

Transport Management from a Shipper's Perspective

Utilizing the Analytical Hierarchy Process to assess the shipper's transport outsourcing decision

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Summary

Research context

Shippers have to manage their transport processes. Outsourcing or providing these transport process in-house is one of the considerations in transport management. There is a lot of literature available about the shipper's transport outsourcing decision. Which specific transport processes are outsourced is less visible. Documented information about the reasons, arguments and drivers behind the transport outsourcing decision, or underlying factors as these reasons will be referred to in this report, is very limited.

Objective of the Research

The objective of this research is twofold. The first place there is an academic purpose; a contribution is made towards the literature regarding the theory about outsourcing transport processes from the perspective of the shipper. Insight is provided in the factors and the importance of these factors in the shippers outsourcing decision. The extent of outsourcing transport processes has been determined and insight is provided in the need for information about (outsourced) transport processes.

The second objective is of a more commercial nature, namely to make a contribution to knowledge about possible clients of Capgemini. This research provides knowledge about the underlying factors that determine the extent to which shippers outsource their transport planning and execution. Additionally knowledge has been provided about the need for information about the transport processes. This knowledge may be used in the business analysis and acquisition of new projects within the field of transportation management for Capgemini. Finally, the results of this research are a valuable contribution to Capgemini's annual *3PL Study* and this research can lead to new insights in the *TMS for shippers* research.

Research question

To meet the research objective the following main research question is formulated:

What are the factors that determine the shippers decision on outsourcing transport processes in the various market sectors in The Netherlands, what is the extent of transport outsourcing and what is the need for information about (outsourced) transport processes?

Research methodology

Literature study was conducted to identify factors that are related to the transport outsourcing decision. The Analytical Hierarchy Process (AHP) is proposed as the method to find out the importance of the factors and extent of outsourced transport processes. The AHP is a multi-criteria decision making method in which the factors that influence the decision are arranged in a hierarchical structure (Saaty 1990). By applying the AHP the weight of the factors in the outsourcing decision can be determined and it provides insight into which of the transport processes are outsourced and which are provided in-house. Interviews in combination with a questionnaire have been used to gather data for the AHP.

Selection of market sectors

This study could not be conducted for all seven market sectors that are interesting for Capgemini: automotive, high-tech products, chemicals, oil & gas, retail, wholesale and pharmaceuticals. These market sectors all have their own typical supply chain and supply chain participants. The different characteristics of the market sectors possibly result in different factors and different importance of the factors that influence the outsourcing decision. Contrary, in similar market sectors probably the same factors that influence the outsourcing decision.

The market sectors chemicals and high-tech have been selected for in-depth study in this research. The selection was based upon two criteria, the availability and access to knowledge in the sector and the market sector characteristics.

Results chemical market sector

For the chemicals sector it is concluded that not one factor is most important or decisive for the entire sector. In the three chemical companies that were subject for the chemicals case study profit, service quality, business performance and 3PL capabilities were factors that were important in the various cases. Legal issues and monitoring, information and traceability were least decisive. These factors are considered to be a prerequisite and not factors in the transport outsourcing decision.

With respect to the overall evaluation of the transport processes, or extent of outsourcing, it can be concluded that there is not one preferred extent of outsourcing transport processes. Furthermore the importance of the factors on which the extent of transport outsourcing is based varies per chemical company.

Chemical companies that leave the transportation of the goods to the customer do not need any information about the transport processes. It is known which goods are loaded, which quantities and when. They do not need any further information as that is simply an issue between the customer and their third party logistic service provider (3PL). Companies that are their selves responsible for the transport of their products to the customer do however need information about the transport processes. They want to know when goods are delivered, furthermore they need to know when goods are delayed or damaged. This would be presented in a so called 'exception report' by the 3PL. During the interviews it was indicated that this information was not always received from the 3PL.

Results high tech market sector

For the high-tech sector it is concluded that the factors in the outsourcing decision are quite comparable throughout the companies that were studied. It can be said that the factors profit, business performance, service quality are of importance in the transport outsourcing decision. The other factors 3PL capabilities, monitoring and legal issues are of less importance. A 3PL should have the right capabilities to be selected as supplier and the 3PL should provide transparency and visibility in the transport process. That makes these factors criteria for supplier selection. Compliance with the rules and regulations is a basic requirement and not a reason to outsource transport processes.

Based on the evaluations of the transport processes it can be concluded that transport execution processes are outsourced. Additionally a part of the transport planning processes is outsourced. The underlying factors in this outcome are mostly profit, business performance, service quality and 3PL capabilities factors.

Information and control over the transport process is seen as necessary and the shippers that were studied all had a Transport Management System (TMS) installed. Shippers need information about all the standard events in the supply chain. (I.e. when the goods are loaded, when the goods pass a hub in the network and when the goods are delivered to the customer.) This information should be uploaded in the TMS by the carriers and warehousing providers. Information about exceptional events, such as delayed or damaged goods, needs to be communicated in a pro-active manner besides having this information in the TMS.

Factor weights market sectors

The factor weights in the outsourcing decision in the chemicals and high-tech sector are presented in the table below. The weight of the factors varies between 0 and 1, values close to one indicate high importance of the factor and values close to zero indicate low importance of the factor.

Factor \ Company	Chem A	Chem B	Chem C	HT A P*	HT A E*	HT B	HT C	HT D	HT E
Profit	0,02	0,20	0,52	0,11	0,37	0,06	0,24	0,29	0,11
Business performance	0,27	0,10	0,14	0,37	0,17	0,11	0,21	0,29	0,37
Service quality	0,12	0,43	0,14	0,16	0,10	0,19	0,30	0,19	0,16
3PL capabilities	0,29	0,20	0,14	0,06	0,26	0,08	0,13	0,14	0,06
Monitoring, traceability, information	0,16	0,03	0,03	0,26	0,06	0,05	0,09	0,07	0,26
Legal issues	0,13	0,03	0,03	0,04	0,03	0,51	0,03	0,02	0,04
The highest factor weights are printed in bold Chem A, B, C = Chemical company A, B, C HT A, B, C, D = High-tech company A, B, C, D *At high-tech company A outsourcing transport planning (P) and outsourcing transport execution (E) are assessed separately									

Recommendations

The results of the chemical and high-tech market sector provided the answer to the main research question. The weight of the factors in the transport outsourcing decision is known and the extent in which transport processes are outsourced is determined. There are however possibilities to extra research and suggestions to improve further studies.

Firstly, it is recommended to conduct more interviews in the sectors that were studied in order to provide more general applicable results. Secondly, in order to create a complete overview of outsourcing transport processes in the market, it is advised to conduct this study in the automotive, oil & gas, retail, wholesale and pharmaceuticals sectors. Thirdly, it is recommended to add more detail in the decomposition of the transport process that is used to determine the extent of outsourcing. This will improve the applicability of the results. Finally, it is recommended to use more supply chain characteristics in the selection of the market sectors. This will improve the understanding of the market and it will provide more possibilities to generalize the results.

Preface

Monday September 3 in 2001 I started the five year program 'Technische Bestuurskunde' at Delft University of Technology. That was the first day of what appeared to be a great period of fun and personal development.

In the meantime 'Technische Bestuurskunde' was split in an bachelor and master program. This report is the concluding assignment of the master study System Engineering, Policy Analysis and Management at faculty of Technology, Policy and Management at Delft University of Technology. The research project is conducted at Capgemini in Utrecht, The Netherlands.

In this thesis report I studied the factors that influence the shippers decision on outsourcing transport processes. Thereby the Analytical Hierarchy Process is used to establish the weight of the factors in the transport outsourcing decision and to determine the extent of outsourcing transport processes.

This report is not the result of pure individual and isolated work, the contrary is true, many helped and supported me during the project. At this place I would like to take the opportunity to thank those people.

First of all I would like to thank Pino Melis and Dennis Wereldsma. They gave me the opportunity to work on my thesis project at Capgemini and they provided the first idea for the research. Furthermore they supported me during the entire project with substantial as well as practical information.

Secondly much gratitude is owed to my TU Delft supervisors. I would like to thank Alexander Verbraeck for his involvement and input during the four milestone meetings of the research project. But also for the time he took to provide me personally with feedback on Capgemini's first assignment, that was on 'Koninginnenach' at about 7 pm.

Furthermore I owe much thanks to Joseph Barjis for the academic and moral support throughout the entire project. Our first meeting was in the in the first week of his TU Delft assignment and from that day onward he was always available to talk and think about the research project. His unbiased view towards the project enabled me to take a step back and make the right decisions for the project.

And I would like to say thanks to Ron van Duin for finding the time in his schedule to help me with the project. His critical view towards the research improved the work significantly.

Without mentioning their full names I would like to thank several Capgemini account managers that established the first contact with respondents in the market. Without their effort I would not be able to find the supply chain managers with European or Global responsibilities that were needed for the study.

This is also the place to thank all the respondents that took the time and effort to be interviewed about outsourcing transport processes at their company. Without these interviews I could not create the market specific views on outsourcing transport processes.

Last, but certainly not least, I would like to thank my parents, family and friends. Not only for their support during the thesis project but also for their support during my entire study.

The preface will end here, nevertheless the fun will continue in the next 152 pages.

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1 Introduction

In this first chapter an introduction to the research context will be provided. The research problem that initiates this research will be described in section 1.2. From the research problem the main research question and sub-questions will be derived in section 1.3. In section 1.4 the objectives for the research are stated. The research methodology that will be used will be briefly mentioned in section 1.5. Finally in section 1.6 the structure of the report is presented.

1.1 Research context

In the market there is an ever present force for shippers to perform better than their competitors. To outperform other companies, shippers can improve many of their business processes. Transport processes are one of the business processes that can be optimized. The decision to outsource transport processes or to provide these process in-house can be one of the considerations to improve business performance.

From this point of view it became clear that there is lack of information about the factors that influence the shippers decision on whether or not to outsource transport processes. This outsourcing decision will be assessed in this research. At Capgemini this research contributes to the information about possible clients. Furthermore this study is a contribution to Capgemini's 3PL study and TMS for shippers research.

1.2 Research problem

There is limited information about a shippers choice regarding transport outsourcing. The information is limited to what is visible outside. One can literally see if a shipper provides in its own transportation or if third parties provide in the shippers transport services. In some cases the shippers partners are mentioned on their websites or can be found in annual reports.

Which specific transport processes are outsourced is even less visible. This information is in most cases not available on shippers websites or in their annual report. About the reasons, arguments and drivers behind the outsourcing decision, or underlying factors as these reasons are called in this report, is even less information available.

