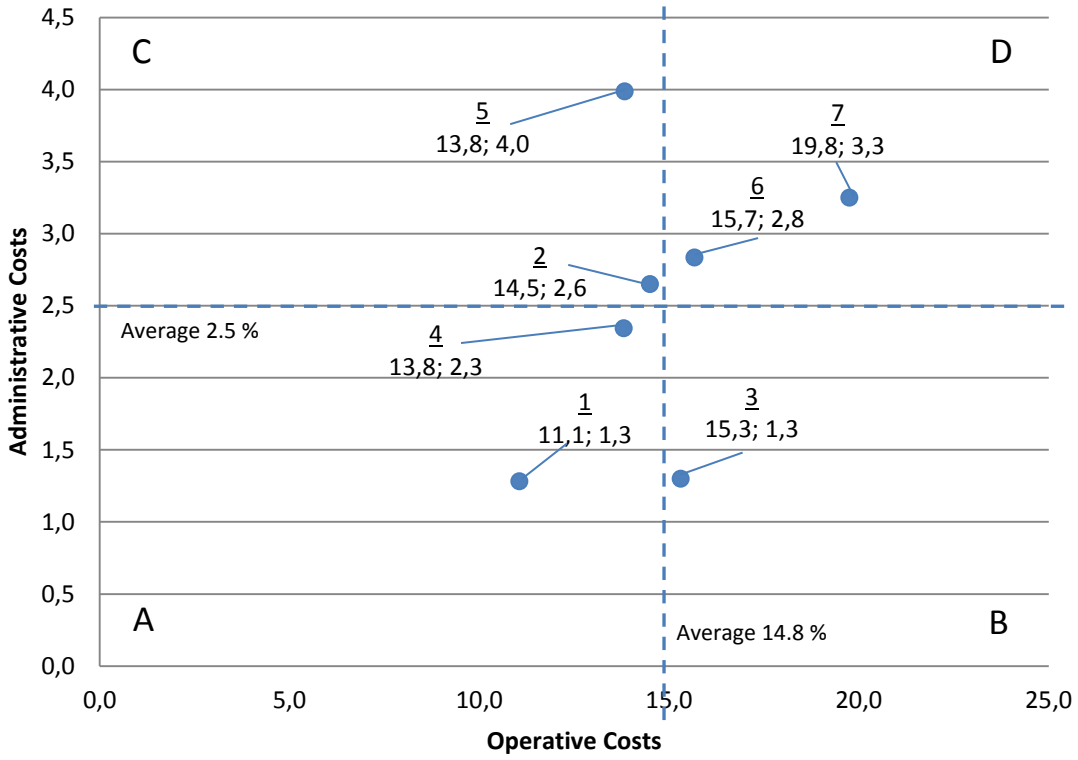


Figure 120 Positioning of Finnish trading industries in respect of the level of operative and administrative costs as a % of turnover (data from 2011)

Average administrative costs were 2.5% of turnover and operative costs 14.8% of turnover. Two industries managed to reach below-average costs in both cost dimensions (A): 1) retail: food, beverages and tobacco and 4) wholesale: other. Wholesale of food, beverages and tobacco (3) reported above-average operative costs and below-average administrative costs (B). While wholesalers of food, beverages and tobacco suffered above-average operative costs, agencies (5) and other retail had above-average administrative costs. Trade of motor vehicles (6) and of fuels and related products (7), on the other hand, had above-average costs in every respect (D). The combined position of trading industries is illustrated below.

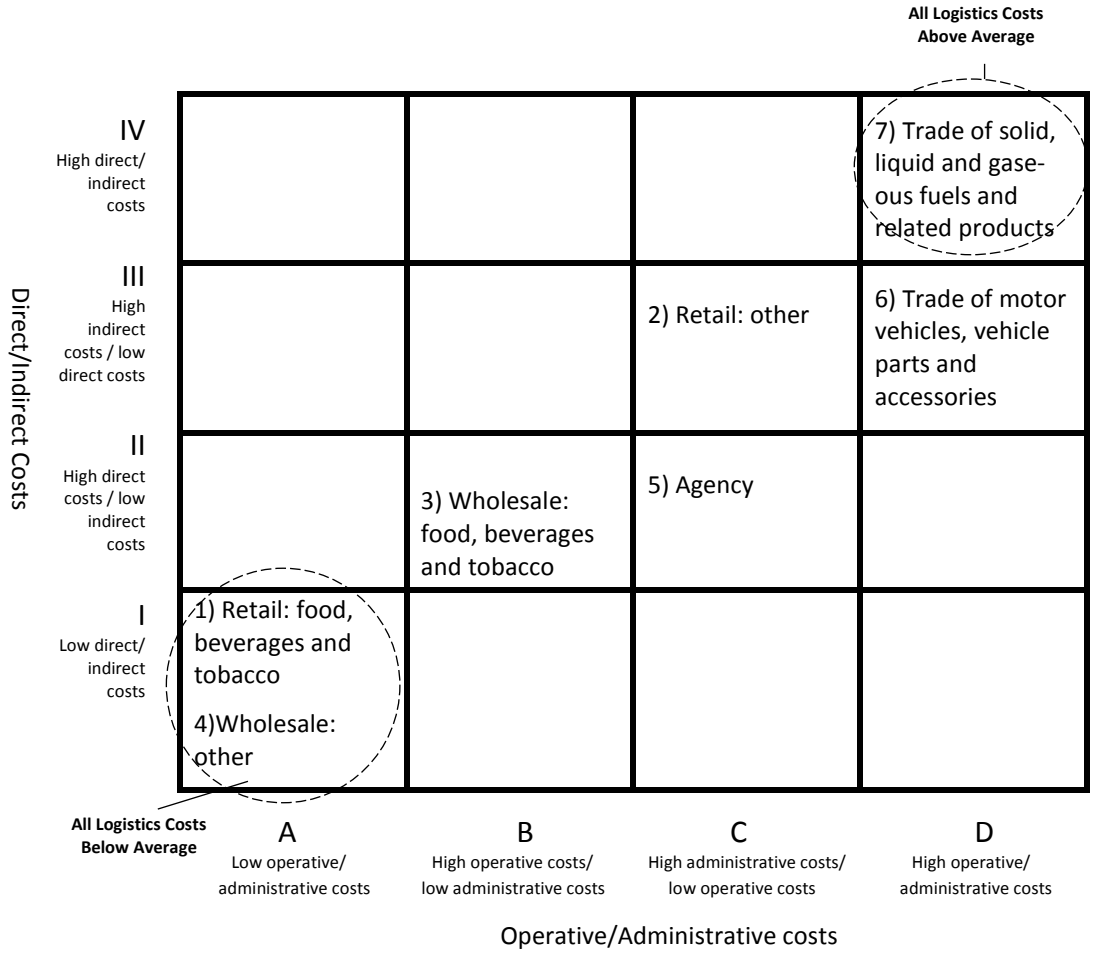


Figure 121 Combining the results of Finnish trading industries positioning (data from 2011)

According to the 2011 data, two trading industries, retail of food etc. (1) and other wholesaling (4) had low logistics costs in all GLOCS dimensions. Other wholesaling (3) had high direct costs and operative costs, but other GLOCS dimensions were at a low level at the time. Agencies (5) hit high administrative and direct costs, while traders of motor vehicles (6) had high logistics costs in three cost dimensions, operative, administrative, and indirect logistics costs. Other retailers suffered from high administrative, operative and indirect costs, but other costs were at a low level. As in previous years, all logistics costs remained at a high level for the fuel trade industry (7). The same data are presented with the GLOCS typing below.

Table 43 Level of logistics costs in Finnish trading industries (data from 2011)

No.	Industry	Direct	Indirect	Operative	Adminis-trative	GLOCS type
1	Retail: food, beverages and tobacco	●	●	●	●	A I
2	Retail: other	●	●	●	●	C III
3	Wholesale: food, beverages and tobacco	●	●	●	●	B II
4	Wholesale: other	●	●	●	●	A I
5	Agency	●	●	●	●	C II
6	Trade of motor vehicles, vehicle parts and accessories	●	●	●	●	D III
7	Trade of solid, liquid and gaseous fuels and related products	●	●	●	●	D IV

● Below-average costs ● Above-average costs

The next chapter examines the differences in GLOCS types of trading industries based on all of the above surveys.

7.3.2.5 Changes in GLOCS type for trading industries

Comparing the positions and GLOCS types of industries from empirical data reveals the changes in the structure and level of logistics costs. These are illustrated in Figure 122.

1. Retail of food etc.

	A	B	C	D
IV				
III				
II				
I	***2005 2008 2009 2011***			

2. Retail: other

	A	B	C	D
IV				
III			***2011***	
II			***2009***	
I	***2005 2008***			

3. Wholesale food etc.

	A	B	C	D
IV				***2008***
III			***2009***	
II		*2011*		***2005***
I				

4. Wholesale: other

	A	B	C	D
IV				***2005 2009***
III				
II				***2008***
I	***2011***			

5. Agencies

	A	B	C	D
IV				
III				
II			***2011***	***2005***
I	***2008***		***2009***	

6. Trade of motor vehicles etc.

	A	B	C	D
IV				
III	***2008***		***2005***	***2011***
II		***2009***		
I				

7. Trade of fuels etc.*

	A	B	C	D
IV				
III		***2008***		***2005 2011***
II				
I				

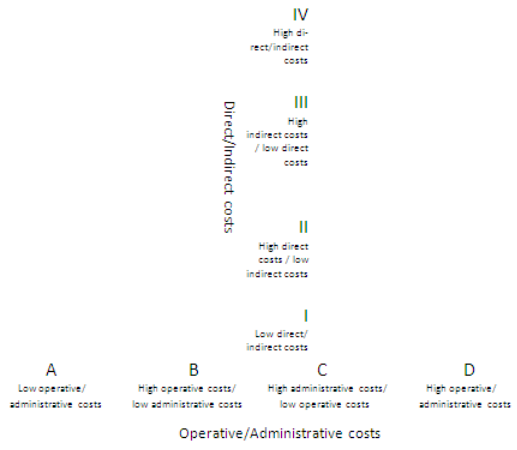


Figure 122 Changes in position of Finnish trading industries (year of data indicated)
*No data available for 2009

As presented in the figure above, the results for some industries are more scattered than others. As discussed in previous chapters, various reasons and factors can have an impact on logistics costs and these cannot be comprehensively covered in this study. However, some potential explanations regarding the development of the structure of logistics costs are discussed below. Chapter 8 concludes with some similarities between industries.

Logistics costs for the retail of food, beverages and tobacco have remained low compared to the average for all trading industries. This position has remained constant in all cost dimensions, the GLOCS type for this industry remaining at AI throughout the period of collecting empirical data. This indicates that logistics costs in this industry are primarily paid by wholesalers, confirmed by comparing the results with those for wholesalers of food, beverages and tobacco. This reveals a relative unusual situation in the Finnish retail industry, where two companies possess around 80% of all markets. This should give them some bargaining power over suppliers and logistics service providers, which together with economies of scale may result in decreased logistics costs.

Compared to the retail of food etc., other retail has experienced an increasing trend in logistics costs. The GLOCS type for the industry in 2005 and 2008 was AI, but in 2009 administrative costs rose above the average for all trading industries. Two years later also indirect costs rose to above average, but operative and direct logistics costs remained lower. This indicates that this particular industry was not able to adapt their overheads to declining demand after the recession. It is very common that with declining demand variable costs like operative costs can be cut, but fixed costs remain at a higher level.

As mentioned above, it seems, based on the data, that in Finland logistics costs are covered by the wholesale sector rather than by retail industries. In general, logistics costs for wholesale industries are above average in most dimensions. Interestingly, according to the latest data, it seems that these industries have succeeded in lowering their costs (wholesale of food etc. – BII / other wholesale - AI), which indicates that some major improvements have been carried out.

Concerning agencies, administrative logistics costs tend to be high due to the nature of the industry. Correspondingly, operative costs have been below average compared to all industries, except for 2005. The changes in GLOCS type for the trade of motor vehicles etc. indicate that indirect costs have been above the average of all trading industries. On the other hand, administrative/operational costs have alternated over the years. Companies operating in trading of fuel etc. had above average logistics costs in three dimensions in 2005 and 2011. The sample was relatively small most of the time, and no data was available for 2009. Finally, the changes in GLOCS types are presented in Table 44.

Table 44 Differences in GLOCS types of Finnish trading industries

No.	Industry	GLOCS type 2005	GLOCS type 2008	GLOCS type 2009	GLOCS type 2011
1	Retail: food, beverages and tobacco	A I	A II	A I	A I
2	Retail: other	D III	A III	C II	C III
3	Wholesale: food, beverages and tobacco	A II	D II	C III	B II
4	Wholesale: other	D IV	A II	D IV	A I
5	Agency	C II	A I	C I	C II
6	Trade of motor vehicles, vehicle parts and accessories	A I	B III	B II	D III
7	Trade of solid, liquid and gaseous fuels and related products	D III	D IV		D IV

GLOCS typing is a feasible tool for indicating the structure of logistics costs of certain industries in a generic way. The final chapter of this study puts together the current state of logistics costs research, and draws conclusions on the feasibility of the proposed generic logistics cost structure, namely GLOCS. Also the synthesis of the level of logistics costs in a global context is presented.

8 CONCLUSIONS

The final chapter draws the major conclusions on the review of identified extant logistics cost research, the GLOCS model, and empirical findings reflecting the three main purposes of this study:

1) To map the current state of national logistics costs research
2) To design a generic model for measuring macro logistics costs
3) To apply the model to empirical data.

Finally, the potential implementations and limitations of the research results are elaborated with some considerations for further research.

8.1 State of logistics costs research in the macro context

The foundation of this dissertation lies in identified extant macro logistics research, which was reviewed (research purpose one). The goal of this process was to build a comprehensive picture of the current state of logistics cost research in the macro context. As presented in the review in chapters 2 and 3, the research conducted in the field of macro logistic research is very fragmented. Altogether eight textbooks, nine scientific articles and 49 studies (including 20 case studies) were reviewed to create a picture of macro logistics cost research.

Separate national and some regional studies were carried out mainly in high-income countries. Some isolated attempts have been made in low-income countries, mainly commissioned by international organizations like the World Bank. No uniform definitions of cost components, databases, or methodologies currently exist, even though the level and structure of logistics costs are discussed in the field of logistics research. The main caveats in macro logistics cost research could be concluded as follows:

- Logistics costs are not an accounting or a statistical unit, meaning that the term is vague and often ill-defined or poorly understood.
- Questionnaire-based surveys are based on subjective self-reported data, which may lead to “double counting” or omissions across sectors.
- Data from questionnaire-based surveys typically reflect firms’ international supply chains beyond national borders; hence the results are not limited to just one country.
- Statistics-based studies rely on data that cover only national activities, and assessment methodologies often include heavy simplifications.

- Case studies usually rely on second-hand information, which has an impact on reliability of results, although this is the only applicable methodology in many parts of the world.

Three reporting metrics employed in identified extant macro logistics costs research were identified as a % of GDP, as a % sales or turnover, and as absolute costs. The GLOCS model designed in this study allows absolute costs to be converted into a % of GDP, which greatly increases the comparability of logistics costs in different areas. Macro logistics costs are usually studied in a single country context (92.5% of all studies) with multiple themes included (60% of all studies). Around 30% of identified extant macro logistics cost studies employed survey-based questionnaires, 23% a statistics-based method, and 47% a case study method or some undisclosed method. It can be concluded that surveys usually tend to include multiple themes, as it is relatively easy to cover these in the same survey with marginal additional work. The main differences related to methodological aspects concern the reliability of results and justification of the chosen method. The case study method is usually applied in countries where sufficient or reliable information is not available. In these cases, researchers combine several methods to draw up the results. The share of studies in relation to employed study methodology and thematic broadness is illustrated in Figure 123.

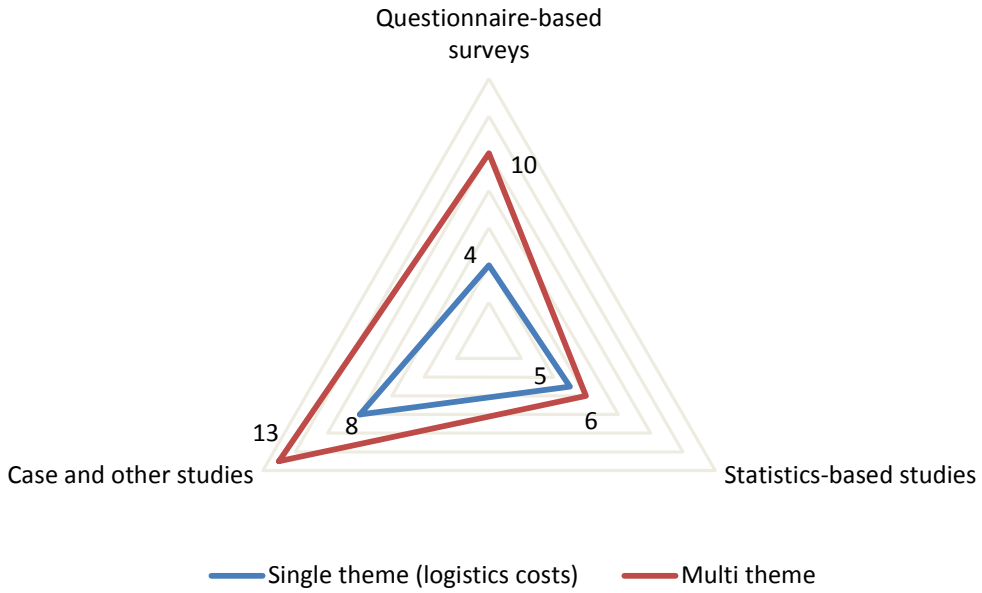


Figure 123 Distribution of logistics cost studies in previous research

As illustrated above, multi-theme studies are more popular than single-themed ones. The main reason lies in the multi-dimensional characteristic of logistics research and processes that encourage researchers to discuss several issues at the same time instead of just one. This is further backed up by the fact that 10 out of

14 questionnaire-based surveys discussed multiple themes, indicating that especially in surveys the effort of including multiple themes is marginal due to the easiness of adding questions to surveys. Conversely, case/other studies and statistics-based studies dominated the single theme aspect, given that these methods are lighter to put into the practice. It is not possible or even necessary to conclude which method generates more accurate or reliable results, since there are both pros and cons to both approaches. However, it can be said that case study methodology should not be applied if questionnaire-based surveys or statistics-based methods are possible.