The lack of information or knowledge gap about the shippers transport outsourcing decision is subject of this research. More specific, the factors that are of influence in the shippers transport outsourcing decision are not known. The weight of these factor in the shippers outsourcing decision is unknown. Thirdly, information about which of the different transport processes is outsourced and which of these processes are provided in house is not available. Finally, the need for information about (outsourced) transport processes is not known.

This research will provide knowledge about the information gaps described above. First factors that influence the outsourcing decision and their weight in the decision will be determined. Secondly, the extent in which transport processes are outsourced will be studied. Finally the need for information about (outsourced) transport processes will be assessed.

1.3 Research questions

In the previous section the problem is stated. This section deals with the formulation of the main research question and the sub-questions. The main question is broken down into several sub-questions all cover a specific aspect of the main question.

1.3.1 Main research question

The main research question is formulated as follows:

What are the factors that determine the shippers decision on outsourcing transport processes in the various market sectors in The Netherlands, what is the extent of transport outsourcing and what is the need for information about (outsourced) transport processes?

When this main research question is answered the information gaps that were mentioned in the previous section will be resolved.

1.3.2 Sub-questions

To answer this research question sub-questions are drawn up to clarify the different aspects of the main question. The questions will be answered in the subsequent chapters of the report.

1. What are the main concepts in transport management and which parties are involved in the transport outsourcing decision?

This first sub-question gives insight in the definitions and concepts that will be used throughout the thesis. When this question is answered the stakeholders that influence the shipper's transport outsourcing decision are known. From this question follows the question about what transport processes exactly are and how these processes are related.

2. Which sub-processes can be identified in the overall 'transport process' and what is the relation between these sub-processes.

The second sub-question provides insight in what is exactly meant with the term transport process in this study. The sub-processes will be identified and the relation between those sub-processes will be clarified. The identification of these sub-processes is relevant since that makes it possible to determine which processes will be outsourced or not.

3. What are the characteristics of the seven market sectors that are interesting for Capgemini and how can two market sectors for further in-depth analysis be selected.

Sub-questions 3 provides insight in the seven market sectors in which Capgemini is active in. Not all these market sectors can be studied in-depth given the limited time for this research so a choice for two sectors has to be made. The result of questions three is an overview of the various market sectors and the criteria to characterize the market sectors. Based on this model a choice can be made for the two sectors that will be the subject of this research. Later the model can be used to assess the applicability of the findings in other five sectors according to similar scores on the various criteria.

4. What are the factors originated at the shipper and the other stakeholders that influence the shipper's outsourcing decision?

From question 4 the various factors that are of importance in the outsourcing decision for shippers are known. Probably not all these factors are of equal importance, therefore the weight of these factors in the transport outsourcing decision has to be determined.

5. Which method can be used to determine the weight of the factors in the outsourcing decision and to find out the extent of outsourcing?
6. What is the research setup and how can Capgemini conduct research to the shipper's outsourcing decision in the five not selected market sectors?

The result of sub-questions 5 and 6 are methodologies that can be used to determine the importance of the factors in various market sectors.

When these six sub-questions are answered then all the information to answer the main research question for two market sectors is known. Then conclusions can be drawn for the scope that is defined at the start of the research. The last sub-question is included to find out if the results are applicable in other situations.

7. Can the findings for the two market sectors be applied to the five other market sectors or to other processes than transport processes?

1.4 Objective of the research

In this report the factors and the weight of these factors in the shipper's transport outsourcing decision will be studied. Furthermore the extent in which transport processes are outsourced is subject of this research.

The objective of this research is twofold. The first place there is an academic purpose; a contribution is made towards the literature regarding the theory about outsourcing transport processes from the perspective of the shipper. Insight is provided in the factors and the importance of the factors in the shippers outsourcing decision. In addition insight is given in which transport processes are outsourced and which transport processes are carried out by the shipper itself, this is the extent of outsourcing transport processes. Finally, the shipper's need for information about (outsourced) transport processes is revealed.

The second objective is a more commercial one, namely to make a contribution to knowledge about possible clients of Capgemini. This research provides knowledge about the underlying factors that determine the extent in which shippers outsource transport planning and execution. Knowledge is provided about the shipper's need for information about (outsourced) transport processes. This knowledge may be used in the business analysis and acquisition of new projects within the field of transportation management for Capgemini. Furthermore, the results of this research are a valuable contribution to Capgemini's annual *3PL Study* and the research may lead to new insights in the *TMS for shippers* research.

Not all market sectors that are interesting for Capgemini can be studied in this research. Therefore it is also the objective to provide Capgemini with structured approach that can be used to conduct this study in other market sectors than the two sectors that will be studied in this report.

1.5 Research approach

From the research questions and the objective of the research it has become clear that the factors that determine the outsourcing decision and the extent in which these processes are outsourced are key in this research. To determine the which transport processes are outsourced the factors have to be linked to various transport outsourcing alternatives.

The research starts with the identification of the factors that are positively or negatively related to the transport outsourcing decision. Additionally the various transport processes will be identified and their relations will be decomposed. Literature study is the method that will be used. Both the factors and the transport processes are input for the next step in the research.

Subsequently the Analytical Hierarchy Process (AHP) is applied as the method to find out the importance of the factors and the relation of those factors to the outsourced transport processes. The AHP is a multi-criteria decision making method in which the factors that influence the decision are arranged in a hierarchical structure (Saaty 1990). The hierarchy has the overall goal of the decision problem on top and descends via criteria, sub-criteria to the alternatives in successive levels.

By applying the AHP the weight of the factors in the outsourcing decision can be determined and it provides insight in which of the transport processes are outsourced and which are provided in-house.

Interviews in combination with a questionnaire will be used to gather data for the Analytical Hierarchy Process. The respondents, experts in the field of transport management or supply chain management, will first answer a series of open questions. Secondly they assess a set of pair-wise comparisons which are used to determine the weight of the factors and the extent of outsourcing transport processes. This combination of open questions and pair-wise comparisons allows internal verification of the results.

Previous to the interviews at companies in the market, interviews are held with Capgemini experts. From these interviews insight is gained into the specific issues in a market sector. With this knowledge better external interviews can be developed. More on the research methods will be discussed in chapter six.

1.6 Structure of the report

After this introduction the thesis will continue with the theoretical framework in chapter 2. In this chapter the definition of the concepts that will be used throughout the report will be provided. Additionally the stakeholders that influence the shipper's transport outsourcing decision will be identified. At the end of this chapter conceptual model of the shipper's transport outsourcing decision is presented.

In chapter 3 the term transport process will be clarified and the sub-processes of the transport process and their mutual relation will be identified. A good overview of the transport processes is needed to determine which transport processes are outsourced and which processes are provided in-house.

Not all market sectors that are interesting for Capgemini can be studied in this report, therefore all the market sectors are briefly mentioned in chapter 4 and a choice for two market sectors is made. The choice is based on the access to information and clients in the market sector and on the market sector characteristics. The characteristics will be used again in chapter 10 at the generalization of the results.

In chapter 5 the factors that can influence the outsourcing decision will be identified based on literature study. The factors are categorized into six categories to make analysis with the AHP possible.

In chapter 6 the research methods used in will be presented and motivated. To gather data from supply chain management expert in the high-tech and chemicals market sectors a combination of interviews and questionnaires will be used. The analytical hierarchy process will be proposed as a suitable method to analyze the data from the questionnaires.

Chapter 7 provides insight in the data gathering process. First the selection of respondents for the internal interviews as well as the external will be explained. Secondly the development of both types of interviews will be explained. This chapter is concluded with a description of the data gathering process. This section is relevant since it provides Capgemini with a structured approach for the analysis of other market sectors.

In chapters 8 and 9 the results of the in-depth studies in the chemical and high-tech market sector will be presented and interpreted.

In chapter 10 the results of the two cases will be applied to other sectors, thereby the market sector characteristics from chapter 4 are used.

Conclusions with respect to the main research question will be drawn in chapter 11 and recommendations for further research will be given.

Finally, in chapter 12 a reflection on the research process and results is provided.

In the figure below the structure of the report and the relation between the chapters is graphically shown (figure 1).

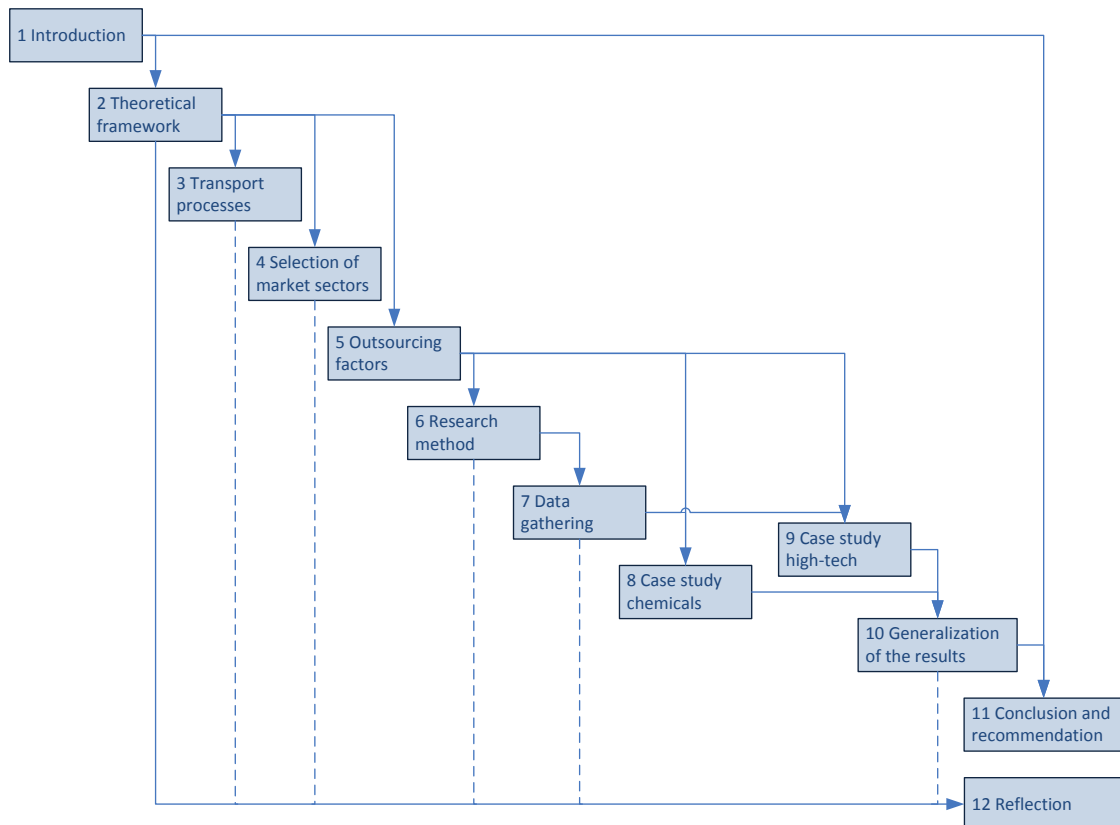


Figure 1 Structure of the report

2 Theoretical framework

This chapter provides the theoretical basis upon which the thesis builds. The definition of the relevant concepts is provided. The chapter starts with the identification of the stakeholders in the shipper's transport outsourcing decision. In section 2.2 the supply chain is elaborated on and the relation between some of the stakeholders already becomes clear. Section 2.3 elaborates on business processes and the position of certain business processes in the organization. Subsequently, in section 2.4, outsourcing of business processes is explained. The idea of strategic decision making and how it will be used in this research is mentioned in section 2.5. In section 2.6 a conceptual model of the situation is made. Finally in the conclusion of this chapter the first sub-conclusion can be answered.

2.1 Stakeholder analysis

In this section the stakeholders that are involved in the shipper's decision on outsourcing transport processes will be discussed. A good understanding and definition of the stakeholders is important since later the stakeholders influence the outsourcing decision.

2.1.1 Shipper

The shipper is the focal company in this research. The shipper is that company in the supply chain that receives goods from their suppliers. Those goods are input for their business processes in which the input is transformed into output. The shipper's output is sent to the customer.

In most supply chains multiple shippers exist, in this research the focus is on one of these shippers and their supplier and customer. This is depicted in the upper diagram of figure 2. The focus can easily be shifted to upstream or downstream in the supply chain and the same analysis can be carried out. A focus shift downstream in the supply chain is depicted in the lower diagram of figure 2.

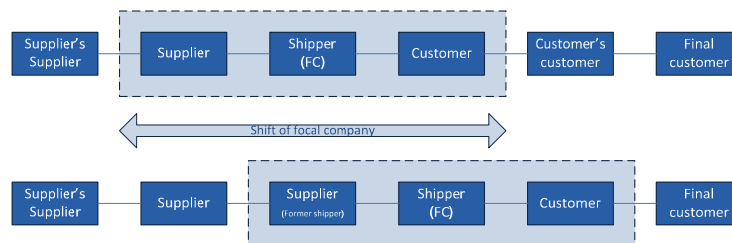


Figure 2 Focal company

The shipper has to decide on how to carry out the inbound and outbound logistics. In general, a shipper has three possibilities to carry out the logistics activities (Razzaque and Sheng 1998):

- It can provide the logistic functions in-house by making the service.
- It can own logistic subsidiaries by setting up or buying a logistic company.
- It can outsource (=buy service) the logistic activities to a third party logistic service provider (3PL) (See definition in sub-section 2.1.4)

The focus in this research is on the choice between the first and last mentioned possibilities. Setting up or taking over a logistic company is not considered because that is in fact the same as providing the logistic service in-house. The advantages of outsourcing transport processes are not gained when a logistic company is set up by the shipper.

The ultimate goal of a shipper is to continue business. This ultimate goal can be broken down into many sub-goals, however in this section the breakdown of goals will be limited to the sub-goals that are relevant in the field of transport. To continue business the shipper has to make a certain profit, both high revenues and low cost are drivers of profit. Furthermore the shipper's customers should be satisfied with

the service and quality delivered, note that this is not necessary high quality or service. Finally, a shipper should protect his strategic knowledge or information. The breakdown of goals is depicted the objectives tree in figure 3. In chapter 5 this structure will be used to categorize the factors that influence the outsourcing decision.

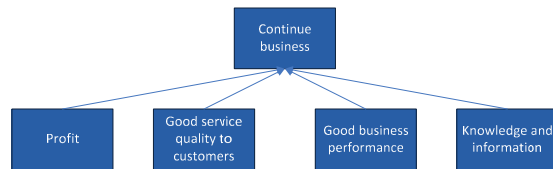


Figure 3 Generic objective tree of a shipper

2.1.2 Supplier

The suppliers are those companies that provide the input for the business processes of the shipper. The suppliers are positioned at the upstream side of the shipper in the traditional supply chain diagrams.

In most cases the supplier is responsible for the transport of his goods to the party that bought these goods, the shipper in this case. How the transport is arranged from the supplier to the shipper is therefore up to the supplier and thus not many factors from the supplier will influence the outsourcing decision.

However in some cases the shipper itself collects the goods from the suppliers, for instance when the shipper does not want to be dependent on the accuracy of its suppliers. In that case some of the factors that influence the shippers outsourcing decision can be originated at the suppliers. The type of product and the conditions for transport are, for example, two of those possible factors.

2.1.3 Customer

The customers are the companies that receive goods from the focal company as input for their processes. Customers are positioned downstream of the shippers and usually the shipper is responsible for the transport of the goods towards its customers.

During the transport process quality and service aspects for the customer can be determined or influenced. Therefore the customers' demands towards quality, service and costs can be determinants in the decision whether or not to outsource transport processes.

2.1.4 Third party logistic provider

The third party logistic service providers, often abbreviated as 3PL, are those companies that provide logistic services to other companies. Bowersox and Closs define 3PL's as firms that provide in all or a significant part of the shippers total logistic requirements (Bowersox and Closs 1996). A similar definition is provided by Coyle, Bardi and Langely, they define 3PL as a external supplier that performs all or part of a company's logistic functions (Coyle, Bardi et al. 2003). The respondents in Capgemini's annual third party logistics report define 3PL's as follows: '3PL's are companies that provide multiple logistic services for its clients and customers' (Capgemini^B 2007).

These three definitions are quite similar and represent exactly what is meant by a 3PL in this report. The definitions of a 3PL are relatively broad. As a result a broad range of transport services falls under the scope of third party logistic services. Transportation, warehousing, distribution, financial services, brokers, customs, stevedores, forwarders and carriers can be seen as 3PL services (Coyle, Bardi et al. 2003), regardless if they are directly contracted by the shipper or sub-contracted.

Furthermore also fourth-party logistic service providers are identified, fourth-party logistic service providers (4PL) were defined as follows: 'A fourth party logistic service provider is a company that provides more advanced logistic outsourcing services that the conventional 3PL provide' (Capgemini^B 2007).

In this research no difference will be made between 3PL and 4PL companies since the focus of this research is on the factors in the outsourcing decision. In that view the difference between a 3PL and 4PL is of minor importance. Furthermore, the difference between logistic services and 'more advanced' logistic services is rather vague. Therefore the term third-party logistic service provider or 3PL will be used to refer to those companies that provide logistic services to other companies in the supply chain.

2.1.5 Society

Society are the stakeholders in the environment of the supply chain participants and the 3PL like national and local governments, branch organizations, environmental groups et cetera. These stakeholders are not actively involved in the supply chain processes however these stakeholders do create the boundary conditions for the supply chain participants. Laws and regulations are boundary conditions but also the influence of for instance environmental groups on public opinion pose conditions.

Society puts legal constraints and demands on the transport process. These constraints are factors that can influence the shippers decision on outsourcing transport. Stricter emission rules for companies or working conditions for employees are for instance factors that are originated at society.

2.2 Supply Chain and Supply Chain Management

The terms supply chain and supply chain management are commonly used in literature. What is meant by these terms and how they terms will be used in this research is mentioned in this section.

2.2.1 Supply chain

The supply chain is defined as all the organizations and activities that are associated with the flow and transformation of goods from the raw materials stage towards the final product for the end user (Christopher 2005). The supply chain consists of three types of flows, namely the flow of physical goods, the flow of information and the financial flow. See figure 4.

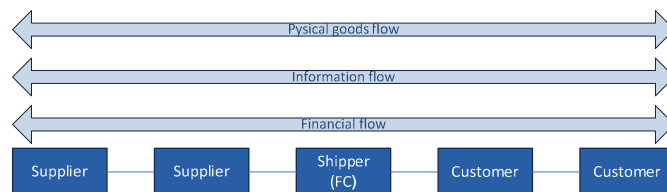


Figure 4 Generic supply chain with flow of goods, information and finances

Meredith-Smith defines the supply chain somewhat different: 'The supply chain is the network of processes, resources and enterprises that provides for the supply of goods from raw materials through processing and production to the end consumer' (Meredith-Smith 2002). Note that the supply chain, as simplified depicted in figure 4 is defined by Meredith-Smith as a *network* of relations. In this network of suppliers, warehouses and consumers in various sectors different supply chains emerge and disappear depending on the products demanded. The network representation of a supply chain is depicted in figure 5 below. This network contains the following supply chain participants, focal company (FC) and their suppliers (S) and customers (C). Warehouses between the supply chain participants are indicated with a triangle. Figure 5 is just a snapshot of the situation on a particular time. The network is dynamic and it will look different at another moment in time.

The network is still a simplified representation since other parties in the network also are part of a network. Supply chain participants can be part of multiple supply chains and they can have different roles in the various supply chains.

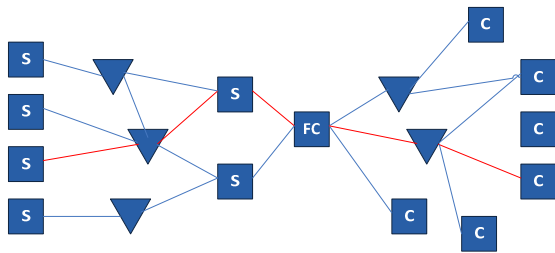


Figure 5 Network of suppliers (S), focal company (shipper, FC) and customers (C)

From this sub-section it is known that the traditional representation of a supply chain is much more complex in reality. Further in this report the supply chain will be depicted as a chain, however the reader should keep in mind that these chains are a part of a network.

2.2.2 Supply chain management and logistics

Supply Chain Management (SCM) is defined in various ways by different authors:

SCM is the integration and management of supply chain organizations and activities through cooperative organizational relationships, effective business processes, and high levels of information sharing to create high-performing value systems that provide member organizations a sustainable competitive advantage (Handfield and Nichols 2002).

Another definition of SCM is as follows: *'The management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole'* (Christopher 2005).

Both definitions together cover the variety of concepts that are relevant in this research, effective business, upstream and downstream relations with suppliers and customers, high business performance, costs and customer service.