The interest in measuring logistics costs is constantly on the rise. This trend can be identified from the increasing number of studies conducted yearly on several continents (see Figure 61). Based on the review of identified extant research, the line of 10 published studies per year was surpassed in 2005. Reflecting the different methodological approaches, the number of statistics-based studies has increased more rapidly compared to a less significant increase of case studies and survey-based questionnaires.

Despite the extensive review of identified extant research, no exhaustive and comprehensive definition of logistics cost components was found. There was also a significant variance between applied definitions and logistics cost components from one study to another. Totally 24 different components of logistics costs were identified in the review of identified extant literature, 23 cost components in scientific articles, 22 in statistics-based studies, and 21 in questionnaire-based surveys (see Appendix 5). Some of these were obviously parallel but many appeared only in one study, which further supports that a common terminology is missing.

The outcome of the review of identified extant macro logistics cost research confirmed the scattered nature of the research in this field, but also provided some estimation of logistics costs in different countries. These results are presented below.

8.2 Applicability of GLOCS to measuring macro logistics costs with comparative analysis in different areas

Since different studies measure logistics costs with very different methods, there is a growing need for a model that would allow the level of macro logistics costs to be compared between different areas (research purpose two). GLOCS was designed to harmonize the taxonomy of different cost classifications by categorizing individual components under four generic cost components. Aggregating individual cost components into four GLOCS components provides comparable results. The operational principle of the model is grounded on three linchpins:

- Meta-analysis of previous logistics cost research
- Transaction Cost Approach (TCA) theory
- Fourfold table of logistics costs systemization

Based on these, four GLOCS cost components were identified:

- Operating costs (direct costs, related to logistics operations)
- Market costs (indirect costs, related to certain logistics operations)
- Administration costs (direct costs, related to administrative operations)
- Other costs (indirect costs, not directly related to certain logistic operations)

Applying the GLOCS model provides some benefits and added value to macro logistics costs research. Given that the model is designed partly according to a review of identified extant research, it can also be applied to almost every piece of research already published.

In order to make different industry classifications commensurable, the original purpose of GLOCS was also to include them in the model. In Chapter 5.2, the technique for meeting this objective was developed, explained and illustrated comprehensively. Due to the large number of studies with insufficient background information (e.g. logistics costs per industry) provided in identified extant studies, this technique was only applicable to very few studies. On a general level, it can be concluded that the applicability of industry classification is low due to significant variances in reporting of applied methods and industry classification in identified extant research. However, as there are some global industry classifications (like ISIC) available, and many countries are adapting these to their national statistics, the technique proposed in this study can be applicable in the future.

To increase the usability of GLOCS, an Excel-based tool was also introduced. This tool provides an effective and user-friendly instrument for solving the problems addressed above. First of all, the tool re-classifies different cost components identified in identified extant research under four generic GLOCS components. In addition to this, the tool also possesses an in-built currency converter that automatically converts absolute costs into a common currency (euro) and also presents the costs as a % of GDP. This facilitates the relative comparison of logistics costs between different countries. A small difference was observed between the results processed with the GLOCS tool and the original data. There are two reasons for this. First the GLOCS tool uses the very latest GDP data, published by the IMF, which may include revised figures compared to those used in the original sources. Also the currency conversion, which is based on the exchange rates of the ECB, may cause a slight difference. Again, this is considered an inevitable trade-off of providing comparable results of logistics costs. Since the cost component-specific results from recent years are discussed in chapter 7, the development of total logistics costs as a % of GDP in those

countries that provided data for more than 2 consecutive years is presented in Figure 124.

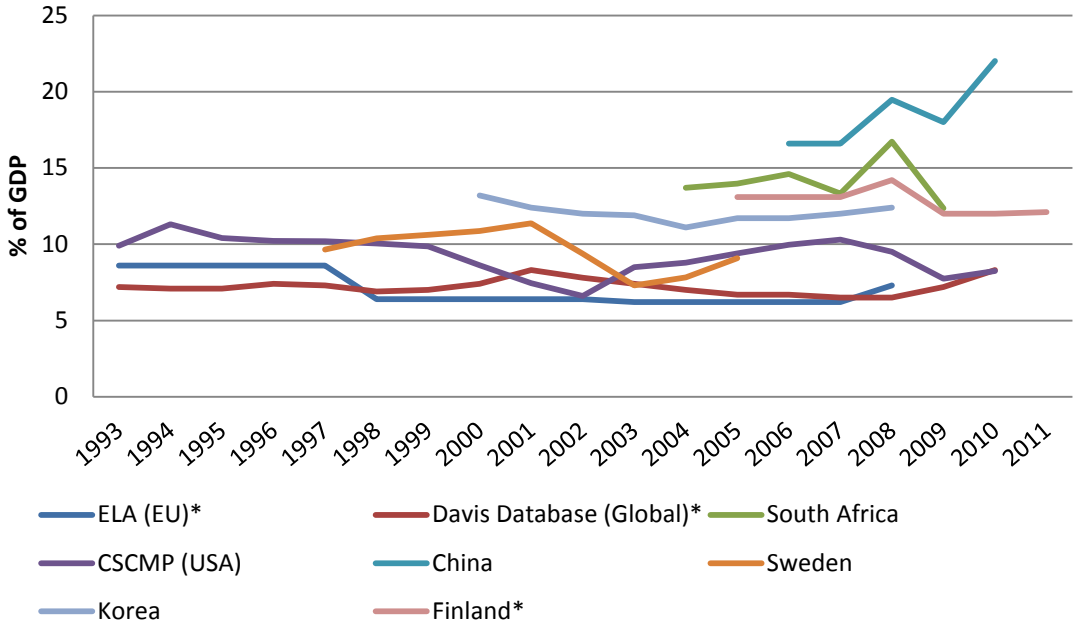


Figure 124 Logistics costs as a % of GDP in selected Studies (*as a % of sales or turnover)

The figure compiles the cost information from studies that provided sufficient datasets over a longer time perspective. The Finnish figures were only available for 2005, 2008, 2010, and 2011. The variation between studies is relatively broad, from around 6% to over 20% of GDP. The figure presents a clear difference between the total logistics costs in developed and developing countries in favor of developed countries. In developed countries, the level of logistics costs is around 10% of GDP. Excluding the few sharp changes in total logistics costs, the level seems to be at a more or less stable level in the long run. Figure 125 illustrates the most recent results of logistics costs studies.

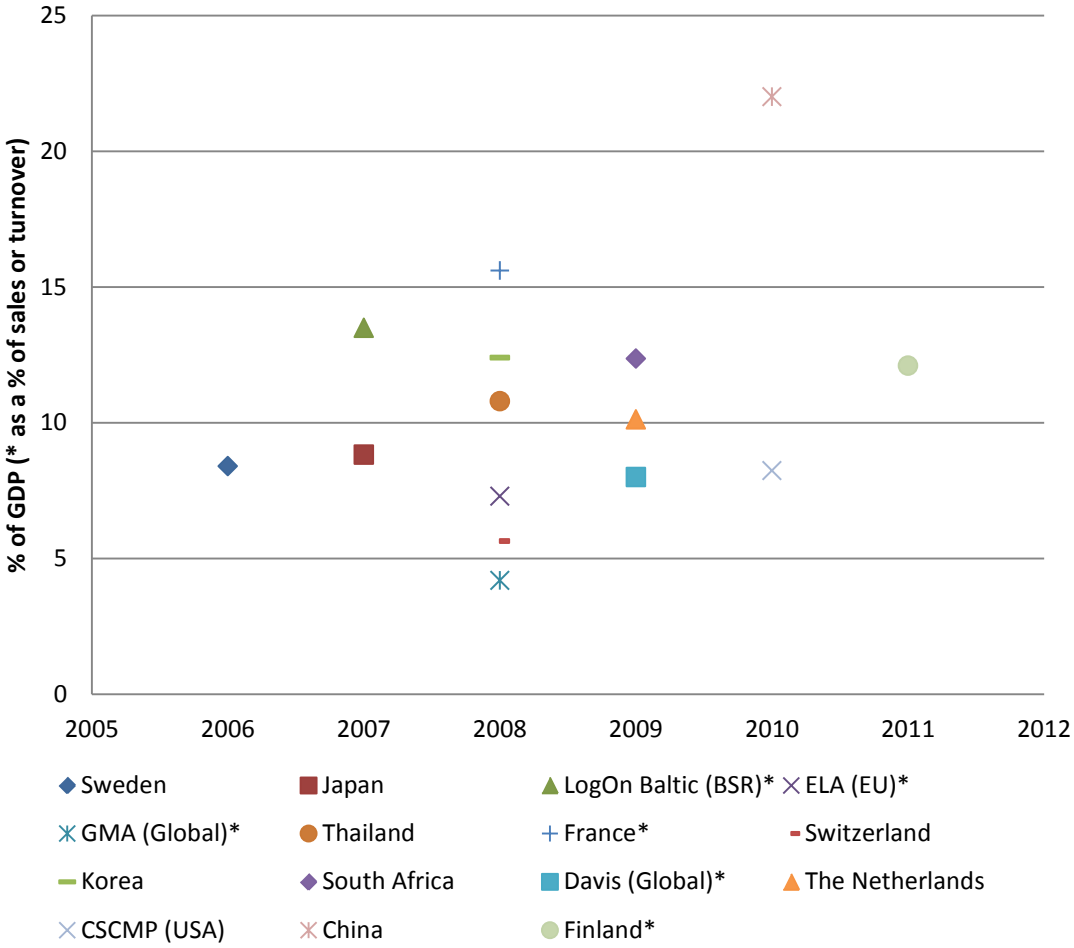


Figure 125 Level of logistics costs in the 21st century as a % of GDP in selected studies (*as a % of sales or turnover)

Figure 125 illustrates the level of total logistics as a percentage of GDP (* as a % of sales or turnover) in 15 selected studies. The broad variance of cost levels is visible in this figure as well.

8.3 Development of logistics costs in Finnish manufacturing and trading industries

In chapter 7, GLOCS was applied to the logistics cost data of Finnish manufacturing and trading industries (research purpose three). As illustrated in chapter 6, applying GLOCS did not significantly change the results of Finland State of Logistics surveys compared to the original ones. According to the cost data of Finnish manufacturing and trading companies, the level of logistics costs is higher compared to other developed countries. Operating costs account for almost two thirds of total logistics costs for Finnish companies. These are strongly due to the geographical aspects of Finland, causing long transport

distances and inventory levels. As the average (unweighted) of logistics costs for manufacturing companies in Finland was 16.3% of turnover (17.4% for retail companies), it is vital to understand the logistics performance and costs.

Positioning of the industries in accordance with the level of administrative, operative, direct and indirect costs, each industry was assigned a corresponding GLOCS type. This typing is an efficient way to give a quick recap of the typical logistics cost level and structure in a given industry. This also allows industries or companies to compare their performance against the average cost level in the respective area. As illustrated (see Figure 109 and Figure 122), the logistics costs of different industries have followed different development patterns. Figure 126 illustrates the six main patterns identified from the changes in GLOCS types of four consecutive surveys.

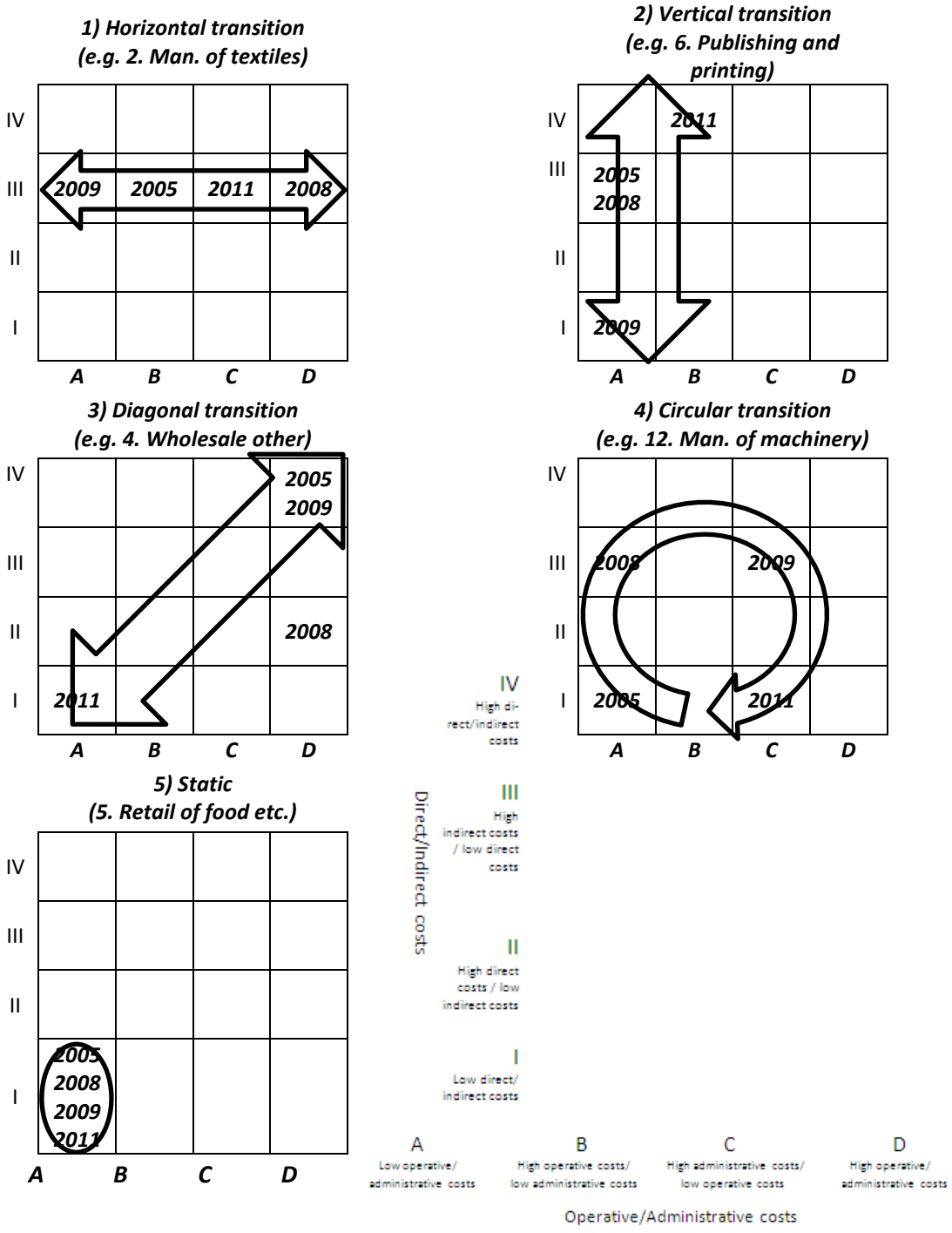


Figure 126 Five patterns of development of logistics costs in Finland

Figure 126 illustrates the five patterns with example industries. Pattern 1: horizontal transition includes companies that have experienced changes in operative/administrative costs in consecutive surveys. Industries with this pattern are manufacturing of textiles, manufacturing of transport equipment, construction, agencies, trade of motor vehicles, and trade of fuels. These industries have stable logistics costs in terms of direct and indirect costs, but administrative and opera-

tive logistics costs vary compared to the average of all industries. This may indicate that industries in this pattern have close to average costs in this context. Interestingly, manufacturers of vehicles etc. and traders of motor vehicles have similar cost patterns, indicating that indirect costs are high for companies operating in this field. Companies with pattern 2 profile changes in respect of direct/indirect cost aspects. Two industries had this pattern: publishing and printing, and manufacturing of coke etc. At a glance they have little in common, but both industries have a somewhat predictable demand for products. This is why industries with pattern 2 have relatively stable operating and administrative costs compared to the average of all industries, but indirect and direct costs are more volatile to external changes in the business environment. The diagonal transition pattern (pattern 3) represents those companies that have experienced changes from one end of the GLOCS scale to other. Many industries fall under this pattern, but no single factor can explain this. Where the direction of transition is from low to high costs, these industries should scrutinize their processes critically in order to improve their cost structure. Conversely, those companies that have experienced a transition from high to low costs should identify what has been done particularly well and continue this development. Finally, the circular transition pattern (pattern 4) indicates that the respective industry has experienced some changes in all GLOCS dimensions. This indicates a turbulent business environment, addressing the need for a proactive mindset in order to cope with future changes. Only one industry, retail of food etc., had a constant cost pattern (pattern 5), which is typical of the food retail market structure in Finland. This was discussed in chapter 7. A strength of pattern is also recognizable, and is indicated here from 1 to 3 from the weakest up. The reasons behind the patterns themselves as well as their strengths are outside the scope of this study and should be subjected to further research. The development of GLOCS types for all industries (manufacturing and retail), along with the strength of the pattern, is indicated in Table 45.