Logistics is concerned about the organization, coordination and control of the flow of goods through the supply chain (Meredith-Smith 2002). Bowersox and Closs also include services in their definition: *'Logistics is concerned with getting the products and services where they are needed and desired. It involves the integration of information, transportation, inventory, warehousing, materials handling and packaging'* (Bowersox and Closs 1996). Dam Jespersen and Skjott-Larsen look upon logistics as an activity with a more internal focus whereas SCM has a more external focus. They write that logistics is typically based on individual business with the objective to make this enterprise's logistic system more efficient through internal and external planning and control. Whereas SCM is based on the external relations between supply chain participants (Dam Jespersen and Skjott-Larsen 2005). The SCM concept therefore provides a broader perspective.

These definitions cover the aspects of logistics that are used in this research. The inclusion of services in the definition of Bowersox and Closs is not relevant in this research since this research is about outsourcing the transportation of physical goods.

Companies do have to manage the in-bound or upstream supply chain as well as their out-bound or downstream supply chain. The upstream supply chain is the flow of goods and materials that is used as input for the business process of the focal company. The downstream supply chain is the flow of finished products from the focal company towards the customers. Next to the upstream and downstream logistics companies also have to manage their internal logistics. The latter is the transport between entities of the same company. See figure 6.

The transport in either the internal and the external supply chain can be carried out by a logistic service provider or by the shipper itself. There are many reasons, arguments, drivers or factors to outsource transport activities or not. However, the total of factors and how these factors influence the outsourcing decision is still unclear. This will be studied in chapter five and further. More on outsourcing of transport is will be discussed in section 2.4 'outsourcing'.

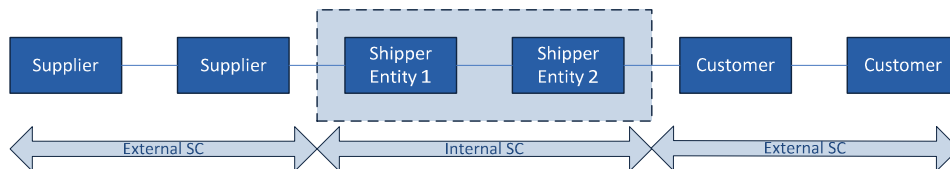


Figure 6 Internal and external supply chain

2.2.3 Supply chain and market sector

The terms market sector and supply chain do not refer to the same concepts. The supply chain is, as mentioned earlier, the network of processes, resources and enterprises that provides for the supply of goods from raw materials through processing and production to the end consumer (Meredith-Smith 2002). The term market sector is used to describe companies that make or sell the same or comparable goods and services, these companies are usually competitors (See figure 7). In this research the market sectors are compared at the level of the shipper.

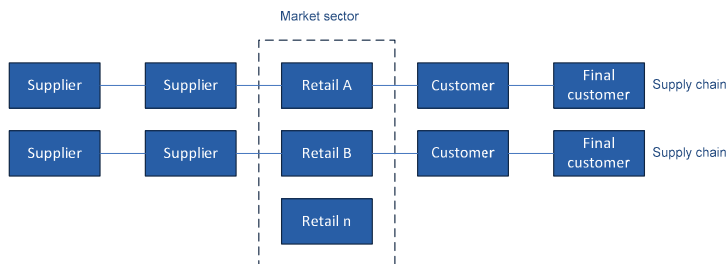


Figure 7 Market sector and supply chain

2.3 Business processes

In this subsection the term business process will be discussed and a good understanding of the term business process will be created. This is important since the thesis is about outsourcing a specific type of business processes, namely transport processes.

2.3.1 Definition business process

In the field of workflow engineering a process is commonly defined as 'a collection of activities that take one or more kinds of input and creates an output that is of value to the customer' (Keen 2004). In this definition a process directly adds value to customers.

Also Davenport provides a similar definition of a business process: 'A process is simply a structured, measured set of activities designed to produce a specified output for a particular customer or market' (Davenport 1993). In other words a process is a specific ordering of work activities across time and place, with a beginning, an end and clearly identified inputs and outputs. This definition puts a strong emphasis on how the work is done in an organization (Davenport 1993).

Both Keen and Davenport include the term customer in their definitions. These customers can be external customers as well as internal customers. The business process of an entire organization obviously has added value for the customer. But the sub-processes within the organizations also add value to the subsequent sub-processes, as if they are internal customers.

Keen also provided a more complete definition of a process and the characteristics of a process. A process is 'an organizational routine with clearly identified tasks and responsibilities' (Keen 2004). The characteristics of a business process are listed below:

- Recurrent. This means that the persons often carry out the process and in large numbers.
- Replicable. The process can be transferred to multiple contexts and is not unique to a single company.
- Consequential. The process has impact on the company's performance like customer service, revenues, costs, staff productivity and internal efficiency.
- Leveragable. A company's business processes are interrelated, improving a process can be used as the base for further improvements in company performance through these linkages to other processes.
- Well-coordinated. The fundamental element of a process is coordination, coordination of tasks, people, information, and procedures. In contrast, mis-coordination causes process errors like delays, inefficiencies, high costs and customer dissatisfaction.

In this thesis Keen's definition and the characteristics of a business process will be used. Transport business processes are compliant with all these characteristics. Transport processes are recurrent and replicable, many employees at different companies in various market sectors are involved in transport processes. Transport processes are not isolated but they have consequences for other business processes. Transport processes are also leveragable, due to the interrelatedness of transport process with other processes they can be a base for further improvements within a company. Transport processes need to be coordinated well since there is input, output, people and other resources and information involved.

The characteristics of transport processes will also become clear in chapter 3. In this chapter a decomposition of the transport process into sub-processes will be made. The interrelatedness and need for coordination is clearly shown there.

2.3.2 Primary business process or supportive function?

Some business processes are a part of the company's primary business whereas other processes fulfill a more supportive role in the company. In this sub-section the difference between the core-business processes and supportive process will be elaborated on. The objective is to clarify the position of transport processes in the organization and to identify the implications for the outsourcing decision.

According to Mintzberg all organizations consist of five elements, a strategic management, middle line management, operating core, technostructure and the supportive functions (Mintzberg 2003). The constellation of these elements is depicted in figure 8 below. It is not relevant to discuss all elements in depth here, just the difference between the supportive functions and the operations is relevant here.

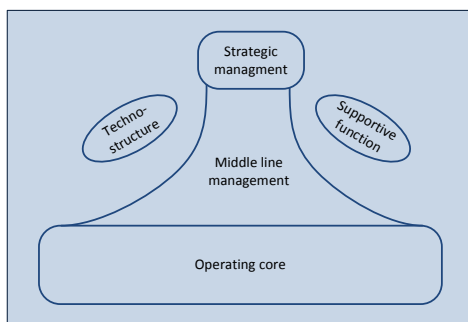


Figure 8 Five elements of organizations (Mintzberg 2003)

The operating core are those in the organization that carry out the work that is directly linked to the production of goods and services, these are also called operators. Four main functions or primary processes of operations are listed below (Mintzberg 2003):

- Provide the input for operations, this is the purchase of input.
- Transformation of input into output.
- Distribution of the output.
- Provision of supportive services to the previous three primary processes.

The supportive functions of an organization provide services within the organization. These services do not belong to the primary processes of the organization. Examples of supportive functions are cleaning services, ICT maintenance and security services.

In Porters' value chain the company's key activities that create value are depicted, see figure 9. Porter distinguishes primary activities and supportive functions. The primary activities are (Porter 1985):

- Inbound goods flow. This includes the activities for receive, store and distribute incoming goods.
- Operations. This activity is the transformation of the input into output.
- Outbound goods flow. This includes store, collect and transport of the final goods to customers.
- Sales and Marketing. This activity make the potential customers aware of the products characteristics.
- Service. All activities that maintain or improve the quality of a product are service activities.

In addition to these primary activities Porter also identifies four supportive functions:

- Procurement of input goods and services from suppliers.
- Technological development. Develop new technology for products and business processes.
- Human resource management. Recruit, select and reward employees.
- Infrastructure. This is the system of planning, financing, quality control and information management.

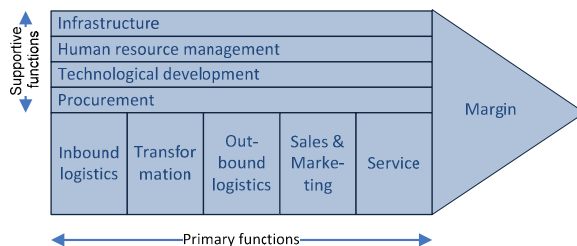


Figure 9 Primary and supportive activities in the value chain (Porter 1985)

From the texts above it can be concluded that both Mintzberg and Porter see transport processes as primary activities or core-business of a company. This has implications for the possibilities of outsourcing transport processes. Is it for instance sensible or even possible to outsource primary business processes?

In the next sub-section the theory about outsourcing and outsourcing of transport processes will be discussed. It also will become clear if transport processes are seen or treated as primary processes or as supportive functions.

2.4 Outsourcing

This thesis is about the shippers decision about whether or not to outsource transport processes. In this section the term outsourcing will be explained and the relation between outsourcing and primary or supportive processes will be made.

2.4.1 Outsourcing in general

Outsourcing refers to the strategic decision to contract out one or more activities required by the company to a third party specialist (Brewer, Button et al. 2001). Outsourcing is simply farming out of services to a third party (WebsiteCIO 2008). Another formulation of outsourcing is the transfer of management and/or daily execution of business processes to an external service provider. The client and

the service provider therefore make a contractual agreement that defines the outsourced processes and the terms and conditions.

Transferring services to a third party is therefore a variation on the traditional buy-or-make decision. Any company can choose how to obtain certain goods and services that are needed in the business processes of that company. When the company thinks that the open market is the best place to get those goods or services, than the buy decision is made. When not the open market but the company's own employees are the best place to obtain the goods or services than the make decision is made (Maltz and Ellram 1997).

In the description of the make-or-buy decision Maltz and Ellram explicitly make a difference between obtaining (physical) components and (intangible) services. The most important difference they make is that outsourcing services involves the acquisition of a process instead of a discrete quantity of components (Maltz and Ellram 1997). Furthermore the moment of delivery of a service is equal to the moment of consumption of the service. The moment of delivery of a product is not necessary the moment of consumption of that product. Obviously transport services are services and not products.