Table 45 GLOCS types of Finnish manufacturing and trading industries with transition patterns

No	MANUFACTURING INDUSTRIES	GLOCS type 2005	GLOCS type 2008	GLOCS type 2009	GLOCS type 2011	Pattern	Strength
1	Manufacturing of food products, beverages and tobacco	A I	B II	D IV	C II	3	1
2	Manufacturing of textiles and textile products	B III	A III	D III	C III	1	2
3	Manufacturing of leather and leather products	D II	C II	A I	B III	3	3
4	Manufacturing of wood and wood products	D IV	B II	B II	C III	3	1
5	Manufacturing of pulp, paper and paper products	D IV	A I	B II	A I	3	1
6	Publishing and printing	A III	A III	A I	B IV	2	1
7	Manufacturing of coke, refined petroleum products, and nuclear fuel	A I	B III	B III	*	2	2
8	Manufacturing of chemicals, chemical products, and man-made fibers	A II	D IV	B IV	C I	4	2
9	Manufacturing of rubber and plastic products	A II	A I	B II	D IV	3	2
10	Manufacturing of other non-metallic mineral products	D II	B II	D IV	B II	4	2
11	Manufacturing of basic metals and fabricated metal products	A III	A III	C III	C I	4	3
12	Manufacturing of machinery and equipment	A I	A III	C III	C I	4	1
13	Manufacturing of electrical and optical equipment	D III	C I	A III	C III	4	1
14	Manufacturing of transport equipment	C III	D III	A III	D IV	1	1
15	Other manufacturing	B IV	C I	C I	A I	4	2
16	Construction	C I	C I	A I	C I	1	1
No	**TRADING INDUSTRIES**	**GLOCS type 2005**	**GLOCS type 2008**	**GLOCS type 2009**	**GLOCS type 2011**	**Pattern**	**Strength**
1	Retail: food, beverages and tobacco	A I	A I	A I	A I	5	1
2	Retail: other	D III	A III	C II	C III	3	2
3	Wholesale: food, beverages and tobacco	A II	D II	C III	B II	3	3
4	Wholesale: other	D IV	A II	D IV	A I	3	2
5	Agency	C II	A I	C I	C II	1	2
6	Trade of motor vehicles, vehicle parts and accessories	A I	B III	B II	D III	1	1
7	Trade of solid, liquid and gaseous fuels and related products	D III	D IV	*	D IV	1	1

***No data available**

As shown in the table, GLOCS typing with the transition pattern number gives a quick overview of the typical characteristics and development of logistics cost

structure in different industries. The transition pattern and strength are provided in the right hand columns.

8.4 Research implications and suggestions for further research

At country level, an improved understanding of logistics costs is important not only to better evaluate and target policy efforts in the freight transport and logistics sector, but also to facilitate competitiveness across industries. Lower logistics costs reduce the cost of delivering products nationally and internationally, thereby encouraging business activity, increasing trade, opening new markets and increasing sales. Furthermore, assessment of logistics costs and performance also facilitates the efficiency of supply chains, infrastructure developments, services, procedures and regulative initiatives. In the global context, a comprehensive understanding of the level and structure of macro logistics costs is critical for high-level policy dialogue, as well for preparation and implementation of regulative actions.

Irrespective of the research method, the increased complexity of global supply chains of companies and related services are becoming increasingly difficult to study. Despite these obstacles, described in this dissertation, work continues on better understanding these issues. A serious global effort, to which this study also contributes, is already underway to bring dedicated stakeholders together. As state-of-the-art information on national-level logistics performance and costs gains in importance, not only in national and regional policy-making but also in the business context, this effort needs to be continued in future, especially on the scientific front.

Concerning future research, GLOCS could be employed as a “standard taxonomy” ensuring the comparability of results in the macro context. In addition to scientific contributions, several managerial and industry implications of GLOCS may be identified (e.g. comparing a company’s logistics costs to the industry average). As mentioned above, the main contribution of this dissertation is to provide an optional model/method for macro level logistics cost research and thus facilitate the research of logistics costs in different industries and on the macro scale. The logical next step would be deepening the research into different factors behind the developments in cost patterns. At the same time it should be considered how the reliability of GLOCS input data could be improved, especially from the aspect of weighting industries related to GDP.

REFERENCES

Abdallah, H. (2004) *Guidelines for Assessing Costs in a Logistics System*. Arlington, USA.

Arbnor, I. – Bjerke, B. (1997) *Methodology for Creating Business Knowledge*. 2nd edition. Thousand Oaks, California, USA.

Arbnor, I. – Bjerke, B. (2009) *Creating Business Knowledge*, 3rd edition. Thousand Oaks, CA, US.

Arvis, J.-F. (2010) *Logistics performance and competitiveness: What is available*, presentation at International Trade Department, The World Bank, May 6th 2011, Washington, US.

Arvis, J.-F. – Mustra, A. – Ojala, L. – Shepherd, B. – Saslavsky, D. (2010) *Connecting to Compete: Trade Logistics in the Global Economy report 2010*. <http://siteresources.worldbank.org/INTTLF/Resources/LPI2010_for_web.pdf>, accessed Oct 16th 2009.

Arvis, J.-F. – Raballand, G. – Marteau, J.-F. (2007) The Cost of Being Landlocked: Logistics Costs and Supply Chain Reliability (World Bank Policy Research Working Paper 4258). <http://www-wds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187283&theSitePK=523679&entityID=000016406_20070615150019&searchMenuPK=64187283&theSitePK=523679>, accessed Jan 19th 2010.

ASLOG L'état de l'art de la logistique française. <http://www.aslog.org/fr/ACTU_historique.php?niv2=31&id_actu=315>, accessed Jan 20th 2010.

Ayers, J. (2006) *Handbook of Supply Chain Management.* 2nd Edition. Boca Raton, FL, USA.

Banomyong, R. – Cook, P. – Kent, P. (2008) Formulating Regional Logistics Development Policy: The Case of ASEAN. *International Journal of Logistics: Research and Applications.* Vol. 11 (5), 359–379.

Banomyong, R. – Supatn, N. (2011) Developing a supply chain performance tool for SMEs in Thailand, *Supply Chain Management: An International Journal*, Vol. 16 (1), 20–31.

Bar-Ilan, J. (2007) Manipulating search engine algorithms: the case of Google, *Journal of Information, Communication and Ethics in Society*, Vol. 5, (2), 155–166

Ballou, R. H. (2004) *Business Logistics/Supply Chain Management: Planning, Organizing, and Controlling the Supply Chain*. 5th Edition. New Jersey, USA.

Battacharya, A. K. (2005) *Principles and Practice of Cost Accounting*, 3rd edition. New Delhi, India.

Behar, A. – Manners, P. – Nelson, B. (2011) *Exports and International Logistics*. The World Bank Policy Research Working Paper 5691.

Bidgoli, H. (2010) *The Handbook of Technology Management: Supply Chain Management, Marketing and Advertising, and Global Management*. 2nd edition. Hoboken, New Jersey, US.

Blanchard, B. S. (1992) *Logistics Engineering and Management*. 4th edition. New Jersey, USA.

Boudon, R. (1998) Limitations of Rational Choice Theory. *American Journal of Sociology*, Vol. 104 (3), 817–828.

Bourke, J. (2010) Carlsberg slashes £3.5m in logistics costs. *Motor Transport*, September 20th, 2010, p. 6.

Boykin, A. W. – Cunningham, K. – Danowitz, E. – Lee, M. – Lehmann, S. – Nail, C. – Scanlon, D. – Seale, C. – Shuyler, K. – Sonsteby, A. (2011) Best Free Reference Websites: Thirteenth Annual List. *Reference & User Services Quarterly*, Vol. 51 (1), 19–24.

Bowersox, D. – Calantone, R. – Rodrigues, A. (2003) Estimation of Global Logistics Expenditure Using Neural Networks. *Journal of Business Logistics*, Vol. 24 (2), 21–36.

Bowersox, D. – Rodrigues, A. – Calantone, R. (2005) Estimation of Global and National Logistics Expenditures: 2002 Data Update. *Journal of Business Logistics*, Vol. 26 (2), 1–16.

Brewer, A. M. – Button, K. J. – Hensher, D. A. (2001) *Handbook of logistics and supply-chain management*. Oxford, UK.

Brophy, J. – Bawden, D. (2005) Is Google enough? Comparison of an internet search engine with academic library resources. *Aslib Proceedings*, Vol. 57 (6), 498–512.

Campos-Garcia, R. M. – Garcia-Vidales, M. A. – Gonzalez-Gomez, O. (2010) Relationship between cost and logistics practices in small and medium enterprises: A case study of Queretaro, Mexico. *African Journal of Business Management*, Vol. 5 (4), 1245–1252.

Catalonia Logistics Barometer methodology, available at <http://www.bcncl.es/barometro/Metodologia%20Barometre%20costos.pdf>, accessed 28.7.2011.

Catalonia Logistics Barometer Q2/2009 Final, available at: <http://www.bcncl.es/barometro/Nota%20Barometre%20-%202T%202009%20definitiu.pdf>, accessed Jul 27th 2011.

CFLP (2007) China Federation of Logistics and Purchasing 2007, <http://www.sdpc.gov.cn/zjgx/t20070315_121530.htm>, accessed Jul 27th 2011.

CFLP (2008) China Federation of Logistics and Purchasing 2008, <http://yxj.ndrc.gov.cn/xdwl/t20080327_200477.htm>, accessed Jul 27th 2011.

CFLP (2009) China Federation of Logistics and Purchasing 2009, <http://www.ndrc.gov.cn/jjyx/xdwl/t20090306_264999.htm>, accessed Jul 27th 2011.

CFLP (2010) China Federation of Logistics and Purchasing 2010, <http://yxj.ndrc.gov.cn/xdwl/t20100310_334070.htm>, accessed Jul 27th 2011.

CFLP (2011) China Federation of Logistics and Purchasing 2011, <http://www.ndrc.gov.cn/zjgx/t20110301_397842.htm>, accessed Jul 27th 2011.

Chen, X. (2006) MetaLib, WebFeat, and Google: The strengths and weaknesses of federated search engines compared with Google. *Online Information Review,* Vol. 30 (4), 413–427.

Choi, C.-Y. – Lee, J.-Y. (2009) Strategic Issues for Korean distribution companies' penetration of the Chinese market. *Journal of International Logistics and Trade*, Vol. 7 (2), 83–98.

Christopher, M. (2005) *Logistics and supply chain management: creating value-adding networks*. Dorchester, UK.

Cooper, M. C. – Lambert, D. M. – Pagh, J. D. (1997) Supply Chain Management: More Than a New Name for Logistics. *International Journal of Logistics Management*, Vol. 8 (1), 1–14.

Coyle, J. – Bardi, C. – Langley, J. (1988) *The Management of Business Logistics*. 4th edition. St. Paul, MN, USA.

Coyle, J. – Langley, J. – Bardi, E. – Gibson, B. – Novack, R. (2009) *Supply chain management: a logistics perspective*. 8th edition, Mason, OH, U.S.

Gonzalez – Guasch – Serebrisky (2008) Improving Logistics Costs for Transportation and Trade Facilitation (Policy Research Working Paper 4558). <http://www-wds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187283&theSitePK=523679&entityID=000158349_20080313132618&searchMenuPK=64187283&theSitePK=523679>, accessed 19.1.2010.

Creazza, A. – Dallari, F. – Melacini, M. (2010) Evaluating logistics network configurations for a global supply chain. *Supply Chain Management: An International Journal*, Vol. 15 (2), 154–164.

CSCMP definitions. <http://cscmp.org/aboutcscmp/definitions.asp>, accessed 17.11.2009.

CSCMP 19th Annual State of Logistics Report 2008. <http://cscmp.org/memberonly/state.asp>, accessed 20.1.2010.

CSCMP's 20th Annual State of Logistics Report 2009. <http://cscmp.org/memberonly/state.asp>, accessed 20.1.2010.

Datta, D. K. – Narayanan, V. K. (1989) A Meta-Analytic Review of the Concentration-Performance Relationship: Aggregating Findings Strategic Management, *Journal of Management*, Vol. 15 (3), 469–483.

Davis Database Instructions. <http://www.establishinc.com/pdfs/Form_and_Instructions.pdf>, accessed Jan 20th 2010.

Davis Database Presentation 2008. <http://www.establishinc.com/sendmail.asp?d=CSCMP_2008&l=../pdfs/2008_CSCMP_Presentation.pdf>, accessed Jan 20th 2010.

Davis Database Presentation 2009. <http://www.establishinc.com/sendmail.asp?d=CSCMP_2009&l=../pdfs/2009_Logistics_Cost_and_Service_Presentation.pdf>, accessed Jan 20th 2010.

Davis Database Presentation 2010 (2010), available at <http://www.establishinc.com/pdfs/2010_Logistics_Cost_and_Service_ Presentation.pdf>, accessed Jul 11th 2011.

Davis Logistics Cost and Service Database. <http://www.establishinc.com/davisdatabase_info.asp>, accessed Jan 20th 2010.

De Logistieke Kracht van Nederland 2009. <http://www.ndl.nl/files_content/publicaties/Log_kracht_NL-aug2009.pdf>, accessed 21.1.2010.

De Vaus, D. A. (2002) *Surveys in social research*, 5th edition. Oxon, England.

Dianwei, Q. (2006), The Research on Logistics Cost Accounting and Management in China. *Proceedings of 2006 International Conference on Management of Logistics and Supply Chain*: September 20–22, 2006, Sydney, Australia.

Dimitrov, P. (1991) *National Logistics Systems*. Publications of Institute for Applied Systems Analysis, CP-91-06, Laxemburg, Austria.

European Central Bank, currency data, available at: <http://www.ecb.europa.eu/stats/eurofxref/eurofxref-hist.xml>, accessed Jan 30th 2012.

ELA homepage, About us. <http://www.elalog.org/>, accessed Nov 13th 2009.

ELA – Differentiation for Performance Excellence in Logistics (2004), Hamburg, Germany.

Eurostat Indicators Newsletter February 2009. <http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/LN-022009/EN/LN-022009-EN.PDF>, accessed Dec 1st 2009.

Factsheet zur Logistikmarktstudie: Volumen Logistikmarkt Schweiz, (2011) <http://www.logistik.unisg.ch/org/logm/web.nsf/SysWebRessources/Factsheet+2+Logistikmarktstudie/$FILE/LO_2011_02_LMS.pdf>, accessed Jul 12th 2011.

Fang, Y. – Ng, S. T. (2011) Applying activity-based costing approach for construction logistics cost analysis. *Construction Innovation*, Vol. 11 (3), 259–281.

Farahani, R. Z. – Asgari, N. – Davarzani, H. (2009) *Supply Chain and Logistics in National, International and Governmental Environment – Concepts and Models*. Physiga-Verlag, Berlin, Germany.

Feng, S. – Guijun, T. (2008) *On Factors Influencing Regional Logistics Costs*, 2008 International Conference on Intelligent Computation Technology and Automation. Hunan, China, October 2008.

Finnish Governmental Programme 2007. <http://www.vn.fi/hallitus/hallitusohjelma/pdf/en.pdf>, accessed Nov 21st 2009.

Friedman, M. (1953) *Essays in positive economics*, Harvard, US.

Frost – Sullivan (2009) *ASEAN Logistics End Users - Trends and Preferences* press release 23.12.2009, available at: <http://www.frost.com/prod/servlet/market-insight-top.pag?docid=188456835>, accessed Jul 28th 2011.

Fröderberg, A. (2006) *Cutting Logistics Costs with a Centralized Distribution Model for ABB's Distribution of LV Products in Asia Pacific.* Luleå University of Technology, Master's Thesis 2006:217, Luleå, Sweden.

Ghemawat, P. – Altman, S. A. (2011) "DHL Global Competitiveness Index 2012", available at: <http://www.dhl.com/content/dam/flash/g0/gci/download/DHL_GlobalConnectednessIndex.pdf>, accessed Jun 9th 2012.

GMA Logistics Survey 2008. <http://www.gmabrands.com/publications/GMALogisticsStudy2008.pdf>, accessed Jan 24th 2010.

Gogoneata, B. (2008) An analysis of explanatory factors of logistics performance of a country. *Amfiteatru Economic*, Vol. 10 (24), 143–156.

Gunn, E. A. (2009) *A Total Logistics Cost Framework to Compare the Container Traffic Through the Port of Halifax to Other Routes*, Dalhousie University, Centre for International Trade and Transportation, Working Paper 6, Halifax, Nova Scotia, Canada.

Hansen, D. R. – Mowen, M. M. (2010) *Cornerstones of Cost Accounting*. Mason, OH, US.

Hansen, W. – Hovi, I. B. (2008) *En gjennomgang av ulike studier som forsöker å kvantifisere logistikkostnadene.* TÖI rapport 969/2008, Oslo, Norway.

Hansen, W. – Hovi, I. B. (2010) *Logistics costs in Norway, survey results, calculations and international comparison*. European Transport Conference 2010, Glasgow, Scotland.

Harrison, A. – van Hoek, E. (2002) *Logistics Management and Strategy*. Ashford, Great Britain.

Hausman, W. – Lee, H. – Subramanian, U. (2005) *Global Logistics Indicators, Supply Chain Metrics and Bilateral Trade Patterns (World Bank Policy Research Working Paper 3773).* <http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2005/11/17/000016406_20051117161830/Rendered/PDF/wps3773.pdf>, accessed Jan 20th 2010.