The terms outsourcing and off-shoring are frequently used as synonyms despite the differences. Outsourcing means that business processes are transferred to a third party, in other words: business process are transferred outside the organizational borders. Outsourcing is also off-shoring when the third party is situated in another country, however these concepts do not always go together. Off-shoring is the transfer of business processes to other counties, or transferring business processes over geographical borders. Regardless whether the transfer is made within or outside the same company.

In this report only the concept of outsourcing is subject of research. The focus is on the decision whether or not to outsource transport processes and to what extent. Where to carry out these outsourced processes is not in the scope of this research.

2.4.2 Outsourcing primary business processes and supportive functions

The difference between primary business processes and supportive functions is already discussed in the previous sub-section. In this sub-section a relation is made between the outsourcing theory and the two types of business processes.

In outsourcing literature there seems to be consensus about which processes can successfully be outsourced and which processes cannot or should not be outsourced. A company's primary process should never be outsourced and supportive functions should be outsourced.

In this report the importance of transport processes will not be denied. Transport processes are key to the performance of a company and, in accordance with Mintzberg and Porter, can be classified as primary processes. Primary processes should be carried out by those who are best at the job since business depends on it. In most cases the focal company performs best in his primary processes, that is, in essence, his reason for existence. However in some cases, as with transport processes, the shipper does not have the best qualifications for the task. The shipper does for instance not have the optimal organizational structure to perform good in transport processes or they do not have the right personnel for the job. Or third party logistic service providers just outperform shippers in the field of transport processes. 3PL's deliver, for example, better service for a lower price.

Therefore it is concluded that transport processes are key in business and that the shipper should take good care of these processes in order to continue successful business. However the shipper does not necessary have to carry out the transport processes itself, so he can arrange other parties to perform the transport processes for him. Which of the transport processes will be outsourced and which factors determine that decision will be studied in this research.

2.4.3 Outsourcing transport and logistics services

Comparable with the outsourcing of other business processes, transport and logistics are also business processes that can be outsourced. Transport and logistics processes can be transferred to an external party, a third-party logistics service provider, see figure 10. In the context of transport and logistics the terms outsourcing, third-party logistics and contract logistics refer to the same concept.

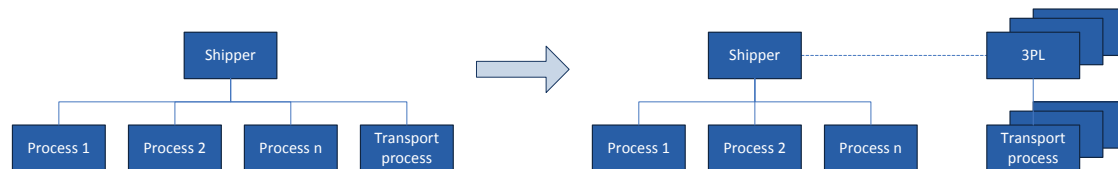


Figure 10 Transfer of transport processes from shipper to 3PL's

Outsourcing transport processes is typically outsourcing of a service as mentioned in the previous subsection. The third-party logistics service provider does not provide the shipper a component but rather a series of transactions that together form the transport process (Maltz and Ellram 1997). The series of transactions for instance starts with an order from the shipper and ends with the delivery of the goods at the shipper's customer.

When outsourcing production of components usually just one interface has to be covered, namely the interface between the service buyer and the third party service provider. When outsourcing transport processes at least two interfaces are present. The interface between the service buyer, or shipper in this case, and the third-party logistics service provider and second interface between the third-party logistics service provider and the customer. In most cases more interfaces will be present, for instance with sub-contracted 3PL's and warehousing providers (Maltz and Ellram 1997). How these interfaces are managed can be of influence in the outsourcing decision.

Previous research of Padillo and Diaby showed that there is a wide body of research concerning outsourcing of transport processes (Padillo and Diaby 1999). However most of the proposed methodologies and models are based on just financial considerations. Financial considerations are of course important in the decision on outsourcing transport, however they are not the only important factors. Various qualitative or non-financial factors, like service level, image and quality, do influence the outsourcing of transport processes (Padillo and Diaby 1999).

In this research the financial as well as non-financial and qualitative factors that influence the extent of outsourcing transport processes will be studied. In chapter five the factors found in literature will be listed and categorized. Later in the report the relation with the stakeholders of the decision problem and the transport processes will be made.

2.5 Strategic decision making

In this section the concept of strategic decision making will be elaborated on. The general background of strategic decision making and what strategic decision making means in outsourcing transport activities will be discussed.

2.5.1 Strategic decision making in general

Keeny and Raiffa provide us with an idea of decision making. They describe decision making as to determine the best course of action or strategy out of various alternative actions or strategies (Keeny and Raiffa 1993). These decisions are surrounded with uncertainty, conflicting values, multiple objectives and positive or negative consequences.

Parnell et al define a decision as an 'irrevocable allocation of resources' (Parnell, Driscoll et al. 2008). When a decision is made it cannot be changed without any loss of resources that were allocated in the

decision. More concrete one could describe decision making as a process that leads to the selection of a course of action among several alternatives. Strategic decision making in business is than the process of selecting the best course of action for the company which has long term implications for the company's performance.

The long term implications of these strategic business decisions make that these decisions are surrounded with uncertainties, since the future state of business and the environment of the business cannot be foreseen yet. The amount of resources that will be allocated in a decision is very high at the strategic level. That makes strategic decision making different from decisions at tactical and operational level.

Another but similar definition of decision making is provided by Keen and Sol. They define decision making as a process that leads to a commitment to action (Keen and Sol 2008). When they elaborate on decisions than it is about 'decisions that matter'. Not all decisions that matter are strategic decisions, however strategic decisions are decisions that matter. Therefore in this report the term decisions that matter are comparable with the term strategic decision, the latter term will be used in this report.

Many are influenced by strategic decision and therefore many stakeholders are involved in making strategic decisions. Strategic decisions are urgent and one cannot postpone the decision without repercussions. They are consequential, the decision has consequences for others within and outside the organization. Furthermore these decisions are non-reversible, once the decision is made it is difficult to undo the decision and all the consequences it had. Strategic decisions are also packed with uncertainties. One cannot foresee the future in which the long term consequences of the decision still take place. Finally these decisions are wicked, there is not one right decision to make. There are several alternatives that satisfy more or less of the stakeholders objectives.

Furthermore, strategic decisions are often unstructured, messy and un-programmed (Schwenk (N.A.)). Due to the lack of structure the decision process is vulnerable to political maneuvering by the stakeholders. The stakeholders use their power, like coalition formation, not sharing information, lobbying and setting agendas, to influence the decision (Schwenk (N.A.)). Bhushan and Rai also mention the human perceptions and personal judgments that are involved in making strategic decisions. So, in order to make a good choice, strategic decisions need a rational and structured approach (Bhushan and Rai 2004).

The characteristics of strategic decision making mentioned in the texts above are summarized in table 1 below.

Table 1 Strategic decision making characteristics

ID	Characteristic of strategic decision making	Source
1	Long term implications	Parnell, Driscoll et al. 2008
2	Uncertainty	Keeny and Raiffa 1993 Keen and Sol 2008 Bhushan and Rai 2004
3	Multiple objectives	Keeny and Raiffa 1993
4	Conflicting values	Keeny and Raiffa 1993
5	Multiple actors and stakeholders	Keen and Sol 2008
6	Urgent	Keen and Sol 2008
7	Consequential	Keeny and Raiffa 1993 Keen and Sol 2008,
8	Non-reversible	Keen and Sol 2008
9	Wicked	Keen and Sol 2008
10	Unstructured, messy and un-programmed	Schwenk (N.A.)
11	Presence of political maneuvering	Schwenk (N.A.)
12	Human perceptions	Bhushan and Rai 2004
13	Personal judgments	Bhushan and Rai 2004
14	Conflict	Schwenk (N.A.)

2.5.2 Strategic decision making in outsourcing processes

Outsourcing decisions are very important for companies since these decisions have great influence on the width of a company span of processes, relationships of the company with suppliers, customers and logistic service providers. Furthermore outsourcing business processes affects the business processes, methods used within the company, in-house capacities, in-house capabilities, overhead structure and ultimately this all contributes to the company's competitive position in the market (Padillo and Diaby 1999).

It is worth mentioning that also here a distinction can be made between outsourcing the production of parts and services. Some of the effects are merely the result of outsourcing production processes, changing in-house capacity for example. But most of the effects are also the result of outsourcing services, for instance the effect on the overhead structure and in-house capabilities of a company.

The stakes in outsourcing decisions are high and they have long term consequences for the company's performance. Many stakeholders are influenced and involved by the outsourcing decision, these were already identified in sub-section 2.1. Therefore it is concluded that outsourcing decisions, including transport outsourcing decisions, are definitely strategic decisions. The effect that outsourcing decisions have on the business stipulates, once again, the relevance and need for research to in this field.

In this research a structured approach is used to assess the transport outsourcing decision. The shippers outsourcing decision should not be ad-hoc or based on a 'feeling'. The research will provide insight in the underlying factors in the transport outsourcing decision in a structural manner.

At the end of this section it can be concluded that the transport outsourcing decision is a strategic decision. Therefore a structured approach is needed to assess this decision. More on the approach or method that will be used in this research will be provided in chapter six. At this stage it is also clear that the research about decision making in the transport processes focuses on two different themes. First the reasons for, the benefits and risks of the outsourcing decision and secondly the selection of the right third party logistic service provider to do the job. Obviously the focus of this research is on the first theme.

2.6 Conceptual model

In the previous sub-sections the various system elements that are subject of this research are separately discussed. The various stakeholders were discussed in sub-section 2.1, these stakeholders are part of the supply chain as discussed in sub-section 2.2. This research is about the question which factors influence the decision on outsourcing transport processes which is specific type of business process. Business processes are discussed in sub-section 2.3 and the idea of outsourcing was discussed in sub-section 2.4. This outsourcing decision is a strategic decision, this is explained in section 2.5.

In this section these elements are combined into a conceptual model of the relations between stakeholders, transport processes and the factors that influence the outsourcing decision. See figure 11.