Havenga, J. (2010) Logistics costs in South Africa – The case for macroeconomic measurement. *South African Journal of Economics*, Vol. 74 (4), 460–48.

Heikkilä, T. (2005) *Tilastollinen tutkimus*. Helsinki, Finland.

Hirsjärvi, S. – Remes, P. – Sajavaara, P. (2003) *Tutki ja kirjoita.* Helsinki, Finland.

Hobbs, J. (1996) A transaction cost approach to supply chain management. *Supply Chain Management*, Vol. 1 (2), 15–27.

Hollweg, C. – Wong, M.-H. (2009) *Measuring Regulatory Restrictions in Logistics Services*, ERIA Discussion Paper Series, ERIA-DP-2009-14, available at: <http://www.eria.org/pdf/ERIA-DP-2009-14.pdf>, accessed Sept 6th 2011.

Hovi, I. B. – Hansen, W. (2010) *Logistics Costs in Norway: Key figures and international comparison* TÖI report 1052/2010, Oslo, Norway, available at: < http://www.toi.no/getfile.php/ Publikasjoner/T% D8I%20rapporter/2010/1052-2010/1052-2010-nett-ny.pdf>, accessed Jul 18th 2011.

Huff-Rouselle, M. – Raja, S. (2002) Ghana: Estimating the Costs of Logistics in the Ministry of Health Supply System, Arlington, Va., U.S.

Industriens logistikk - en studie av logistikkostnader og ressursbruk i norskindustri. <http://www.tf.no/modules.php?op=modload&name=PagEd&file=index&p_deliver=media&m_id=8>, accessed Dec 4th 2010.

Industry Canada – Logistics Cost and Agility Assessment Tool. <http://www.ic.gc.ca/eic/site/dsib-logi.nsf/vwapj/pg00001_eng.pdf/$file/pg00001_eng.pdf>, accessed Jan 12th 2010.

Innovation Excellence in Logistics – Value Creation by Innovation (2007), Publications of ELA, Brussels, Belgium.

JIL Database, available at <http://www.mlit.go.jp/seisakutokatsu/census/census-top.html>, accessed Aug 8th 2011.

JIL Database – Logistics Cost Data, available at: <http://www.logistics.or.jp/jils/soken2/cntHtml/LgCnt19.html>, accessed Aug 8th 2011.

Indian Logistics Industry Insight – Aviation (2007), Cygnus Business Consulting & Research, Banjara Hills, India.

Indonesian Ministry of National Development Planning (2011) *Infrastructure development strategy in Indonesia*, presentation 13.1.2011, Jakarta, Indonesia, available at: <http://www.oecd.org/dataoecd/60/9/47377678.pdf>, accessed Aug 7th 2011.

International Monetary Fund, World Economic Outlook. <http://www.imf.org/external/pubs/ft/weo/2009/02/weodata/index.aspx>, accessed Nov 26th 2009.

Jensen, A (2007) Logistikkostnader, konkurrenskraft och infrastruktur. <http://www.vgregion.se/upload/Regionkanslierna/regionutveckling/Kommunikation/2_Svenska%20f%C3%B6retags%20logistikkostnader.pdf>, accessed Jan 7th 2010.

Kivinen, P. – Lukka, A. (2002) *Value Added Logistical Support Service, Trends and new Concept Model*. Lappeenranta, Finland.

Kivinen, P. – Lukka, A. (2004) *Value Added Logistical Support Service: Logistics cost Structure and Performance in the new Concept*. Lappeenranta, Finland.

Klaus, P. – Kille, C. (2007) *TOP 100 in European Transport and Logistics Services*. 2nd edition. Bobingen, Germany.

Klaus, P. (2009) Logistics research: a 50 years' march of ideas. *Logistics Research*, Vol. 1 (1), 53–56.

Klaus, P. – Kille, C. – Schwemmer, M. (2011) *TOP 100 in European Transport and Logistics Services*, executive summary, available at: <http://www.scs.fraunhofer.de/en/Images/Fraunhofer%20SCS%20-%20Top%20100%20Executive%20Summary_tcm129-97670.pdf>, accessed Dec 7th 2011.

KOF Index of Globalization, available at: <http://globalization.kof.ethz.ch/>, accessed Jun 9th 2012.

KOTI (2010) *Korean Macroeconomic Logistics Costs in 2008*, <http://english.koti.re.kr/board/report/download.asp?code=research_report&record_idx=1440&type=normal>, accessed Jul 26th 2011.

Kotzab, H. – Seuring, S. – Müller, M. – Reiner, G. (2005) *Research Methodologies in Supply Chain Management.* Heidelberg, Germany.

KPMG: Logistics in China 2008. <http://www.kpmg.com.cn/en/virtual_library/Property_Infrastructure/LogisticsChina.pdf>, accessed Jan 10th 2010.

Kumar, N. (2010) Logistics of low cost country sourcing. *International Journal of Logistics: Research & Applications*, Vol. 13 (2), 143–160.

La Logistique du Commerce et la Compétitivité du Maroc 2006. <http://www.mtpnet.gov.ma/Morocco%20trade%20logistics%20Final%20May%2030 %202006.PDF>, accessed Jan 24th 2010.

Lambert, D. – Grant, D. – Stock, J. – Ellram, L. (2006) *Fundamentals of Logistics Management*. European edition. McGraw-Hill, Maidenhead, Berkshire, UK.

Langley, J. (2008) *2008 Third Party Logistics.* <http://3plstudy.com/?p=2008-3pl-study>, accessed Nov 20th 2009.

Li, Q. – Fang, T. (2010) Research on Difference of Logistics Cost between China and America Based on Gray Relational Analysis, 2010 IEEE International Conference on Advanced Management Science (ICAMS), Chengdu, China, July 2010.

Logistics in Australia: A Preliminary analysis (2001), Bureau of Transportation Working Paper No. 49, October 2001.

Logistics Report 2007 Thailand. <http://www.nesdb.go.th/LinkClick.aspx?fileticket=D5g5B0ZId1I%3D&tabid=58&mid=418>, accessed Jan 18th 2010.

Logistiikkafoorumi (2009) Finnish Logistics Strategy, draft, mimeo, unpublished report to Ministry of Transportation and Communications, Finland.

Lummus, R. R. – Krumwiede, D. W. – Vokurka R. J. (2001) The relationship of logistics to supply chain management: developing a common industry definition. *Industrial Management & Data Systems*, Vol. 101 (8), 426–432.

McBurney, D. – White, T. (2009) *Research Methods*. 8th edition. Belmont, CA, US.

McNeill, P. – Chapman, S. (2005) *Research methods*. 3rd edition. Oxon, England.

Mentzer, J. – DeWitt, W. – Keebler, J. – Min, S. – Nix, N. – Smith, C. – Zacharia, Z. (2001) Defining Supply Chain Management. *Journal of Business Logistic*, Vol. 22 (2), 1–25.

Mentzer, J. – Kahn, K. (1995) A Framework of Logistics Research. *Journal of Business Logistics*, Vol. 16 (1), 231–250.

Merriam, S. B. (2009) Qualitative research: a guide to design and implementation, San Francisco, CA, US.

Ministry of Transport in New Zealand (2010) *Understanding Transport Costs and Charges – Transport costs in freight logistics* available at <http://www.transport.govt.nz/research/Documents/UTCC-Phase-2-Transport-and-freight-logistics-final-report-Nov2010.pdf>, accessed Aug 2nd 2011.

Naula, T. – Ojala, L. – Solakivi, T. – Takalolastari, M. – Rantanen, M. – Kalske, M. – Engblom J. – Häkkinen, L. – Essén, T. – Töyli, J. – Stenholm, P. (2006) *Logistics Survey 2006*. Publications of the Ministry of Transport and Communications 35/2006, Helsinki, Finland.

Nguyen-Lu, N. – Reide, P. – Yentis, S. M. (2009) Do you have a stick in your mouth – use of Google Translate as an aid to anaesthetic pre-assessment. *Anaesthesia*, Vol. 65 (1), 96–97.

Norsk Logistikkbarometer results 2003. <http://www.logistikkbarometeret.no/index.php?wh=question&ac=view&id=24>, accessed Jan 5th 2010.

Norsk Logistikkbarometer 2007 results. <http://www.logistikkbarometeret.no/index.php?aar=2007&wh=question&ac=view&id=34>, accessed 5.1.2010.

Norsk Logistikkbarometer 2009 results. <http://www.logistikkbarometeret.no/index.php?res=2009>, accessed 5.1.2010.

OECD Economics Department. <http://www.oecd.org/document/46/0,3343,en_2649_34109_33701806_1_1_1_1,00.html>, accessed Nov 21st 2009.

OECD Statistics 1. <http://stats.oecd.org/glossary/detail.asp?ID=2780>, accessed Nov 20th 2009.

OECD Statistics 2. <http://stats.oecd.org/glossary/detail.asp?ID=2368>, accessed Nov 20th 2009.

OECD's Statistical Portal Main Economic Indicators database. <10.1787/data-00052-en>, accessed Jan 30th 2012.

Ojala, L. *Albania Country Economic Memorandum, Trade Logistics input*. Mimeo, unpublished report to The World Bank.

Ojala, L. (1992) *Modelling Approaches in Port Planning and Analysis.* Publications of the Turku School of Economics and Business Administration, Series A-4:1992, Turku, Finland.

Ojala, L. (1995) *Logistics Management in Finnish Foreign Trade Transport.* Publications of the Turku School of Economics and Business Administration, Series A-3:1995, Raisio, Finland.

Ojala, L. – Dyachenko, T. (2010) *Ukraine: Trade and Transit Facilitation Study*. The World Bank Group. Available at: <http://siteresources. worldbank.org/UKRAINEEXTN/Resources/TTF_April2010.pdf>, accessed Jun 8th 2012.

Ojala, L. – Solakivi, T. – Hälinen, H.-M. – Lorentz, H. – Hoffmann, T. M. (2007) *State of Logistics in the Baltic Sea Region 2007*. LogOn Baltic Master reports 3:2007. Tampere, Finland.

Orrenmaa, A. (2009) Kauhajoelta käytännön logistikkoja. *Kauppalehti – Logistiikka Extra* 12.4.2010, 17.

Paavola, J. – Vehviläinen, A. – Ojala, L. – Antikainen, T. – Iikkanen, P. (2012) *"Finnish Foreign Trade: Logistics Competitiveness and Needs for Development. Final report of working group"*. Publications of Ministry of Transportation and Communications in Finland 6/12, available at: <http://www.lvm.fi/c/document_library/get_file?folderId=1986562&name=DLFE-14202.pdf&title=Julkaisuja%206-2012>, accessed Jun 8th 2012.

Pakistan Logistics Cost Study (2006) Final Report, June 2006, available at: <http://www.nttfc.org/reports/Logistics_costs_study_Pakistan_report_June_06.pdf>, accessed Jul 18th 2011.

Pohlen, T. – Klammer, T. – Cokins, G. (2009) *The Handbook of Supply Chain Costing*, Lombard, Illinois, USA.

Rantasila, K. – Ojala, L. (2012) *The Measurement of National-Level Logistics Costs and Performance*. International Transport Forum's Discussion Paper No. 2012–4, OECD.

Rey, M. F. (2008) E*ncuesta Nacional Logística: Resultados del Benchmarking Logístico – Colombia 2008*, available at <http://www. encuestanacionallogistica.com/docs/file/REPORTE%20ENL%20COLOMBIA.pdf>, accessed Aug 16th 2011.

Rushton, A. – Croucher, P. – Baker, B. (2006) *Handbook of Logistics and Distribution Management*. 3rd edition. Kogan Page. Glasgow, UK.

Rushton, A. – Oxley, J. – Croucher, P. (2001) *The handbook of logistics and distribution management*. 2nd edition. London, UK.

Ryerson, M. S. – Hansen, M. (2009) *Capturing the Impact on Jet Aircraft Operating Costs with Engineering and Econometric Models*. UCTC Research P 884, University of California Transportation Center, University of California, Berkeley, CA, USA.

Saunders, M. – Lewis, P. – Thornhill, A. (2009) *Research Methods for Business Students*. 5th edition. Essex, England.

SCD – Logistics Cost Survey (2006). <http://www.scdigest.com/assets/reps/SCDigest_Logistics_Cost_Survey_2006.pdf>, accessed Oct 20th 2009.

Schwab, K. (2011) *The Global Competitiveness Report 2010-2011*. World Economic Forum, Geneva, Switzerland.

SCI Verkehr Logistikbarometer July 2011 (2011) available at: <http://www.sci.de/fileadmin/user_upload/logistikbarometer/pdf/2011/050-051DVZ11-I006.pdf>, accessed Jul 12th 2011.

SCI Verkehr website. <http://www.sci.de/en/company.html>, accessed Jan 7th 2010.

SCI Verkehr Logistikbarometer November 2009. <http://www.sci.de/fileadmin/user_upload/logistikbarometer/pdf/Auswertung_Nov2009.pdf>, accessed Jan 7th 2010.

SCM and KPI Analysis – A Canada / United States Manufacturing Perspective 2006. <http://www.ic.gc.ca/eic/site/dsib-logi.nsf/vwapj/pg00016_eng.pdf/$file/pg00016_eng.pdf>, accessed Dec 23rd 2009.

SCM and KPI Analysis – A Canada / United States Perspective 2006. <http://www.ic.gc.ca/eic/site/dsib-logi.nsf/vwapj/pg00015_eng.pdf/$file/pg00015_eng.pdf>, accessed Dec 23rd 2009.

SCM and KPI Analysis – A Canada / United States Retail Perspective 2006. <http://www.ic.gc.ca/eic/site/dsib-logi.nsf/vwapj/pg00017_eng.pdf/$file/pg00017_eng.pdf>, accessed Dec 23rd 2009.

Seuring, S. A. (2008) Assessing the rigor of case study research in supply chain management. *Supply Chain Management: An International Journal*, Vol. 13 (2), 128–137.

Smith, A. – Huber, B. (2005) *Comparative Challenges: Chain Reactions: an Analysis of Supply Chain Management and Competitive Solutions for the Island of Ireland*. National Institute of Transport Logistics, Dublin, Ireland.

Solakivi, T. – Ojala, L. – Lorentz, H. – Laari, S. – Töyli, J. (2012) *Finland State of Logistics 2012*. Publications of the Ministry of Transport and Communications 11/2012, Helsinki, Finland.

Solakivi, T. – Ojala, L. – Töyli, J. – Hälinen, H.-M. – Lorentz, H. – Rantasila, K. – Huolila, K. – Laari, S. (2010) *Finland State of Logistics 2010*. Publications of the Ministry of Transport and Communications 36/2010, Helsinki, Finland.

Solakivi, T. – Ojala, L. – Töyli, J. – Lorentz, H. – Hälinen, H.-M. – Rantasila, K. – Naula, T. (2009) *Finland State of Logistics 2009*. Publications of the Ministry of Transport and Communications 21/2009, Helsinki, Finland.

Sopple, V. V. (2007) *Logistics Management: The Supply Chain Imperative*. Delhi, India.

Sotharith, C. – Vannarith, C. (2010) *Cambodian Economy*, CICP E-BOOK NO.5, available at: <http://www.cicp.org.kh/download/CICP%20E-Book/cicp%20e-book%20no%205.pdf>, accessed Aug 3rd 2011.

Sourcing and Logistics in China. <http://www.pwc.co.uk/pdf/sourcing_and_logistics_in_china_v2.pdf>, accessed Jan 4th 2010.

Spijker A. – Trijsburg RW. – Duivenvoorden HJ. (1997) Psychological sequelae of cancer diagnosis: a meta-analytical review of 58 studies after 1980. *Psychosom Med*, Vol. 59 (3), 280–293.

State of Logistics Survey for South Africa 2004, Pretoria, South Africa.

State of Logistics Survey for South Africa 2007, Pretoria, South Africa.

State of Logistics Survey for South Africa 2008. <http://www.csir.co.za/pdf/2009/SOL_2008.pdf>, accessed Nov 16th 2009.

State of Logistics Survey for South Africa 2010 (2011), available at: <http://www.csir.co.za/sol/docs/7th_SoL_2010_March.pdf>, accessed Jul 12th 2011.

State of Logistics: The Canadian Report 2008. <http://www.ic.gc.ca/eic/site/dsib-logi.nsf/vwapj/pg00026_eng.pdf/$file/pg00026_eng.pdf>, accessed Dec 22nd 2009.

Statistics Finland, <http://tilastokeskus.fi/meta/luokitukset/toimiala/001-2002/kuvaus.html>, accessed Dec 13th 2011.

Stölzle, W. – Hofmann, E. – Gebert, K. (2008) *Logistikmarktstudie Schweiz 2009*, St. Gallen, Switzerland.

Stölzle, W. – Hofmann, E. – Gebert, K. (2009) *Logistikmarktstudie Schweiz 2010*, St. Gallen, Switzerland.

Straube, F. – Pfohl, H.-C. (2008) *Trends and Strategies in Logistics: Global Networks in an Era of Change*. Bundesvereinigung Logistik e.V., Berlin, Germany.

Supply-Chain-Excellence in der globalen Wirtschaftskrise (2009) ELA & A.T. Kearney publications. Dusseldorf, Germany.

Svensk Makrologistik. <http://www.vinnova.se/upload/EPiStorePDF/vr-08-13.pdf>, accessed Jan 11th 2010.

Tajikistan Trade Diagnostic Study (2005) World Bank Report No. 32603-TJ. <http://siteresources.worldbank.org/INTRANETTRADE/Resources/Pubs/TajikTradeStudy.pdf>, accessed Mar 14th 2010.

Tavasszy, L. A. – Ruijgrok, C. J. – Thissen, M.J.P.M. (2003) Emerging Global Logistics Networks: Implications for Transport Systems and Policies. *Growth and Change*, Vol. 34 (4), 456–472.

Thailand Logistics Report 2008 (2009) Publications of Office of National Economic and Social Development Board, December 2009, available at: <http://www.logisticsdigest.com/images/stories/Articles_Jun10/LogisticsCost_2008eng.pdf>, accessed Jul 13th 2011.

The GMA 2010 Logistics Benchmark Report (2010) available at: <http://www.gmaonline.org/downloads/research-and-reports/GMA_2010_Logistics_Benchmark_Report.pdf>, accessed Jul 11th 2011.

The Logistics Report 2011 UK (2011) available at: <http://www.fta.co.uk/export/sites/fta/_galleries/downloads/logistics_report/logistics_report_2011.pdf>, accessed Aug 5th 2011.

The Republic of Moldova: Trade Diagnostic Study (2004) World Bank Report No. 30998-MD. <http://siteresources.worldbank.org/INTMOLDOVA/Resources/trade1.pdf>, accessed Mar 14th 2010.

Töyli, J. – Häkkinen, L. – Ojala, L. – Naula, T. (2008) Logistics and financial performance - An analysis of 424 Finnish small and medium-sized enterprises. *International Journal of Physical Distribution & Logistics Management*, Vol. 38 (1), 57–80.

The World Bank LPI ranking. <http://info.worldbank.org/etools/tradesurvey/mode1b.asp#ranking>, accessed Mar 12th 2010.

Underhill, C. M. (2006) The effectiveness of mentoring programs in corporate settings: A meta-analytical review of the literature. *Journal of Vocational Behavior*, Vol. 68 (2), 292–307.

United Nations, Economic and Social Commission for Asia and the Pacific: Commercial Development of Regional Ports as Logistics Centres. <http://www.unescap.org/ttdw/Publications/TFS_pubs/pub_2194/pub_2194_fulltext.pdf>, accessed Nov 13th 2009.

United Nations Statistics Division. <http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27&Lg=1> , accessed Nov 20th 2009.

United Nations Statistical Division: ISIC Statistical Paper Rev. 4. <http://unstats.un.org/unsd/cr/registry/regdntransfer.asp?f=135>, accessed Dec 1st 2009.

United Nations Statistics Division: National Accounts Main Aggregates Database, available at: <http://unstats.un.org/unsd/snaama/dnlList.asp>, accessed Jul 6th 2011.

Visser, E.-J. (2007) Logistic innovation in global supply chains: an empirical test of dynamic transaction-cost theory. *GeoJournal*, Vol. 70 (2–3), 213–226.

Wajszczuk, K. – Wielicki, W. (2004) *The Level and Structure of Logistics Costs in Great Area Agricultural Enterprises*, Publications of Roczniki Akademii Rolniczej w Poznaiu – CCCLIX, Ekon.3, Poznan, Poland, available at: <http://www.jard.edu.pl/pub/18_3_2004.pdf>, accessed Sept 13th 2011.

Waters, D. (2003) *Logistics: An Introduction to Supply Chain Management.* Gosport, UK.

Wiklund, A. (2008) PSA Peugeot Citroën Logistics costs and efficiency presentation. <http://www.odette.se/BinaryLoader.axd?OwnerID=89a08f04-0a60-4ae8-a321-cffa959eb333&OwnerType=0&PropertyName=File1&FileName=Axel%20Wiklund.pdf>, accessed Jan 18th 2010.

Williamson, O. E. (1981) The Economics of Organization: The Transaction Cost Approach. *American Journal of Sociology*, Vol. 87 (3), 548–577.

Williamson, O. E. (2008) Outsourcing: Transaction Cost Economics and Supply Chain Management. *Journal of Supply Chain Management*, Vol. 44 (2), 5–16.

Wilson, R. (2009) 20th Annual State of Logistics Report presentation slides, June 17th 2009. <http://cscmp.org/memberonly/state.asp>, accessed Jan 20th 2010.

Wilson, R. (2011) *U.S Annual State of Logistics Report* presentation, presented at World Bank, Washington, DC, June 17, 2011.

World Bank reports 1 (2006) Argentina - The Challenge of Reducing Logistics Costs. Report No. 36606-AR, <http://www-wds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187283&theSitePK=523679&entityID=000020439_20071108092451&searchMenuPK=64187283&theSitePK=523679>, accessed Jan 18th 2010.

World Bank reports 2 (2007) Latin America: Addressing High Logistics Costs and Poor Infrastructure for Merchandise Transportation and Trade Facilitation. <http://www.copenhagenconsensus.com/Admin/Public/DWSDownload.aspx?File=%2FFiles%2FFiler%2FCC+LAC%2FCCLAC+SP%2FInfrastructure_Guasch_SP_Final.pdf>, accessed Jan 18th 2010.

Yin, R. (2012) *Applications of Case Study Research*. 3rd edition. Thousand Oaks, CA, US.

Zeng, A. – Rossetti, C. (2003) Developing a framework for evaluating the logistics costs in global sourcing processes. *International Journal of Physical Distribution & Logistics Management*, Vol. 33 (9), 785–803.

Zhao, H. – Luo, Y. – Suh, T. (2004) Transaction Cost Determinants and Ownership-Based Entry Mode Choice: A Meta-Analytical Review. *Journal of International Business Studies*, Vol. 35 (6), 524–544.

APPENDICES

Appendix 1 CSCMP 2008

Source currency :	USD	Exchange rate:	1.4688	GDP:	14441.425	
Cost sub component	**Value (billons USD)**	**Value (billions EUR)**	**% of GDP**		**Main components**	**% of GDP**
Interest	47	32	0.33 %		Carrying costs	2.92 %
Taxes, insurance etc.	252	172	1.74 %		Transport costs	5.98 %
Warehousing	122	83	0.84 %		Shipper related c.	0.06 %
Truck-Intercity	460	313	3.19 %		Logistics administ.	0.36 %
Truck-Local	220	150	1.52 %		**sum:**	9.31 %
Railway	63	43	0.44 %			
Waterway	39	27	0.27 %		=SUM(B7:B13)/F1	
Oil Pipeline	10	7	0.07 %			
Air	40	27	0.28 %			
Forwarders	32	22	0.22 %			
Shipper related	8	5	0.06 %			
Administration	52	35	0.36 %			
sum	**1345**	**916**	**9.31 %**			

Appendix 2 LogOn Baltic 2007

Manufacturing N=	315	Index	Cost %		=D2*C2
Micro	164	0.520635	15	7.81	
Small	82	0.260317	13.2	3.44	
Medium	41	0.130159	13.5	1.76	
Large	28	0.088889	8.1	0.72	=SUM(E2:E5
		=B2/B1	Log cost	13.7	
Trading N=	259	Index	Cost %		
Micro	140	0.540541	16	8.65	
Small	67	0.258687	15.5	4.01	
Medium	29	0.111969	13	1.46	
Large	23	0.088803	13.9	1.23	
			Log cost	15.3	
Total N=	574	Index	Cost%		
Manufacturing	315	0.54878	13.7	7.53	
Trading	259	0.45122	15.3	6.93	
			Log cost	14.5	

LogOb Baltic 2007, data source: State of logistics in the Baltic Sea Region (%of sales)

	Germany (MV)	Poland (Pomerania)	Estonia	Finland (SW)	Germany (Hamburg)	Latvia	Sweden (Eastern Gothia)	Lithuania	average
Transportation costs	7.20 %	5.15 %	5.98 %	5.26 %	4.89 %	5.90 %	3.84 %	5.00 %	5.40 %
Warehousing costs	5.48 %	2.08 %	1.89 %	2.44 %	2.33 %	2.40 %	1.89 %	1.67 %	2.52 %
Inventory carrying costs	3.95 %	3.00 %	4.07 %	3.13 %	3.00 %	2.00 %	2.89 %	2.00 %	3.00 %
Logistics administration costs	2.78 %	2.92 %	1.13 %	1.80 %	1.44 %	0.80 %	1.45 %	1.00 %	1.67 %
Other logistics costs	0.70 %	1.46 %	0.67 %	0.75 %	0.72 %	0.80 %	0.95 %	1.00 %	0.88 %
	20.10 %	14.62 %	13.75 %	13.38 %	12.39 %	11.90 %	11.02 %	10.67 %	13.48 %

Average total of manufacturing (% of turnover)	13.48 %

	Germany (MV)	Poland (Pomerania)	Estonia	Finland (SW)	Germany (Hamburg)	Latvia	Sweden (Eastern Gothia)	Lithuania	average
Transportation costs	4.11 %	5.31 %	5.39 %	7.56 %	5.77 %	5.27 %	6.00 %	3.88 %	5.41 %
Warehousing costs	3.89 %	3.20 %	2.84 %	2.67 %	3.73 %	2.16 %	4.20 %	2.38 %	3.13 %
Inventory carrying costs	7.11 %	5.37 %	3.13 %	3.26 %	2.32 %	3.69 %	1.00 %	3.63 %	3.69 %
Logistics administration costs	4.00 %	1.92 %	1.94 %	1.10 %	1.73 %	1.55 %	1.07 %		1.66 %
Other logistics costs	3.44 %	0.98 %	2.00 %	0.46 %	0.86 %	0.67 %	0.87 %		1.16 %
	22.56 %	16.79 %	15.29 %	15.05 %	14.41 %	13.33 %	13.13 %	9.88 %	15.05 %

Average total of trading (% of turnover)	15.05 %

Appendix 3 Sourcing and Logistics in China 2008

% of responden	Index 100/66=1.52	% of respondent	cost	Weighted cost	
14	21.28	0.2128	17.5	3.724	=E4*D4
10	15.2	0.152	10	1.52	
42	=1.52*42 63.84	0.6384	13	8.2992	=SUM(F2:F4
		Manufacturing average costs		13.5432	

Appendix 4 Davis Database Questionnaire Form

Logistics Cost and Service Database

Company Name _____ **Contact Name** _____
Address _____ **Title** _____
_____ **Telephone** _____ **Fax** _____
_____ **Email** _____

CLASSIFICATION DATA

Company's Industry Description and Principal Products _____

Nature of Business:
☐ Manufacturing ☐ Retail Chain
☐ Wholesale/Distributor ☐ Other

Products are Primarily:
☐ Durable ☐ Consumer
☐ Non-Durable ☐ Industrial

SIZE OF BUSINESS

A. Net US Sales Dollars $ _____
B. Weight Shipped to Customers _____ lbs.
C. Number of Customer Shipping Points _____
D. Number of Sales Orders _____
E. Number of Sales Order Lines _____

TRANSPORTATION COST TERMS TO CUSTOMERS

Percent of Sales on which Freight is:

Paid by You	_____ %
Paid by Customer	_____ %
Picked up by Customer without Allowance	_____ %
Other _____	_____ %
Total	**100 %**

LOGISTICS COSTS

Data for 12 Months Ending _____/_____/_____

A. Finished Goods Transportation

1. **Primary Transportation.**
   Domestic (From domestic plants/vendors to DCs and DC transfers) $ _____
   International (From international plants/vendors to DC's excluding duty) $ _____
2. **Secondary Transportation.** Delivery to customers. $ _____

Total Transportation $ _____

B. Finished Goods Warehousing. Plant, DC, public, and third-party warehouse costs for storage and handling of finished goods. Costs should include the following: labor, space, energy, equipment, computers (hardware and software), and material for packing and shipping.
Warehousing $ _____

C. Order Entry/Customer Service (OE/CS). Costs should include the following: labor, space, energy, computers (hardware and software), and supplies.
OE/CS $ _____

D. Administration of Distribution. Personnel and support costs for indirect management (central distribution staff, computers (hardware and software), inventory control, and transportation and traffic).
Administration $ _____

E. Finished Goods Inventory Carrying Cost
Average Inventory Value at Standard Cost $ _____
Average Finished Goods Inventory Turns _____
Carrying Cost (Inventory Value x 0.18) $ _____

Total Logistics Cost $ _____

To value the cost to carry inventory, does your company use:
☐ A specific rate for inventory carrying ☐ An internal hurdle rate ☐ Not sure/don't know

What is the rate currently used by your company to value the cost to carry inventory? _____%

CUSTOMER SERVICE PERFORMANCE MEASURES

A. Total Order Cycle Time (Customer PO to Delivery of Shipment) _____ calendar days
B. Percent of Orders Shipped Complete on the First Shipment _____ %
C. Percent of Lines Shipped Complete _____ %
D. Percent of Units Shipped Complete _____ %

Appendix 5 Cost Element Aggregate

Literature	COUNT	Articles	COUNT	Statistics based studies	COUNT	Surveys	COUNT
Transportation	8	Transportation	7	Transportation	7	Transportation	12
Inventory carrying	7	Warehousing	5	Administration	5	Warehousing	12
Warehousing	7	Inventory carrying	4	Inventory carrying	4	Administration	11
Packaging	4	Administration	3	Warehousing	3	Inventory carrying	7
Administration	2	Risk and Damage	3	Cargo handling	3	Other	5
Customer service	2	Insurance	2	Transport pack.	2	Transport pack.	3
Order processing / information	2	Packaging	2	Communication	2	Insurance	2
Associated labor	1	Tied capital costs (transportation)	2	Customer service	2	Obsolescence	2
Tied capital costs (transportation)	1	Cost of commodities space movement	1	Documentation	1	Customer service /order entry	2
Communication	1	Customer service	1	Equipment	1	Appraisal	1
Consultancy	1	Customs	1	Information	1	Cost of capital	1
Cost of damaged during transit	1	Design, restructure and option cost	1	Insurance	1	Customs	1
Fixed costs	1	Forecasting	1	Internal logistics costs	1	Damages	1
Logistics technology	1	Cargo handling	1	Internal services	1	Depreciation	1
Lot quantity	1	Indirect logistics costs	1	Obsolescence	1	Delivery	1
Manufacturing	1	Information	1	Outsourced logistics	1	Distribution centers	1
Procurement	1	Order processing	1	Order processing	1	Management/overhead	1
Purchased materials	1	Other costs	1	Other costs	1	Other indirect log. costs	1
Quality control	1	Permission losses	1	Plan/management	1	Shipper related	1
Recycling logistics	1	Procurement	1	R&D	1	**SUM**	**66**
Reverse logistics	1	Substance consumption	1	Shipper related	1		
Stock-out costs	1	Returned goods	1	**SUM**	**41**		
Trade costs	1	Wages, bonus, allowance	1				
Value-added services	1	**SUM**	**43**				
SUM	**49**						

COST COMPONENT	COUNT	GENERIC COMPONENTS/ SUB COMPONENTS
Transportation	34	Warehousing
Warehousing	27	*Cargo handling*
Inventory carrying	22	*Depreciation*
Administration	21	*Distribution centers*
Other costs	13	*Lot quantity*
Packaging	6	*Obsolescence*
Customer service	5	Transportation
Insurance	5	*Customs*
Transport pack.	5	*Delivery*
Cargo handling	3	*Shipper related*
Communication	3	*Trade costs*
Obsolescence	3	Administration
Risk and Damage	3	*Appraisal*
Tied capital costs (transportation)	3	*Associated labor*
Customer service /order entry	2	*Communication*
Customs	2	*Consultancy*
Information	2	*Customer service*
Order processing / information	2	*Customer service/order entry*
Procurement	2	*Documentation*
Shipper related	2	*Forecasting*
Appraisal	1	*Indirect logistics costs*
Associated labor	1	*Information*
Consultancy	1	*Internal logistics costs*
Cost of capital	1	*Internal services*
Cost of commodities space movement	1	*Management/ overhead*
Cost of damaged during transit	1	*Order processing*
Damages	1	*Order processing / information*
Delivery	1	*Other indirect log. costs*
Depreciation	1	*Planning/management*
Design, restructure and option cost	1	*Procurement*
Distribution centers	1	*R&D*
Documentation	1	*Stock-out costs*
Equipment	1	*Value-added services*
Fixed costs	1	Inventory carrying
Forecasting	1	*Manufacturing*
Indirect logistics costs	1	*Purchased materials*
Internal logistics costs	1	*Tied capital costs (transportation)*
Internal services	1	*Wages, bonus, allowance*
Logistics technology	1	Packaging
Lot quantity	1	*Transport packaging*
Management/overhead	1	Other
Manufacturing	1	*Cost of capital*
Order processing	1	*Cost of commodities space movement*
Other indirect log. costs	1	*Cost of damaged during transit*
Permission losses	1	*Damages*
Plan/management	1	*Design, restructure and option cost*
Purchased materials	1	*Equipment*
Quality control	1	*Fixed cost*
R&D	1	*Insurance*
Recycling logistics	1	*Logistics technology*