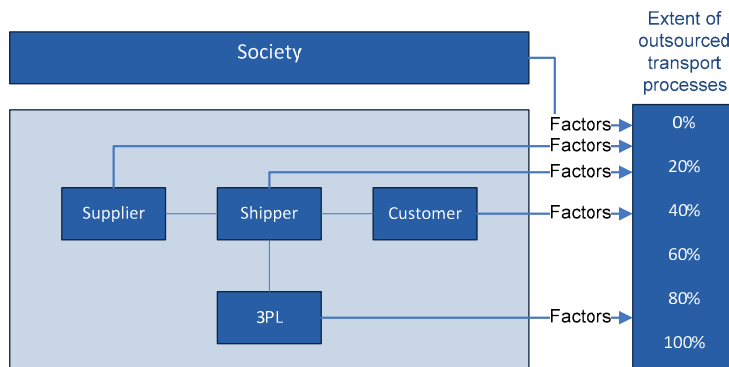


Figure 11 Conceptual model

Generally the model consists of three main elements, society, part of the supply chain and a scale which represents the extent of outsourced transport processes. Each of these elements will be discussed in the following texts.

The light blue shaded square contains that part of the supply chain that is studied in this research. As explained in sub-section 2.1.1 the focus of the research can easily be shifted up or down the supply chain without changing the entire setup of the study. The supplier, shipper and customer are part of the supply chain that is studied. The shipper is the focal company in this research. Between these supply chain participants there is a flow of goods, information and finances as described in sub-section 2.2.1. The transport processes can be carried out by the shipper itself or by a third party logistic service provider. Therefore the third party logistic service provider is part of the system that is studied.

Society is the second element of the model and is represented in the blue square above the supply chain. As explained in sub-section 2.1.5 society consists of all parties that are not directly involved in the supply chain but can have influence on the supply chain participants, for instance via regulatory offices.

The shipper's choice whether or not to outsource transport processes is influenced by many reasons, drivers, arguments or factors. Some of the factors that determine the extent of outsourcing are under control of the shipper itself. Other factors that also influence the shipper's decision are not originated at the shipper but they are originated at supply chain participants or at society as a whole.

All the stakeholders in the system and society contribute factors that influence the extent in which transport processes are outsourced. These contributions are depicted as arrows towards the 'outsourcing scale', this is the third element of the model. At this point in the research the scale contains percentages that represent the extent of outsourced transport processes. In reality the scale consists of all the transport processes like packing, loading, driving, storing, unloading et cetera. In the following chapter these activities will be clearly identified and a proper outsourcing scale will be developed. Some of these activities can be outsourced and some of these activities can be carried out by the shipper itself. This determines the shipper's position on the outsourcing scale.

Three parts of the model are key in this research. First the scale on which the extent of outsourcing can be indicated will be developed. Secondly the factors that influence the decision on outsourcing transport processes will be identified. Thirdly the weight of these factors in the outsourcing decision will be determined.

2.7 Conclusion

In this chapter the concepts and definitions on which the rest of the thesis builds are identified and explained. Thereby the first research questions can be answered.

1 What are the main concepts in transport management and which parties are involved in the transport outsourcing decision?

Sections 2.3 to 2.5 provide insight in the important concepts in this research. In this research transport processes are looked upon as one of the business process. In accordance with Mintzberg and Porter transport processes are classified as a company's primary process, transport processes are key to company's performance. The shipper should therefore should make sure that these processes are performed well, either by the shipper itself or by a 3PL.

As mentioned, transport is one of the primary processes. The decision whether or not to outsource this processes has high consequences for the company, has long term implications, is hard to reverse and is surrounded with uncertainty. That makes the outsourcing decision a strategic decision for which a formal method is needed.

Next to the shipper itself four other (groups of) stakeholders that can influence the shippers outsourcing decision. That are the shipper's supplier and customer, the third party logistic service provider and society. Despite that the transport outsourcing decision is a decision that the shipper has to make other stakeholders may influence this decision. The relation between the stakeholders is partly depicted in the supply chain in section 2.2. The conceptual model in sub-section 2.6 gives the relations between all the stakeholders and the relation or influence that the stakeholders have on the outsourcing decision.

3 Transport processes

Outsourcing transport processes is the focus of this research and the term 'transport process' is frequently mentioned before. At this stage insight is needed in the exact meaning of this term. In this section insight is provided in the transport process by identifying all the sub-processes. The transport process will be described by means of the IDEF modeling technique. In section 3.1 the transport process and the sub-processes will be identified. In section 3.2 a decomposition of the transport process will be presented by means of an IDEF diagram. In section 3.3. the decomposition of the transport process will be used to develop transport alternatives. Finally in section 3.4 research question 2 will be answered.

3.1 Identification of transport processes

In this section the various transport processes are identified. The transport process is broken down to sub-processes and sub-sub-processes at equal levels. In the next section an IDEF representation is made of these processes including the input, output, control and mechanisms needed for the processes.

Transport can be broken down in the sub-processes transport planning and transport execution. Both these processes can again be broken down in the sub-sub-processes order processing, load planning, route planning, order picking, loading, transportation, unloading, value added services and delivery. These processes are listed in table 2 below.

Table 2 Transport processes

ID	Process
0	Transport
1	Transport planning
1.1	Order processing
1.2	Route planning
1.3	Load planning
1.4	Invoice
2	Transport execution
2.1	Order picking
2.2	Loading
2.3	Transport
2.4	Un-loading
2.5	Value added services
2.6 / 2.2	Loading
2.7 / 2.3	Transport
2.8 / 2.4	Un-loading
2.9	Delivery

Note that the list of sub-processes in table 2 is far from exhaustive. Much more sub-processes can be listed. The following processes could be added (Brewer, Button et al. 2001): goods dispatch, customs documentation, returns, labeling, stock count, order planning, load consolidation, stock control, track and trace, palletization, fleet maintenance and fleet management. Furthermore customer order management, export, import, freight forwarding can be distinguished as sub-processes (Coyle, Bardi et al. 2003). When multi modal transport is considered than sub-processes like transshipment and storage of goods can be included in the analysis. However for the purpose of this research the aggregation level of table 2 and the IDEF diagram is sufficient.

Table 2 also provides insight in the hierarchy of the transport processes however it does not provide insight in the mutual relation between these processes and the input, output, control and mechanisms needed to carry out the processes. Therefore in the next section a decomposition of the transport process is made.

3.2 Decomposition of the transport process

The transport processes will be decomposed using the IDEF modeling technique, this technique is explained in detail in appendix 1. The IDEF A0 diagram gives a representation of the process at the highest aggregation level. The highest aggregation level is the transport process, transporting goods from the shipper to the customer. Input for the transport process are goods at the location of the shipper. These goods will be transported to the customer therefore the output are goods at the location of the customer.

The transport process is controlled by a transport procedure. This procedure is a working method which describes who-does-what-and-when. Mechanisms to perform the transport process are varying from employee to loading dock. For this moment these mechanisms will be summarized with the term transport tools. The A0 diagram is depicted in figure 12.

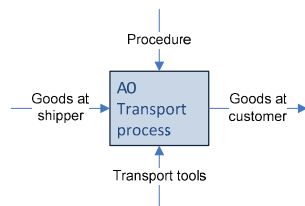


Figure 12 IDEF A0 diagram transport processes

Transport processes can be broken down into two separate, but interrelated, sub-processes namely transport planning and transport execution. Transport execution is the process in which good are physically moved from one location to the other, from the shipper to the customer or from shipper to warehouse. The transport planning process is involved in the preparation and administration of transport execution.

The IDEF diagram with A1 and A2 process is depicted in figure 13 below. Both transport planning (A1) and execution (A2) are separated and their relation becomes clear. The transport planning process transforms external orders into a transport plan. Transport planning is controlled by a planning procedure. The mechanisms needed are a planning tool (PC, software) and employees to carry out planning tasks. Note that the term external orders is used to indicate that those orders are not initiated by the planning department itself but outside the planning department. In most cases this will be sales orders from the sales department of the company but it can also be orders from dealerships that sell the shippers products.

In the transport execution process goods are moved from the one location to the other. This process is controlled by the transport plan made during the planning process. Mechanisms needed are transport tools (truck, loading dock) and employees to do these tasks.

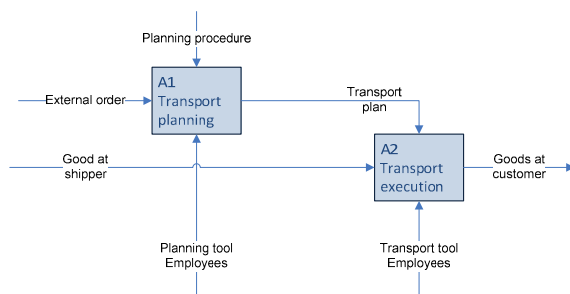


Figure 13 IDEF diagram transport planning (A1) and execution (A2)

Both these processes are broken down in basic sub-processes. Transport planning consists of the following four processes: order processing (A1.1), route planning (A1.2) load planning (A1.3) and invoice (A1.4).

During the order processing external orders are processed into an internal order and a freight bill that will accompany the goods through the supply chain. The internal orders function as input for load planning as well as route planning. Logically the output of load and route planning are respectively a load plan and a route plan. These processes need employees and planning tools like route and planner software as mechanisms.

Transport execution is broken down to the sub-processes order picking (A2.1), loading (A2.2), transport (A2.3), Unloading (A2.4), value added service (A2.5), loading (A2.6/A2.2), transport (A2.7/A2.3) and unloading (A2.8). During the order picking processes the goods that need to be delivered to a customer are consolidated and prepared for shipment. Then the consolidated goods are loaded into a mode of transport. This mode of transport transports the goods to another geographical location. That can be a warehouse whereas the goods are temporarily stored and value added services are performed or the delivery to the customer is made directly. Value added services can be various activities, custom clearing can be arranged in intercontinental transports, the goods can be forwarded, the goods can be repacked, instruction leaflets can be added et cetera. When the goods are stored extra load, unload and transport processes have to be carried out.

Many of the controls for the transport processes are made in the planning process. Order picking will be controlled by the freight bill, loading will be controlled by the load plan and transport will be controlled by the route plan. The freight bill also controls the unloading process at the warehouse or final customer because it states which goods have to be delivered at which location.

Various mechanisms are used to execute the transport processes. Order picking needs an order picker to consolidate the goods to shipments. Furthermore this person needs a reach truck to collect the goods that are stored in a warehouse. The loading process needs a forklift and a transport modality to be loaded, this can be a truck. The same mechanisms are needed when unloading the transport modality at the warehouse or at the customer. For the transport process obviously a transport modality is needed and personnel to operate the modality. The warehousing process needs a warehouse.

For handling of bulk goods obviously other mechanisms are needed. Bulldozers and conveyor belts are needed to load and unload these goods. The transport modalities will mostly be ships or trains.