Appendix 6 Screenshots of the GLOCS Tool

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
4	WEO Subject Code		NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD	NGDPD
5	Country		Afghanist	Albania	Algeria	Angola	Antigua a	Argentina	Armenia	Australia	Austria	Azerbaija	Bahamas	Bahrain	Banglade	Barbados	Belarus	Belgium
6	Subject Descriptor		Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi	Gross doi
7	Subject Notes		Values ai	Values ai	Values ai	Values ai	Values ai	Values ai	Values ai	Values ai	Values ai	Values ai	Values ai	Values ai	Values ai	Values ai	Values ai	Values ai
8	Units		U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla	U.S. dolla
9	Scale		Billions	Billions	Billions	Billions	Billions	Billions	Billions	Billions	Billions	Billions	Billions	Billions	Billions	Billions	Billions	Billions
10	Country/Series-spe		See note:	See note:	See note:	See note:	See note:	See note:	See note:	See note:	See note:	See note:	See note:	See note:	See note:	See note:	See note:	See note:
11	1980	1	n/a	1.833	42.346	5.428	0.11	209.018	n/a	160.494	80.218	n/a	1.621	3.072	19.507	0.884	n/a	121.31
12	1981	2	n/a	2.099	44.372	5.08	0.125	169.759	n/a	185.657	69.51	n/a	1.679	3.468	19.011	0.973	n/a	100.877
13	1982	3	n/a	2.162	44.78	5.08	0.138	84.297	n/a	184.095	69.5	n/a	1.891	3.646	17.408	1.017	n/a	88.75
14	1983	4	n/a	2.184	47.529	5.294	0.153	103.989	n/a	176.403	70.413	n/a	2.105	3.735	18.243	1.079	n/a	83.959
15	1984	5	n/a	2.156	51.513	5.612	0.174	116.758	n/a	194.029	66.423	n/a	2.248	3.877	20.741	1.176	n/a	79.952
16	1985	6	n/a	2.202	61.132	6.914	0.202	88.187	n/a	171.94	68.026	n/a	2.448	3.658	21.337	1.231	n/a	83.258
17	1986	7	n/a	2.436	61.535	6.473	0.246	106.045	n/a	178.441	96.526	n/a	2.646	2.862	22.37	1.352	n/a	115.417
18	1987	8	n/a	2.417	63.3	7.4	0.287	108.725	n/a	210.137	120.71	n/a	2.913	3.101	24.679	1.488	n/a	143.482
19	1988	9	n/a	2.382	51.664	8.027	0.339	127.35	n/a	266.715	132.409	n/a	3.029	3.832	26.637	1.583	n/a	155.784
20	1989	10	n/a	2.617	52.558	9.338	0.374	81.706	n/a	302.486	132.064	n/a	3.414	4.113	29.344	1.752	n/a	157.715
21	1990	11	n/a	2.091	61.892	10.278	0.392	141.337	n/a	317.722	165.259	n/a	3.543	4.528	30.497	1.757	n/a	197.38
22	1991	12	n/a	1.255	46.67	9.963	0.411	189.594	n/a	319.721	172.779	n/a	3.533	4.615	31.432	1.733	n/a	202.445
23	1992	13	n/a	0.794	49.217	7.682	0.426	228.776	0.108	313.19	193.516	1.193	3.461	4.75	31.439	1.623	4.115	225.031
24	1993	14	n/a	1.376	50.963	5.575	0.456	236.505	0.835	304.593	188.39	1.309	3.419	5.199	32.954	1.69	3.662	215.774
25	1994	15	n/a	2.223	42.426	4.06	0.501	257.44	0.651	347.146	201.638	2.258	3.631	5.565	35.802	1.743	4.854	235.545
26	1995	16	n/a	2.714	42.066	5.066	0.494	258.032	1.287	371.247	238.55	2.417	3.796	5.848	39.58	1.871	3.384	276.48
27	1996	17	n/a	3.013	46.941	6.535	0.541	272.15	1.597	417.176	234.234	3.177	4.01	6.1	41.516	1.997	14.5	275.04
28	1997	18	n/a	2.164	48.178	7.675	0.58	292.859	1.639	418.048	207.126	3.963	4.3	6.35	43.388	2.195	14.098	249.751
29	1998	19	n/a	2.738	48.188	6.506	0.621	298.948	1.892	373.029	212.439	4.28	4.812	6.183	44.757	2.37	15.222	255.55
30	1999	20	n/a	3.444	48.845	6.153	0.652	283.523	1.845	401.998	211.206	4.581	5.298	6.617	46.529	2.478	12.138	253.996
31	2000	21	n/a	3.64	54.749	9.135	0.678	284.204	1.912	389.956	191.761	5.273	5.65	7.966	47.048	2.559	10.418	232.626
32	2001	22	n/a	4.065	54.745	8.936	0.71	268.697	2.118	368.129	190.319	5.708	5.761	7.969	47.194	2.554	12.355	231.871
33	2002	23	4.009	4.442	56.748	11.386	0.718	97.732	2.376	412.902	206.684	6.236	6.077	8.489	49.56	2.476	14.595	252.732
34	2003	24	4.435	5.694	67.802	13.956	0.754	127.643	2.807	527.753	252.516	7.276	6.187	9.745	54.476	2.695	17.825	310.681
35	2004	25	5.393	7.306	85.144	19.8	0.819	151.958	3.577	640.544	289.419	8.682	6.189	11.233	59.12	2.824	22.716	359.314
36	2005	26	6.489	8.188	102.721	30.632	0.873	181.549	4.9	713.205	303.447	13.245	6.797	13.456	61.127	3.005	30.21	376.99
37	2006	27	7.723	9.112	116.825	45.168	1.006	212.71	6.384	755.202	321.649	21.027	7.28	15.848	65.204	3.191	36.962	400.304
38	2007	28	9.659	10.865	135.343	59.263	1.155	260.402	9.206	910.334	371.144	31.287	7.498	18.443	73.689	3.409	45.276	459.029
39	2008	29	11.709	12.964	159.669	84.945	1.224	324.767	11.917	1,013.461	414.828	46.378	7.564	21.236	84.196	3.67	60.302	506.183
40	2009	30	13.318	11.726	134.797	69.708	1.18	301.331	8.683	920.01	374.417	42.505	7.403	19.361	92.121	3.595	49.043	461.489
41	2010	31	15.406	11.797	154.843	87.718	1.196	296.109	8.238	982.826	389.002	51.916	7.409	21.567	99.088	3.63	53.137	480.154

input | GLOCSengine | currencyrates | **GDPs** | output

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
38			EUR	USD	JPY	BGN	CZK	CYP	DKK	EEK	GBP	HUF	LTL	LVL	MTL	PLN	RON	SEK	SIT	SKK	CHF
39			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
40	2010	1	1	1.4389	133.62	1.9558	26.285		7.4415	15.6466	0.8914	269.85	3.4528	0.7093		4.103	4.2253	10.193			1.4873
41	2009	2	1	1.3866	126.64	1.9558	26.825		7.4499	15.6466	0.961	265.48	3.4528	0.7083		4.1638	4.035	10.8425			1.4874
42	2008	3	1	1.4688	163.83	1.9558	26.364		7.4552	15.6466	0.7413	253.22	3.4528	0.6988		3.6013	3.583	9.4257		33.586	1.6529
43	2007	4	1	1.327	157.76	1.9558	27.525	0.5782	7.4566	15.6466	0.6735	251.44	3.4528	0.6984	0.4293	3.8287	3.3829	9.0245		34.383	1.6104
44	2006	5	1	1.1826	139.56	1.9558	29.03	0.5735	7.4601	15.6466	0.6865	252.69	3.4528	0.6962	0.4293	3.8665	3.6825	9.3977	239.5	37.865	1.5536
45	2005	6	1	1.3507	138.84	1.9559	30.361	0.58	7.4371	15.6466	0.70725	245.58	3.4528	0.6964	0.4343	4.0774	39230	8.9758	239.78	38.655	1.5444
46	2004	7	1	1.2592	134.72	1.9557	32.398	0.58637	7.4452	15.6466	0.70545	261.93	3.4525	0.6715	0.4316	4.7029	41122	9.05	236.85	41.145	1.5615
47	2003	8	1	1.0446	124.4	1.9557	31.59	0.57353	7.4272	15.6466	0.652	235.78	3.4533	0.6134	0.4183	4.005	35012	9.127	230.325	41.412	1.4528
48	2002	9	1	0.9038	119.53	1.9519	31.707	0.57527	7.4388	15.6466	0.6262	244.58	3.6143	0.5665	0.4047	3.5608	28687	9.2825	216.7703	42.728	1.4833
49	2001	10	1	0.9423	108.26	1.9557	35.112	0.57451	7.4611	15.6466	0.6315	264.58	3.7706	0.5814	0.4098	3.8625	24467	8.888	213.4667	43.859	1.5218
50	2000	11	1	1.009	102.75	0.5767	36.063	0.57451	7.4404	15.6466	0.6246	254.53	4.0454	0.5916	0.4151	4.1835	18273	8.552	198.8925	42.317	1.6043
51	1999	12	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
52	1998	13	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
53	1997	14	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
54	1996	15	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
55	1995	16	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
56	1994	17	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
57	1993	18	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
58	1992	19	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
59	1991	20	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
60	1990	21	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
61	1989	22	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
62	1988	23	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
63	1987	24	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
64	1986	25	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
65	1985	26	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
66	1984	27	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
67	1983	28	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
68	1982	29	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
69	1981	30	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
70	1980	31	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
71	1979	32	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
72	1978	33	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
73	1977	34	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
74	1976	35	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
75	1975	36	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
76	1974	37	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
77	1973	38	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
78	1972	39	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
79	1971	40	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
80	1970	41	1	1.1789	133.73	0.58231	35.107	0.57451	7.4501	15.6466	0.7111	251.48	4.717	0.6668	0.4432	4.0712	13111	9.4696	189.045	42.991	1.6168
81																					
82																					
83																					
84																					

input | GLOCSengine | **currencyrates** | GDPs | output

Appendix 7.1 ELA Industry Classifications

ELA 2009, data source: Supply-Chain-Excellence in der globalen Wirtschaftskrise 2009 (%of sales)

Sub industry	% of participants	index	Administration	Inventory	Warehousing	Transportation
Consumer	25	0.51	0.10	1.07	1.12	1.99
Automotive	13	0.27	0.13	0.27	0.40	0.80
Retail	11	0.22	0.09	0.07	0.27	0.36
	49		0.32	1.40	1.79	3.14
Weighted average of wholesale and retail trade					6.66	

Sub industry	% of participants	index	Administration	Inventory	Warehousing	Transportation
Machinery	19	0.56	0.73	0.67	0.61	1.96
Process industry	15	0.44	0.57	0.62	0.53	2.12
	34		1.13	0.88	1.45	3.11
Weighted average of manufacturing					6.57	

Appendix 7.2 Canada and USA Industry Classifications

Canada/US 2008, data source: State of Logistics: The Canadian Report 2008 (%of sales)

Sub industry	GDPs	index	CAN	US
Wholesale	CAN = 1499.551	0.09	0.33	0.28
Retail	US = 14441.425	0.91	2.72	2.36
	15940.98		3.05	2.64
Weighted average of wholesale and retail trade				5.69

Sub industry	GDPs	index	CAN	US
Manufacturing	CAN = 1499.551	0.09	0.61	5.23
	US = 14441.425	0.91		
	15940.98		0.61	5.23
Weighted average of manufacturing				5.84

Appendix 7.3 South Africa Industry Classifications

South Africa 2008, data source: The fifth Annual State of Logistics Survey for S-Africa (absolute costs)

Sub industry	Management, Admin	Inventory carrying	Storage and ports	Transportation	
Primary sector	27	17	30	75	
Weighted total of manufacturing (bn. ZAR)					149.00

Sub industry	Management, Admin	Inventory carrying	Storage and ports	Transportation	
Secondary sector	28	17	16	92	
Weighted total of wholesale and trading (bn. ZAR)					153.00

South Africa 2007, data source: The fifth Annual State of Logistics Survey for S-Africa (absolute costs)

Sub industry	Management, Admin	Inventory carrying	Storage and ports	Transportation	
Primary sector	23.50	10.10	21.50	77.60	
Weighted total of manufacturing (bn. ZAR)					132.70

Sub industry	Management, Admin	Inventory carrying	Storage and ports	Transportation	
Secondary sector	24.80	20.30	17.80	77.80	
Weighted total of wholesale and trading (bn. ZAR)					140.70

South Africa 2004, data source: The fifth Annual State of Logistics Survey for S-Africa (absolute costs)

Sub industry	Management, Admin	Inventory carrying	Storage and ports	Transportation	
Primary sector	7	0.60	5	18	
Weighted total of manufacturing (bn. ZAR)					30.60

Sub industry	Management, Admin	Inventory carrying	Storage and ports	Transportation	
Secondary sector	22	2	10	116	
Weighted total of wholesale and trading (bn. ZAR)					150.00

Appendix 7.4 Straube 2008 Industry Classifications

Straube 2008, data source: Trends and strategies in Logistics: Global Networks... (%of total costs)

Sub industry	Total costs	Administration	Warehousing	Transportation	Value-added services	Packaging	total logistics costs as a % of total costs
Trading	0.16	0.02	0.04	0.05	0.02	0.01	0.14
Manufactiring	0.07	0.007	0.009	0.015	0.003	0.004	0.037

Appendix 8.1 Straube 2008 (trading) GLOCS output

YEAR OF THE STUDY			Original scale of measurement SUM % of sales/turnover.									
2008												
			Administration Costs									
CURRENCY OF THE STUDY (if in absolute costs)			2008	0	0	0	0	0	0	0	0	0
eur			4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Other Costs									
SCALE OF MEASUREME			2008	0	0	0	0	0	0	0	0	0
% of sales/turnover			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Operating Costs									
COST COMPONENT	Costs of component		2008	0	0	0	0	0	0	0	0	0
Administration	2	% of sales/turnover	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Warehousing	4	% of sales/turnover										
Transportation	5	% of sales/turnover	Market Costs									
Value added services	2	% of sales/turnover	2008	0	0	0	0	0	0	0	0	0
Transportation packagi	1	% of sales/turnover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8.2 Straube 2008 (manufacturing) GLOCS output

COUNTRY OF STUDY			Original scale of measurement SUM % of sales/turnover.									
DEU												
			Administration Costs									
YEAR OF THE STUDY			2008	0	0	0	0	0	0	0	0	0
2008			1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Other Costs									
CURRENCY OF THE STUDY (if in absolute costs)			2008	0	0	0	0	0	0	0	0	0
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Operating Costs									
SCALE OF MEASUREME			2008	0	0	0	0	0	0	0	0	0
% of sales/turnover			16.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Market Costs									
COST COMPONENT	Costs of component		2008	0	0	0	0	0	0	0	0	0
Administration	0.7	% of sales/turnover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Warehousing	0.9	% of sales/turnover										
Transportation	15	% of sales/turnover										
Value added services	0.3	% of sales/turnover										
Transportation packagi	0.4	% of sales/turnover										

Appendix 8.3 ELA 2008 (trading) GLOCS Output

COUNTRY OF STUDY		Original scale of measurement SUM % of sales/turnover.									
		Administration Costs									
YEAR OF THE STUDY		*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
2008		0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Other Costs									
CURRENCY OF THE STUDY (if in absolute costs)		*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCALE OF MEASUREMENT		Operating Costs									
% of sales/turnover		*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COST COMPONENT	Costs of component	Market Costs									
Administration	0.32 % of sales/turnover	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Warehousing	1.79 % of sales/turnover	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation	3.14 % of sales/turnover										
Inventory Carrying	1.4 % of sales/turnover										

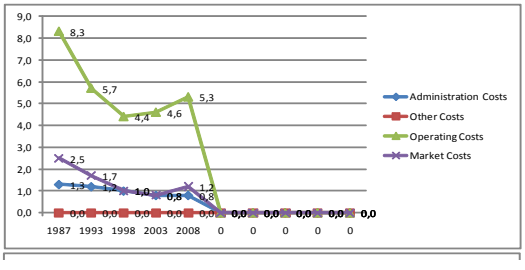
Appendix 8.4 ELA 2008 (manufacturing) GLOCS Output

COUNTRY OF STUDY		Original scale of measurement SUM % of sales/turnover.									
		Administration Costs									
YEAR OF THE STUDY		*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
2008		0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Other Costs									
CURRENCY OF THE STUDY (if in absolute costs)		*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Operating Costs									
SCALE OF MEASUREME		*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
% of sales/turnover		4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Market Costs									
COST COMPONENT	Costs of component	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Administration	0.32 % of sales/turnover	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inventory carrying	1.4 % of sales/turnover										
Warehousing	1.79 % of sales/turnover										
Transportation	3.14 % of sales/turnover										

Appendix 8.5 ELA 1987-2008 GLOCS Output

Original scale of measurement SUM % of sales/turnover.