The complete IDEF diagram of the transport processes is depicted in appendix 2. Note that this decomposition of the transport processes provides actor roles in the mechanisms and not the actual actors. The diagram does not indicate which party, shipper or 3PL, is performing the transport processes.

The IDEF diagram gives a general overview and relations of a shippers outbound transport processes. In some cases shipper provide in their own inbound transport processes, most of the transport processes will be the same but the structure of the diagram will differ. This will be worked out when it is applicable to the market sector that will be studied.

Furthermore a note on reverse logistics should be made. Reverse logistics are not explicitly mentioned as separate transport processes, but they are considered as normal transport processes from the customer back to the shipper. The same steps are carried out only it starts with goods at the location of the customer and ends with goods at the location of the shipper.

The decomposition of the transport processes as presented in table 2 and in the IDEF diagram in appendix 2 is discussed with three Capgemini employees with experience in the field of transport and logistics in various market sectors (CapgeminiEmployee1 2008), (CapgeminiEmployee2 2008) and

(CapgeminiEmployee3 2008). As mentioned earlier in this section more detail can be added in the decomposition, but the current aggregation level suits the purpose of this research.

3.3 Development of transport alternatives

In section 2.6 the conceptual model of the transport outsourcing decision was presented. This model however was missing a concrete scale that can measure the extent of outsourcing transport processes. In the previous sections the transport processes are identified. In this section transport alternatives that represent the extent of outsourcing will be developed.

To obtain insight in which transport processes will be outsourced several transport alternatives have to be developed. These transport alternatives are based on the transport processes that were identified in section 3.1. In these alternatives gradually more activities are outsourced and less is provided by the shipper itself. The alternatives are shown in table 3 below.

Table 3 Transport outsourcing alternatives

Alternative	Shipper	3PL
1	(None)	Order processing Route/load planning Invoice Order picking (Un)loading Transport Value added services (warehousing, customs) Delivery
2	Order processing	Route/load planning Invoice Order picking (Un)loading Value added services (warehousing, customs) Transport Delivery
3	Order processing Route/load planning Invoice Order picking (Un)loading Value added services (warehousing, customs)	Transport Delivery
4	Order processing Route/load planning Invoice Order picking (Un)loading Transport Value added services (warehousing, customs) Delivery	(None)

The development of the transport alternatives is another step in the development of the conceptual model. In chapter 2 the stakeholders in the shipper's transport outsourcing decision were identified. In this chapter a proper scale to measure the extent of outsourcing transport processes is developed. These percentages can now be replaced by concrete transport processes that are provided in-house by the shipper or outsourced to a 3PL. The new conceptual model is depicted in figure 14.

The final step in the development of the conceptual model is the identification of the factors. This will be researched in chapter 5.

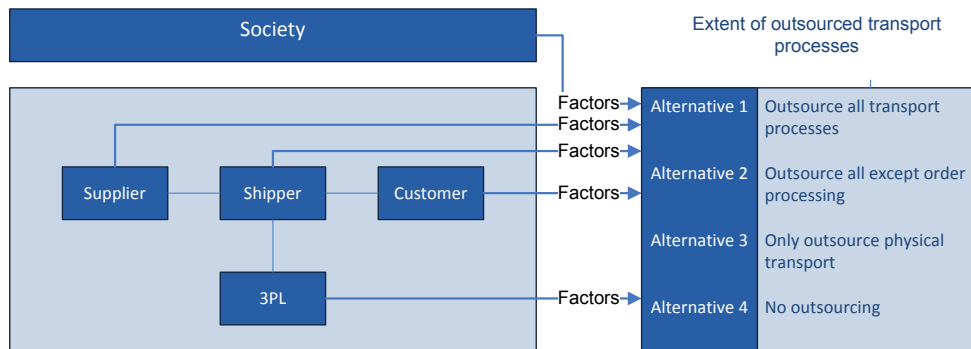


Figure 14 Conceptual model

3.4 Conclusion

In this chapter a decomposition of the transport processes is made and at this stage sub-question 2 can be answered.

2 Which sub-processes can be identified in the overall 'transport process' and what is the relation between these sub-processes?

The term transport process is broken down into two sub-processes, transport planning and transport execution. Furthermore these sub-processes are broken down into about 10 sub-sub-processes. These are listed in table 2.

The mutual relations between the transport processes is shown in an IDEF diagram, see appendix 2. This diagram also shows the controls of the processes and the mechanisms. These mechanisms represent among other things, actor roles. Which actor, shipper or 3PL, is going to perform these processes is subject of this research.

Based on the decomposition of the transport processes four transport alternatives are developed. These alternatives make it possible to indicate which transport processes are outsourced and which processes are provided by the shipper itself. The development of the transport alternative is a valuable addition to the conceptual model presented in figure 14.

The extent of outsourced transport processes will be answered in chapter eight for the chemicals market sector and in chapter nine for the high-tech sector.

4 Selection of market sectors

This study can be conducted in various market sectors. For Capgemini the sectors automotive, high-tech products, chemicals, oil & gas, retail, wholesale and pharmaceuticals are interesting. These market sectors all have their own typical supply chain and supply chain participants. The different characteristics of the market sectors possibly result in different factors and different importance of the factors that influence the outsourcing decision. Contrary, in similar market sectors probably the same factors that influence the outsourcing decision.

Due to time constraints not all seven market sector can be studied in-depth in this research. In this section two market sectors will be selected for in-depth study in this research. The selection will be based upon two criteria, the availability and access to knowledge in the sector and the market sector characteristics.

In section 4.1 the supply chain characteristics that will be used to assess the seven market sectors will be identified and elaborated on. In section 4.2 the market sectors will be discussed, hereby using the supply chain characteristics from section 4.1. In section 4.3 the decision rule that is used to select two market sector will be mentioned and two sectors are selected for further study. Finally in section 4.4 sub-question 3 can be answered.

4.1 Supply chain characteristics

In this section the supply chain characteristics that will be used to assess the various market sectors will be mentioned and elaborated on. The following characteristics will be used:

- Scale of the inbound supply chain
- Scale of the outbound supply chain
- Time criticality of transport
- Type of goods inbound supply chain
- Type of goods inbound supply chain
- Type of supply chain

4.1.1 Scale of the supply chain

The first characteristic is the scale of the supply chain. In this model supply chains are arranged in two levels, global and local scale. Transport within an economic trade zone is seen as local scale, in this research that will be the European Union. The scale of the supply chain influences the complexity of the transport processes. Local transport, within the borders of the European trade zone, is far less complex than transport that crosses the European borders. In the latter case more documents and activities are needed at specified times to carry out the transport processes. Both the inbound and outbound supply chain are assessed on scale.

4.1.2 Time criticality of transport

The second characteristic is the time criticality of the goods in the supply chain. The time criticality itself is determined by three elements:

- Value density. This is the value over weight ratio. The higher this value the higher the interest costs of the goods during transport. These costs are the driver to transport the goods as quick as possible.
- Obsolescence of the goods. This is the time in which goods become obsolete, out of fashion or spoiled. The obsolescence is therefore a driver for quick transport.
- Costs of not having the goods. When the costs of not having a good are high than the goods should be transported quickly. This element is most important in the distribution of spare parts.

The costs that are generated by the three elements above are higher than the transport costs with high speed modalities, that makes quick delivery profitable despite the higher costs of delivery.

The time criticality of transport will be scored on three levels, high, medium and low. A supply chain is indicated with high when the transport and business processes are very time critical and low when they are not time critical.

4.1.3 Type of goods in the supply chain

The third characteristic is the type of the goods. The main categories of goods are bulk, semi-bulk and parts. Bulk goods are goods that are transported unpacked and in large quantities, for instance coal and chemicals. Bulk goods tend to have a low value density, high volumes and relatively high weights. Part goods are the opposite, they are transported packed and in smaller quantities, like computers. The value density of the goods is high and the volume and weight are relatively small. Semi-bulk goods are positioned between bulk and part goods, they are transported in large quantities of equal products but they are packed. Both the type of goods in the inbound and outbound supply chain are assessed.

The goods in the supply chain are indicated on the levels bulk, semi-bulk and parts. The inbound crude oil for the oil and gas industry is an example of a bulk good. Cars and computers are for instance indicated as semi-bulk. Drugs are indicated as part goods.

4.1.4 Type of supply chain

The fourth characteristic is the type of supply chain that the shipper is a part of. Three types of supply chains are distinguished: convergent supply chain, divergent supply chain and a neutral supply chain. See figure 14 below.

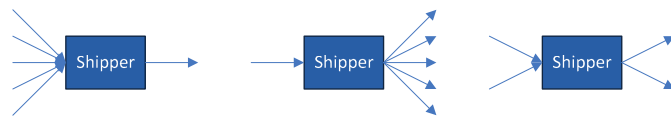


Figure 15 Supply chain types: convergent, divergent and neutral supply chain

These three indications can be given with respect to the number of incoming parts compared to the number of outgoing parts. Or with respect to the number of suppliers compared with the number of customers. There can be overlap in these characterizations since one supplier can deliver a whole variety of different parts. Therefore in this report the number of incoming flows of goods is compared with the number of outgoing flows of goods. From a transport management point of view this is the most interesting characterization of the supply chain or the supply chain participants.

The indication whether a supply chain is convergent, divergent or neutral is also dependent on the aggregation level of the assessment. Is the supply chain as a whole characterized or just a focal company within the supply chain as in figure 14. In this report the focal company is characterized.

In a convergent supply chain the shipper has more inbound flows than outbound flows. The factory in which computers are assembled is an example of a convergent supply chain. Here part from many inbound transport flows are assembled into one computer. These computers are transported in a few flows to the wholesalers. In a divergent supply chain the shipper has more outbound flows than inbound. At a refinery in the oil & gas sector, for example, one inbound flow of crude oil is transformed into many outbound flows of different products.

4.2 Market sectors and characteristics

Within Capgemini seven interesting market sectors are identified, these are listed below (Capgemini^A 2008). These are the market sector wherein Capgemini is active in and the list is therefore not meant to be exhaustive. In this section these market sectors will be described using the characteristics from the previous section. Furthermore the description of the market sectors are based on the Capgemini TMS for shippers research (Capgemini^A 2008).

- Automotive
- High-tech products
- Chemicals
- Oil and Gas
- Retail
- Wholesale
- Pharmaceuticals

4.2.1 Automotive market sector

The automotive industry is characterized by an inbound supply chain with many suppliers. Due to competition the cars manufacturers are outsourcing the production of parts and components to emerging low cost economies. All parts and components for cars are made by many different suppliers all over the world. The geographically spread production of car components leads also to the involvement of many local authorities. These authorities also can have influence on the production and transport processes. The scale of the inbound automotive supply chain is characterized as global. For the transport of these components transport modalities rail, sea, road and air transport modalities are used.