Administration Costs										
1987	*1993*	*1998*	*2003*	*2008*	*0*	*0*	*0*	*0*	*0*	0
1.3	1.2	1.0	0.8	0.8	0.0	0.0	0.0	0.0	0.0	
Other Costs										
1987	*1993*	*1998*	*2003*	*2008*	*0*	*0*	*0*	*0*	*0*	*0*
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Operating Costs										
1987	*1993*	*1998*	*2003*	*2008*	*0*	*0*	*0*	*0*	*0*	*0*
8.3	5.7	4.4	4.6	5.3	0.0	0.0	0.0	0.0	0.0	
Market Costs										
1987	*1993*	*1998*	*2003*	*2008*	*0*	*0*	*0*	*0*	*0*	*0*
2.5	1.7	1.0	0.8	1.2	0.0	0.0	0.0	0.0	0.0	



Appendix 8.6 Canada 2008 report / USA (retail) GLOCS Output

COUNTRY OF STUDY												
USA			Original scale of measurement SUM % of sales/turnover.									
YEAR OF THE STUDY			Administration Costs									
2008			*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	0
			0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CURRENCY OF THE STUDY (if in absolute costs)			Other Costs									
			2008	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCALE OF MEASUREMENT			Operating Costs									
% of sales/turnover			*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COST COMPONENT	Costs of component		Market Costs									
Internal services	0.8	% of sales/turnover	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Outsourced logistics	1	% of sales/turnover	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inventory carrying	0.8	% of sales/turnover										

Appendix 8.7 Canada 2008 report / USA (manufacturing) GLOCS Output

COUNTRY OF STUDY												
USA			Original scale of measurement SUM % of sales/turnover.									
YEAR OF THE STUDY			Administration Costs									
2008			*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	0
			1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CURRENCY OF THE STUDY (if in absolute costs)			Other Costs									
			2008	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCALE OF MEASUREMENT			Operating Costs									
% of sales/turnover			*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COST COMPONENT	Costs of component		Market Costs									
Internal services	1.2	% of sales/turnover	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Outsourced logistics	3.2	% of sales/turnover	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inventory carrying	1.37	% of sales/turnover										

Appendix 8.8 Canada 2008 report / Canada (retail) GLOCS Output

COUNTRY OF STUDY												
CAN			Original scale of measurement SUM % of sales/turnover.									
YEAR OF THE STUDY			Administration Costs									
2008			*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	0
			1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CURRENCY OF THE STUDY (if in absolute costs)			Other Costs									
			2008	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCALE OF MEASUREMENT			Operating Costs									
% of sales/turnover			*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COST COMPONENT	Costs of component		Market Costs									
Internal services	1.22	% of sales/turnover	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Outsourced logistics	0.65	% of sales/turnover	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inventory carrying	1.5	% of sales/turnover										

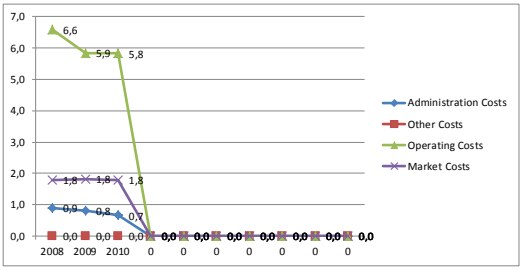
Appendix 8.9 Canada 2008 report / Canada (manufacturing) GLOCS Output

COUNTRY OF STUDY										
CAN		Original scale of measurement SUM % of sales/turnover.								
YEAR OF THE STUDY		Administration Costs								
2008		*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	0
		2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CURRENCY OF THE STUDY (if in absolute costs)		Other Costs									
		2008	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCALE OF MEASUREMENT		Operating Costs									
% of sales/turnover		*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COST COMPONENT	Costs of component	Market Costs									
Internal services	2.68 % of sales/turnover	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Outsourced logistics	2.1 % of sales/turnover	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Inventory carrying	1.71 % of sales/turnover										

Appendix 8.10 Davis database 2008-2010 GLOCS Output

Original scale of measurement SUM % of sales/turnover.

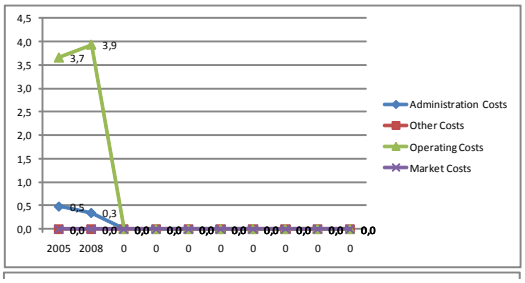
Administration Costs									
2008	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	0
0,9	0,8	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Other Costs									
2008	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Operating Costs									
2008	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
6,6	5,9	5,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Market Costs									
2008	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
1,8	1,8	1,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0



Appendix 8.11 GMA 2005, 2008 GLOCS Output

Original scale of measurement SUM % of sales/turnover.

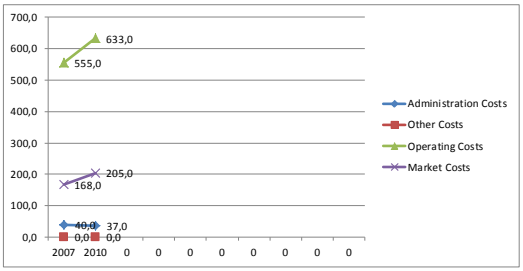
Administration Costs									
2005	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	0
0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Costs									
2005	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs									
2005	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
3.7	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Market Costs									
2005	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



Appendix 8.12 Klaus & Kille 2007 and 2010 GLOCS Output

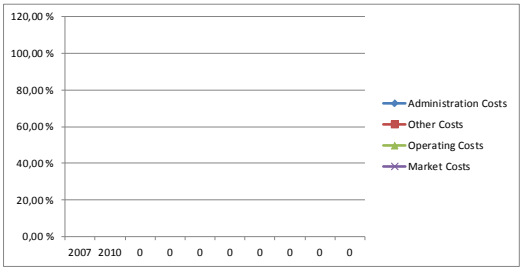
Original scale of measurement **bn. EUR**

Administration Costs									
2007	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
40,0	37,0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs									
2007	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0,0	0,0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs									
2007	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
555,0	633,0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs									
2007	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
168,0	205,0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A



Absolute costs as a % of GDP

Administration Costs									
2007	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs									
2007	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs									
2007	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs									
2007	*2010*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A



Appendix 8.13 South Africa 2004, 2007, 2008 (manufacturing) GLOCS Output

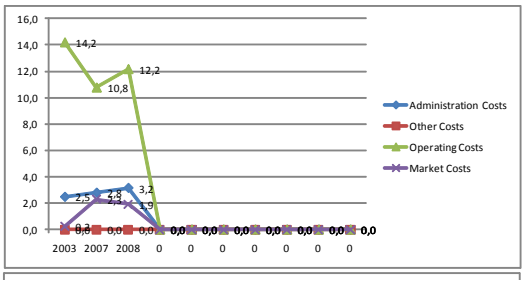
Original scale of measurement	**bn. EUR**

Administration Costs									
2003	*2007*	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0.8	2.6	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Costs									
2003	*2007*	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs									
2003	*2007*	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
2.6	11.2	11.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Market Costs									
2003	*2007*	*2008*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0.1	1.1	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 8.14 South Africa 2004, 2007, 2008 (trading) GLOCS Output

Original scale of measurement bn. EUR

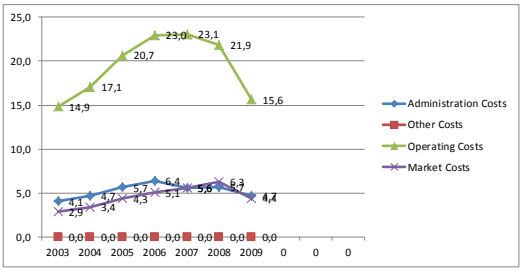
Administration Costs									
2003	2007	2008	0	0	0	0	0	0	0
2.5	2.8	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Costs									
2003	2007	2008	0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs									
2003	2007	2008	0	0	0	0	0	0	0
14.2	10.8	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Market Costs									
2003	2007	2008	0	0	0	0	0	0	0
0.2	2.3	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0



Appendix 8.15 South Africa 2003-2009 (all industries) GLOCS Output

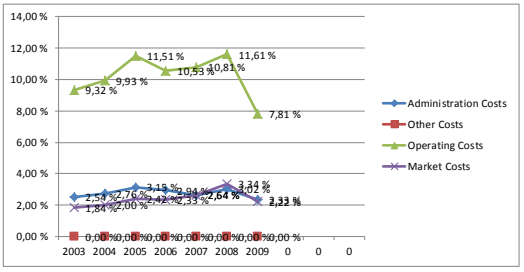
Original scale of measurement bn. EUR

Administration Costs									
2003	2004	2005	2006	2007	2008	2009	0	0	0
4,1	4,7	5,7	6,4	5,6	5,7	4,7	#N/A	#N/A	#N/A
Other Costs									
2003	2004	2005	2006	2007	2008	2009	0	0	0
0,0	0,0	0,0	0,0	0,0	0,0	0,0	#N/A	#N/A	#N/A
Operating Costs									
2003	2004	2005	2006	2007	2008	2009	0	0	0
14,9	17,1	20,7	23,0	23,1	21,9	15,6	#N/A	#N/A	#N/A
Market Costs									
2003	2004	2005	2006	2007	2008	2009	0	0	0
2,9	3,4	4,3	5,1	5,6	6,3	4,4	#N/A	#N/A	#N/A



Absolute costs as a % of GDP

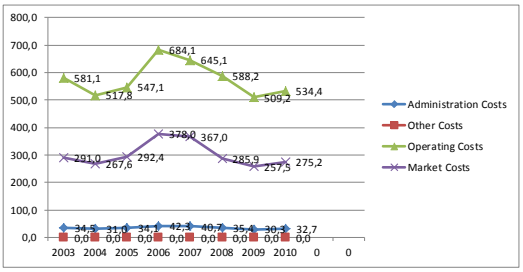
Administration Costs									
2003	2004	2005	2006	2007	2008	2009	0	0	0
2,54 %	2,76 %	3,15 %	2,94 %	2,64 %	3,02 %	2,33 %	#N/A	#N/A	#N/A
Other Costs									
2003	2004	2005	2006	2007	2008	2009	0	0	0
0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	#N/A	#N/A	#N/A
Operating Costs									
2003	2004	2005	2006	2007	2008	2009	0	0	0
9,32 %	9,93 %	11,51 %	10,53 %	10,81 %	11,61 %	7,81 %	#N/A	#N/A	#N/A
Market Costs									
2003	2004	2005	2006	2007	2008	2009	0	0	0
1,84 %	2,00 %	2,42 %	2,33 %	2,64 %	3,34 %	2,22 %	#N/A	#N/A	#N/A



Appendix 8.16 CSCMP 2003-2010 (USA) GLOCS Output

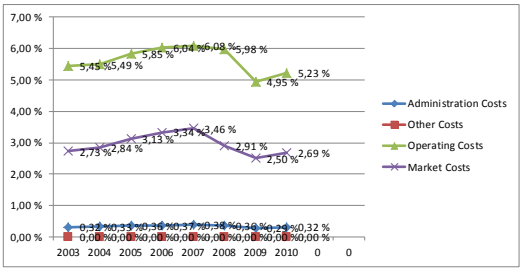
Original scale of measurement bn. EUR

Administration Costs										
2003	2004	2005	2006	2007	2008	2009	2010	0	0
34,5	31,0	34,1	42,3	40,7	35,4	30,3	32,7	#N/A	#N/A
Other Costs									
2003	2004	2005	2006	2007	2008	2009	2010	0	0
0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	#N/A	#N/A
Operating Costs									
2003	2004	2005	2006	2007	2008	2009	2010	0	0
581,1	517,8	547,1	684,1	645,1	588,2	509,2	534,4	#N/A	#N/A
Market Costs									
2003	2004	2005	2006	2007	2008	2009	2010	0	0
291,0	267,6	292,4	378,0	367,0	285,9	257,5	275,2	#N/A	#N/A



Absolute costs as a % of GDP

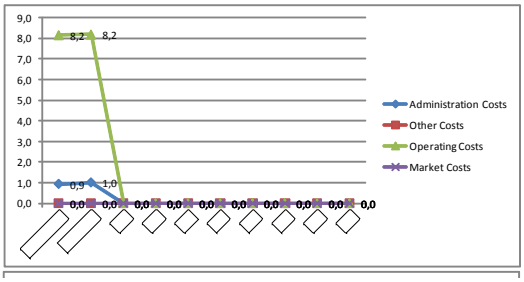
Administration Costs										
2003	2004	2005	2006	2007	2008	2009	2010	0	0
0,32 %	0,33 %	0,36 %	0,37 %	0,38 %	0,36 %	0,29 %	0,32 %	#N/A	#N/A
Other Costs									
2003	2004	2005	2006	2007	2008	2009	2010	0	0
0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	#N/A	#N/A
Operating Costs									
2003	2004	2005	2006	2007	2008	2009	2010	0	0
5,45 %	5,49 %	5,85 %	6,04 %	6,08 %	5,98 %	4,95 %	5,23 %	#N/A	#N/A
Market Costs									
2003	2004	2005	2006	2007	2008	2009	2010	0	0
2,73 %	2,84 %	3,13 %	3,34 %	3,46 %	2,91 %	2,50 %	2,69 %	#N/A	#N/A



Appendix 8.17 TF 2001 (NOR) GLOCS Output

Original scale of measurement **% of sales/turnover**

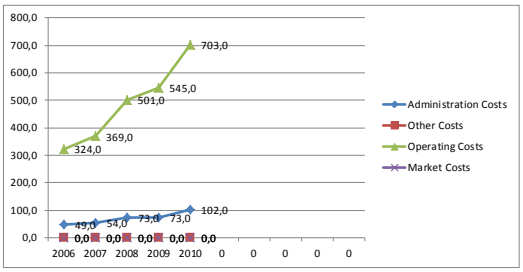
Administration Costs									
manufac	*trading*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0.9	1.0								
Other Costs									
manufac	*trading*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Operating Costs									
manufac	*trading*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
8.2	8.2								
Market Costs									
manufac	*trading*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*



Appendix 8.18 China (CFLP) 2005-2010 GLOCS Output

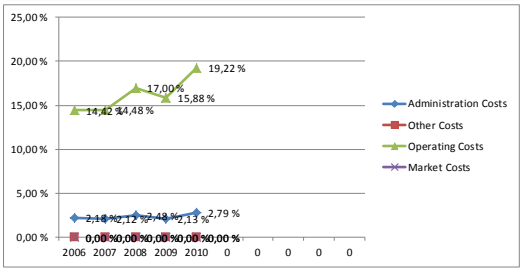
Original scale of measurement **bn. EUR**

Administration Costs									
2006	*2007*	*2008*	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*
49,0	54,0	73,0	73,0	102,0	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs									
2006	*2007*	*2008*	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*
0,0	0,0	0,0	0,0	0,0	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs									
2006	*2007*	*2008*	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*
324,0	369,0	501,0	545,0	703,0	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs									
2006	*2007*	*2008*	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*
0,0	0,0	0,0	0,0	0,0	#N/A	#N/A	#N/A	#N/A	#N/A



Absolute costs as a % of GDP

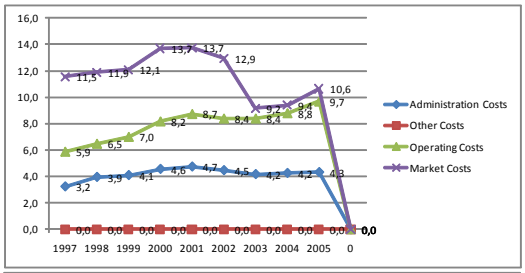
Administration Costs									
2006	*2007*	*2008*	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*
2,18 %	2,12 %	2,48 %	2,13 %	2,79 %	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs									
2006	*2007*	*2008*	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*
0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs									
2006	*2007*	*2008*	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*
14,42 %	14,48 %	17,00 %	15,88 %	19,22 %	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs									
2006	*2007*	*2008*	*2009*	*2010*	*0*	*0*	*0*	*0*	*0*
0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	#N/A	#N/A	#N/A	#N/A	#N/A



Appendix 8.19 Vinnova (SWE) 1997-2005 GLOCS Output

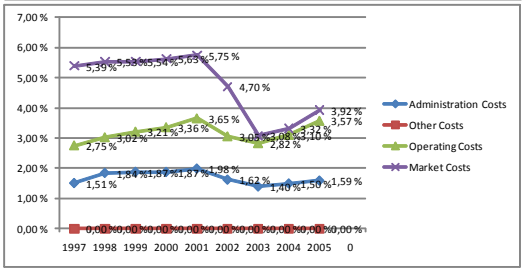
Original scale of measurement **bn. EUR**

Administration Costs									
1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*0*
3.2	3.9	4.1	4.6	4.7	4.5	4.2	4.2	4.3	0.0
Other Costs									
1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*0*
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs									
1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*0*
5.9	6.5	7.0	8.2	8.7	8.4	8.4	8.8	9.7	0.0
Market Costs									
1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*0*
11.5	11.9	12.1	13.7	13.7	12.9	9.2	9.4	10.6	0.0



Absolute costs as a % of GDP

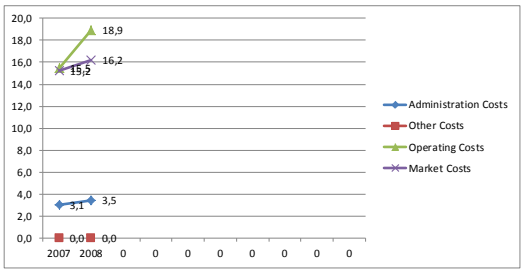
Administration Costs									
1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*0*
1.51 %	1.84 %	1.87 %	1.87 %	1.98 %	1.62 %	1.40 %	1.50 %	1.59 %	#N/A
Other Costs									
1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*0*
0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	#N/A
Operating Costs									
1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*0*
2.75 %	3.02 %	3.21 %	3.36 %	3.65 %	3.05 %	2.82 %	3.10 %	3.57 %	#N/A
Market Costs									
1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*0*
5.39 %	5.53 %	5.54 %	5.63 %	5.75 %	4.70 %	3.08 %	3.32 %	3.92 %	#N/A



Appendix 8.20 Thailand 2007-2008 GLOCS Output

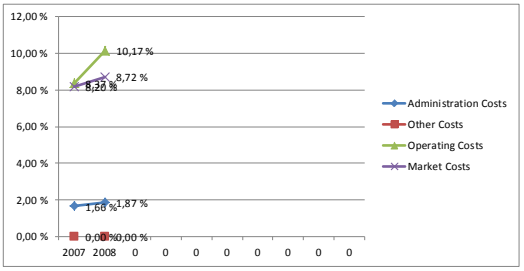
Original scale of measurement bn. EUR

Administration Costs										
2007	2008	0	0	0	0	0	0	0	0	0
3,1	3,5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs										
2007	2008	0	0	0	0	0	0	0	0	0
0,0	0,0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs										
2007	2008	0	0	0	0	0	0	0	0	0
15,5	18,9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs										
2007	2008	0	0	0	0	0	0	0	0	0
15,2	16,2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A



Absolute costs as a % of GDP

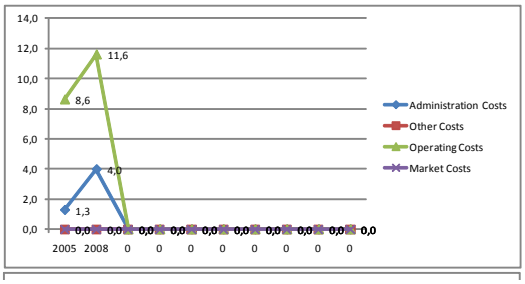
Administration Costs										
2007	2008	0	0	0	0	0	0	0	0	0
1,66 %	1,87 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs										
2007	2008	0	0	0	0	0	0	0	0	0
0,00 %	0,00 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs										
2007	2008	0	0	0	0	0	0	0	0	0
8,37 %	10,17 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs										
2007	2008	0	0	0	0	0	0	0	0	0
8,20 %	8,72 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A



Appendix 8.21 France 2005 & 2008 GLOCS Output

Original scale of measurement SUM % of sales/turnover.

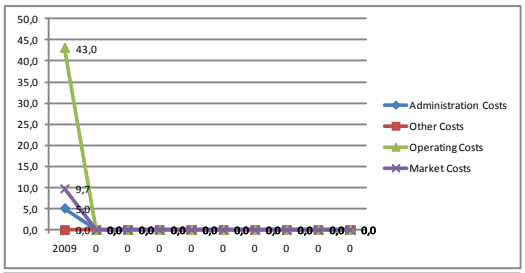
Administration Costs										
2005	2008	0	0	0	0	0	0	0	0	0
1.3	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Costs										
2005	2008	0	0	0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs										
2005	2008	0	0	0	0	0	0	0	0	0
8.6	11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Market Costs										
2005	2008	0	0	0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



Appendix 8.22 Netherlands 2009 GLOCS Output

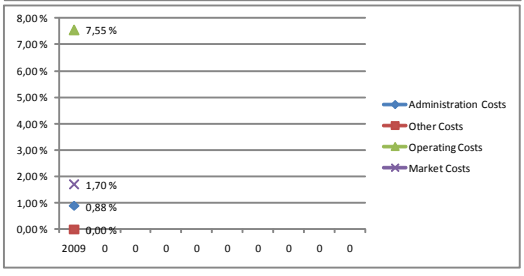
Original scale of measurement bn. EUR

Administration Costs										
2009	0	0	0	0	0	0	0	0	0	0
5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Costs										
2009	0	0	0	0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs										
2009	0	0	0	0	0	0	0	0	0	0
43.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Market Costs										
2009	0	0	0	0	0	0	0	0	0	0
9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



Absolute costs as a % of GDP

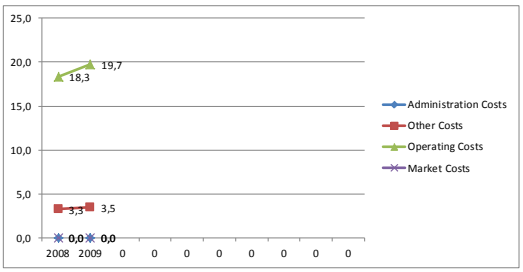
Administration Costs										
2009	0	0	0	0	0	0	0	0	0	0
0.88 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs										
2009	0	0	0	0	0	0	0	0	0	0
0.00 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs										
2009	0	0	0	0	0	0	0	0	0	0
7.55 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs										
2009	0	0	0	0	0	0	0	0	0	0
1.70 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A



Appendix 8.23 Switzerland 2008-2009 GLOCS Output

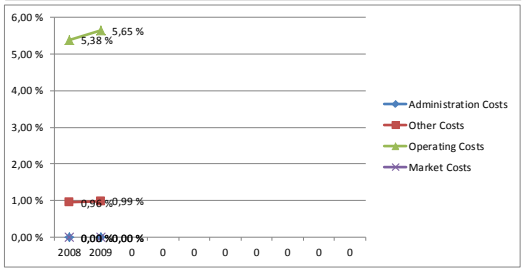
Original scale of measurement **bn. EUR**

Administration Costs									
2008	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0,0	0,0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs									
2008	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
3,3	3,5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs									
2008	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
18,3	19,7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs									
2008	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0,0	0,0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A



Absolute costs as a % of GDP

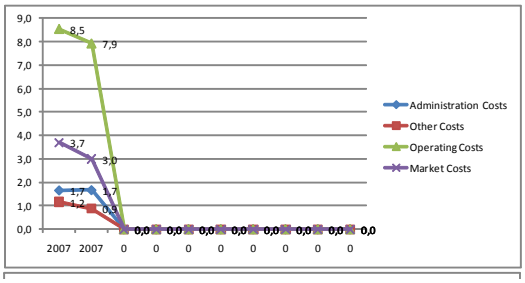
Administration Costs									
2008	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0,00 %	0,00 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs									
2008	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0,96 %	0,99 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs									
2008	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
5,38 %	5,65 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs									
2008	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0,00 %	0,00 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A



Appendix 8.24 LogOn Baltic 2007 GLOCS Output

Original scale of measurement **SUM % of sales/turnover.**

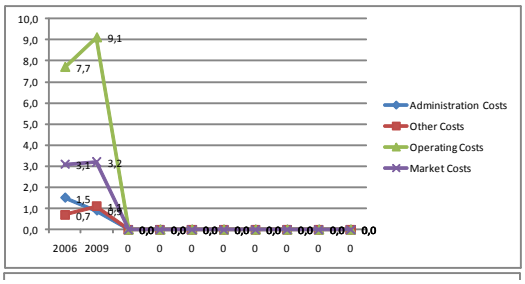
Administration Costs									
2007	*2007*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
1.7	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Costs									
2007	*2007*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
1.2	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs									
2007	*2007*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
8.5	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Market Costs									
2007	*2007*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
3.7	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



Appendix 8.25 Finland State of Logistics 2006, 2009 GLOCS Output

Original scale of measurement **SUM % of sales/turnover.**

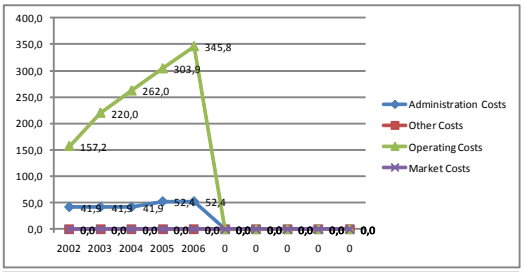
Administration Costs									
2006	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
1.5	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Costs									
2006	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
0.7	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs									
2006	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
7.7	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Market Costs									
2006	*2009*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
3.1	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



Appendix 8.26 China (KPMG) 2008 GLOCS Output

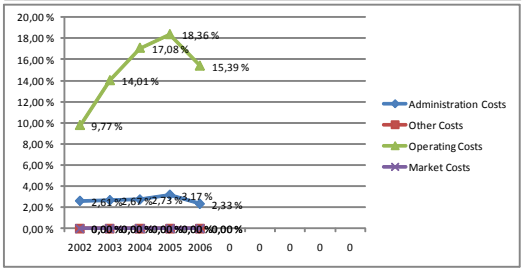
Original scale of measurement bn. EUR

Administration Costs									
2002	2003	2004	2005	2006	0	0	0	0	0
41.9	41.9	41.9	52.4	52.4	0.0	0.0	0.0	0.0	0.0
Other Costs									
2002	2003	2004	2005	2006	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs									
2002	2003	2004	2005	2006	0	0	0	0	0
157.2	220.0	262.0	303.9	345.8	0.0	0.0	0.0	0.0	0.0
Market Costs									
2002	2003	2004	2005	2006	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



Absolute costs as a % of GDP

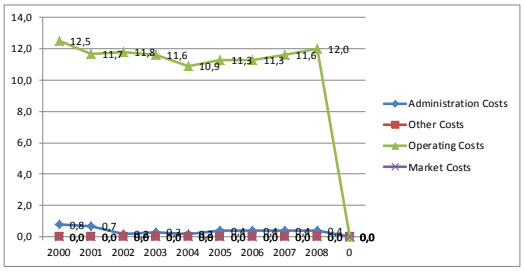
Administration Costs									
2002	2003	2004	2005	2006	0	0	0	0	0
2.61 %	2.67 %	2.73 %	3.17 %	2.33 %	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs									
2002	2003	2004	2005	2006	0	0	0	0	0
0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs									
2002	2003	2004	2005	2006	0	0	0	0	0
9.77 %	14.01 %	17.08 %	18.36 %	15.39 %	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs									
2002	2003	2004	2005	2006	0	0	0	0	0
0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	#N/A	#N/A	#N/A	#N/A	#N/A



Appendix 8.27 Korea 2000-2008 GLOCS Output

Original scale of measurement % of GDP

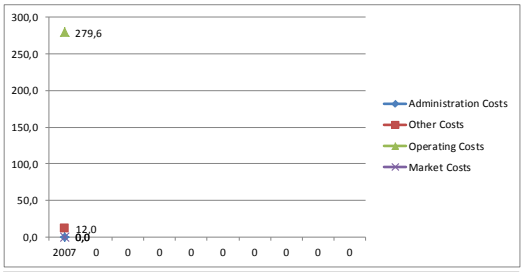
Administration Costs									
2000	2001	2002	2003	2004	2005	2006	2007	2008	0
0,8	0,7	0,2	0,3	0,2	0,4	0,4	0,4	0,4	0,0
Other Costs									
2000	2001	2002	2003	2004	2005	2006	2007	2008	0
0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Operating Costs									
2000	2001	2002	2003	2004	2005	2006	2007	2008	0
12,5	11,7	11,8	11,6	10,9	11,3	11,3	11,6	12,0	0,0
Market Costs									
2000	2001	2002	2003	2004	2005	2006	2007	2008	0
0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0



Appendix 8.28 Japan 2007 GLOCS Output

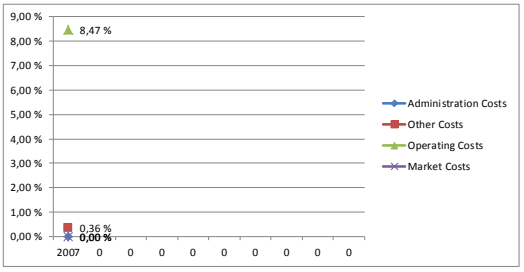
Original scale of measurement bn. EUR

Administration Costs									
2007	0	0	0	0	0	0	0	0	0
0,0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs									
2007	0	0	0	0	0	0	0	0	0
12,0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs									
2007	0	0	0	0	0	0	0	0	0
279,6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs									
2007	0	0	0	0	0	0	0	0	0
0,0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A



Absolute costs as a % of GDP

Administration Costs									
2007	0	0	0	0	0	0	0	0	0
0,00 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Other Costs									
2007	0	0	0	0	0	0	0	0	0
0,36 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Operating Costs									
2007	0	0	0	0	0	0	0	0	0
8,47 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Market Costs									
2007	0	0	0	0	0	0	0	0	0
0,00 %	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A



Appendix 8.29 Cost components in literature and scientific articles combined

	Literature								Articles								
Publication (Year)	Bidgoli 2010	Sople 2007	Ayers 2006	Lambert 2006	Rushton 2006	Kivinen 2004	Coyle 1998	Dimitrov 1991	Banomyong	Creazza 2010	Choi 2009	Jensen 2007	Dianwei 2006	Bowersox 2005	Zeng 2003	Bjørnland 2001	NOU 1988
Transportation costs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
Inventory carrying costs	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓			✓		
Warehousing costs	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓			✓		✓
Packaging costs			✓		✓	✓	✓		✓						✓		
Administration costs					✓		✓				✓	✓			✓		
Customer service				✓		✓			✓								
Risk and damage																✓	✓
Insurance																✓	✓
Tied capital costs																✓	✓
Order processing/information	✓			✓					✓	✓							
Associated labor			✓														
Capital costs of goods in transit	✓																
Communication								✓									
Consultancy						✓											
Cost of damage during transit	✓																
Fixed costs							✓										
Logistics technology						✓											
Lot quantity				✓													
Manufacturing						✓											
Procurement						✓											
Purchased materials			✓														
Quality control						✓											
Recycling logistics						✓											
Reverse logistics						✓											
Stock-out costs	✓																
Trade costs								✓									
Value-added services						✓											
Cost of commodities space movement													✓				
Customs															✓		
Design, restructure and option cost													✓				
Forecasting									✓								
Handling										✓							
Indirect logistics costs												✓					
Other costs													✓				
Permission losses													✓				
Procurement									✓								
Substance consumption													✓				
Returned goods									✓								
Wages, bonus, allowance													✓				

Appendix 8.30 Cost components in statistics-based studies

Study (year of publication)	S- Africa (2011)	CSCMP (2011)	CFLP (2011)	Switzerland (2011)	Korea (2010)	Netherlands (2009)	Thailand (2009)	Canada (2008)	KPMG (2008)	Klaus (2010)	Morocco (2006)	Vinnova (2005)	COUNT
Scope (Multi/Single country)	S	S	S	S	S	S	S	M	S	M	S	S	
Cost components													
Transportation	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	11
Administration	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	10
Inventory-carrying	✓	✓			✓	✓	✓	✓		✓	✓	✓	9
Warehousing	✓			✓		✓			✓	✓	✓	✓	7
Cargo handling				✓	✓						✓		3
Transport pack.			✓		✓						✓		3
Communication											✓		1
Customer service											✓		1
Documentation											✓		1
Equipment											✓		1
Information					✓								1
Insurance											✓		1
Internal logistics costs								✓					1
Internal services											✓		1
Obsolescence											✓		1
Outsourced logistics costs								✓					1
Order processing										✓			1
Other logistics				✓									1
Plan/management						✓							1
R&D											✓		1
Shipper related		✓											1
Industry classification													
Manufacturing								6.13					
Trade								3.13					
Total costs	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
Time series (publications)													
-1990		✓											
1991-1995		✓											
1996-2000		✓											
2001-2005	✓	✓											
2006	✓	✓	✓					✓			✓		
2007	✓	✓	✓			✓	✓			✓			
2008	✓	✓	✓				✓	✓	✓			✓	
2009	✓	✓	✓	✓		✓	✓						
2010	✓	✓	✓		✓								
2011	✓	✓	✓	✓						✓			
Scale of measurement and logistics costs in the most recent study													
% of sales/turnover				3.6				✓					
% of GDP	13.5	8.3	17.8	6.5	12.5		18.6		18		20	9.08	
Absolute costs (bn EUR)	36.5	828	805	28,7	69.9	46	42.3		370	930		25.7	
Recent trend													
Expectations in future cost level.													
Area covered	S-A	US	CHI	SWI	KOR	NET	THA	CAN /US	CHI	EU	MO R	SWE	

Appendix 8.31 Summary of questionnaire-based surveys

Study (year of publication)	SCI (2011)	Davis (2010)	Finland (2010)	GMA (2010)	TÖI (2010)	ELA (2009)	Norway (2009)	Aslog (2009)	Straube (2008)	Colombia (2008)	PwC (2008)	Japan (2007)	Baltic (2007)	TF 2003 (ind.)	TF 2003 (ret.)	COUNT
Scope (Multi/Single country)	S	M	S	M	S	M	S	S	M	S	S	S	M	S	S	
Cost components																
Transportation		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	12
Warehousing		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	12
Administration		✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	11
Inventory carrying		✓	✓			✓	✓		✓				✓	✓		7
Other logistics			✓	✓								✓	✓	✓		5
Transport pack.			✓		✓		✓									3
Insurance					✓						✓					2
Obsolescence					✓		✓									2
Customer serv./order entry		✓							✓							2
Appraisal											✓					1
Cost of capital					✓											1
Customs											✓					1
Damages											✓					1
Depreciation							✓									1
Delivery											✓					1
Distribution centers				✓												1
Management/overhead				✓												1
Other indirect log. costs							✓									1
Shipper related											✓					1
Industry classification																
Manufacturing			✓	✓	✓				7	✓	✓		15.3	✓	✓	
Trade			✓		✓				15.9	✓			13.7			
Total costs	✓	✓	✓		✓	✓	✓	✓		✓			✓			
Time series (year of publication)																
-1990		✓	✓													
1991-1995		✓	✓									✓				
1996-2000		✓										✓				
2001-2005	✓	✓	✓	✓		✓	✓					✓		✓	✓	
2006	✓	✓	✓					✓				✓				
2007	✓	✓				✓	✓					✓	✓			
2008	✓	✓		✓					✓	✓	✓					
2009	✓	✓	✓			✓	✓	✓								
2010	✓	✓	✓	✓	✓											
2011	✓	✓														
Scale of measurement and logistics costs in the most recent study																
% of sales/turnover		8.3	11.9	6.75	14.2	6.1	✓	11.9		12.5			14.5	9.1	9.2	
% of GDP			8.7		14.7				✓			8.9				
Absolute costs (bn. euro)			25.4		32							279		28.8		
% of procurement											✓					
Recent trend	⇄	○	○	⇄		●	●		○			●	●	○		
Expected direction	⇄		●			●			●							
Area covered	DE	Glo	FI	Glo	NO	EU	NO	FRA	EU/US/CHI	CO	CHI	JPN	BSR	NO	NO	

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