The outbound supply chain is on the other hand relatively simple, complete cars from manufacturer via distribution centers to the final customer. The outbound automotive supply chain also has a global scale. The transport of these semi-bulk goods is mainly carried out by road, rail and sea transport modalities. Furthermore, the automotive supply chain can therefore be characterized as a divergent supply chain.

In the automotive industry the just-in-time (JIT) production system is commonly used. The competition in the sector is fierce therefore the automotive industry has to produce the right products at the right time to meet customers demand. The JIT system and competition in the sector is a driver for larger number of deliveries and smaller batches, for inbound logistics as well as outbound logistics. The transportation processes are therefore more important and increasingly challenging.

As a result of the just in time production system the costs of not having parts will cost money. Therefore the inbound supply chain is medium time critical. The outbound supply chain is low time critical, the value density of cars is not very high. Furthermore the cars will not become obsolete very quick. An exception has to be made for spare parts, these are very time critical especially when these parts should be fitted into commercial vehicles.

4.2.2 High-tech market sector

The high-tech industry is characterized by an inbound supply chain with many global suppliers. The outbound supply chain consist of a few local customers, mainly retailers and wholesalers. To reduce the production costs of high tech products the part for these products are manufactured all over the world. The high-tech products are manufactured/assembled in central facilities, so therefore an extensive distribution network is needed to deliver the products to the final customer. These characteristics make the high-tech supply chain a convergent supply chain. However this characteristic is dependent on ones view or focus. When the high-tech supply chain is assessed from the European distribution centers towards the final customer than the high-tech supply chain can be characterized as divergent. Modalities used to provide the inbound and outbound transport are road, rail, sea and air.

The type of goods in both the inbound as outbound supply chain are characterized as semi-bulk or parts. These goods are medium time critical, the value density of the high-tech parts is not as high as, for instance, jewelry but it is on the other hand not as low as grain. Comparable with the automotive market sector an exception has to be made for high-tech spare part distribution. Especially spare parts for commercial applications are very time critical.

Vast competition in the high-tech market sector force the high tech manufacturers to reduce the cost of production and transportation. Due to competition cost increases can hardly be passed down to customers.

The high-tech market sector is fast changing market sector thus producers have to keep inventories as low as possible. At the same the life cycle of high-tech products is decreasing and the customers demand is high. Producers therefore have to do enormous effort to manage their inventory and transport well.

4.2.3 Chemicals market sector

The chemical industry is characterized by a relatively simple global inbound logistic system. The input for a chemical plant consists usually of one or a few chemical products that are processed in other chemical products. The input in the chemical industry is purchased from suppliers all over the world, the scale of the inbound supply chain is therefore global. Transport modalities used for the inbound bulk loads are sea, inland waterways, road and railroad.

The output of a chemical plant is a (large) variety of chemical products for diverse customers. This makes the chemical supply chain a divergent supply chain on a local scale. The used transport modalities are road and rail and sea.

The type of goods in the inbound and outbound supply chains are both bulk goods. These goods are due to their value density also not time critical.

Furthermore the chemical industry is confronted with many rules and regulations for the processes as well as for inbound and outbound transport. These regulatory requirements force the industry to have well defined production and transport processes to maintain control and visibility.

4.2.4 Oil & Gas market sector

The inbound and outbound supply chain of the oil and gas sector is somewhat comparable with the chemicals market sector. The inbound supply chain is relatively simple, containing crude oil and gas from global production facilities. The input is mainly transported by sea transport and pipeline. The outbound goods flow has more variety, containing a several oil and gas products. These products are mainly transported by road and rail (tanker) modalities and pipelines. The scale of the outbound logistic system is local.

The type of goods in the inbound and outbound supply chains are both bulk goods. These goods are due to their value density also not time critical.

The demand for oil and gas is very high the last few years, the sector is highly driven by demand fulfillment. The strong demand for oil and gas make the output of this industry valuable.

4.2.5 Retail market sector

The inbound supply chain of the retail sector consist of many suppliers, goods are manufactured in many geographically scattered, but local, locations. The goods are transported to the retailer's (own) distribution centers mainly using road transport. In these distribution centers the goods are consolidated and prepared for transport to the retailer's outlets. Consolidated goods are in general transported over the road.

The outbound supply chain consists also of the home delivery service that retailers offer. The volume of these transports is small. But goods have to be transported to many different locations, the consumer's house, in small time windows. This makes the outbound supply chain quite complex.

The retailer's customers outnumber the suppliers many times. Therefore the retail supply chain is characterized as a divergent supply chain.

The type of goods in the inbound as well as the outbound logistic system consist of part goods. The retailers logistics is furthermore characterized by a multi category of products like food, non-food, generic brands et cetera. Especially the transport of perishable food and fashion makes the retailer's inbound and outbound supply chain very time critical. This makes the transport and logistics processes extra challenging.

4.2.6 Wholesale market sector

The wholesaler's inbound supply chain is comparable with the inbound supply chain of the retailer. Due to competition and cost pressures manufacturers moved production to low cost countries, so the wholesalers has many global but also local suppliers. The transport modalities used are road, rail, air and sea.

The outbound supply chain is relatively simple, wholesalers deliver their products to local retailers. A wholesaler's supply chain is therefore neutral or divergent. Transport from the wholesaler to the retailer is many provided by road transport.

The type of goods in the inbound as well as the outbound logistic system consist of part goods. At the inbound side of the business wholesalers are confronted with cost pressures and at the outbound side retailers also expect the lowest possible price and short lead times. These forces make the wholesalers transport processes increasingly challenging.

4.2.7 Pharmaceutical market sector

The inbound supply chain of the pharmaceutical sector is relatively simple. Basic biologics and chemicals are the input for the production of drugs. The outbound supply chain is far more complicated because the nature of drugs calls for special treatment. Monitoring transport through the entire supply chain is needed in order to ensure the acceptance of the drugs at the final customer. Both inbound and outbound supply chains are of a global scale.

The input biologics and chemicals are transported as bulk goods. The final products are transported as parts. During transport drugs also require special containers to maintain the products properties during transport and to ensure the life saving qualities. As a result of these qualities and the value density of the inbound and outbound goods flow these flows are time critical. The modalities used in both the inbound as well as the outbound supply chain are various. Drugs are shipped via rail, sea, road and air.

Other products, like food in the retail sector, also need monitoring, tracking and conditioned transport so this is not unique. However the life saving and possible life endangering properties make these factors especially important in the pharmaceutical market sector.

4.2.8 Summary of the market sectors

In table 4 below the markets sectors, criteria and the score are shown. This table gives a quick overview of the characteristics of each market sector. Moreover it provides insight in the extent of overlap and differences between the market sectors.

As mentioned before this overview of the market sector characteristics can be used during the generalization of the results in chapter 10 of this report. The assumption is that in market sectors with similar characteristics also similar outsourcing factors are of importance. During the generalization of the results, the findings of the in depth study of two market sectors are applied to the five other market sectors.

A schematic representation of each market sectors can be found in appendix 3.

Table 4 Assessment criteria for market sector comparison

Market sectors	Automotive	High-tech	Chemicals	Oil & Gas	Retail	Wholesale	Pharmaceutical
Criteria							
Scale inbound SC							
- Global scale	V	V	V	V	V	V	V
- Local scale	X	X	X	X	V	V	X
Scale outbound SC							
- Global scale	V	V	X	X	X	X	V
- Local scale	X	V	V	V	V	V	V
Time criticality							
- Inbound	Medium	Medium	Low	Low	High	Medium	Medium
- Outbound	Low ¹	Medium ¹	Low	Low	High	High	High
Type of goods inbound							
- Bulk	X	X	V	V	X	X	V
- Semi-bulk	X	V	X	X	X	V	X
- Parts	V	V	X	X	V	V	X
Type of goods outbound							
- Bulk	X	X	V	V	X	X	X
- Semi-bulk	V	V	X	X	X	V	X
- Parts	X	V	X	X	V	V	V
Type of supply chain							
- Convergent	X	X	X	X	X	X	X
- Divergent	V	V	V	V	X	X	V
- Neutral	X	X	X	X	V	V	X

1 Except for spare part distribution, high.

In the table above one can recognize three groups of market sectors that have more or less similar characteristics, the groups are listed below. The factors and the importance of the factors that influence the outsourcing decision in the automotive industry can therefore be very comparable with the factors in the high-tech market sector.

- Automotive and High-tech markets sector
- Chemicals and Oil & Gas markets sector
- Retail, Wholesale and Pharmaceutical markets sector

4.3 Market sector selection rule

Not all market sectors can be studied and therefore two market sectors have to be selected for further study. In this section the rule for selecting these market sectors will be mentioned a selection will be made.

For this research it is interesting and relevant to study two market sectors that differ. By choosing market sectors from different groups market sectors can be compared. When the studied market sector has many comparable characteristics with another sector, the results can probably be applied in the other sector. The rule on which the market sectors for this research are selected is that they should not be in the same group.

Studying markets sectors that differ significantly is important but also the availability and access of information about these market sectors is a relevant aspect when selecting a market sector. Without information or access to Capgemini clients in the market sector an in depth study cannot be conducted. Therefore the second rule to select a market sector is the availability of knowledge within Capgemini and access to Capgemini clients. Based on the selection rules above the following two market sectors will be selected for further research in this report: Chemicals and High-tech

4.4 Conclusion

In this chapter the criteria on which the seven market sectors will be assessed are clarified. Secondly the market sectors are described by means of these criteria. Finally the selection rule to select which market sectors will be studied in depth is defined. With this knowledge sub-questions 3 can be answered.

3 What are the characteristics of the seven market sectors that are interesting for Capgemini and how can two market sectors for further in-depth analysis be selected.

Various markets sectors can be identified. In this research the following seven market sectors are identified and described, automotive, high-tech, chemicals, oil & gas, retail, wholesale and pharmaceutical. Capgemini is active in these seven market sectors.

The seven market sectors are described using several transport specific characteristics. These characteristics are the scale of the inbound and outbound supply chain, that can be local or global. The time criticality is also a distinctive supply chain characteristic of a market sector. A third characteristic of the supply chain is the type of goods in the inbound and outbound supply chain. This characteristic can take the values bulk, semi-bulk and parts. The final characteristic that is used to assess the supply chains of the market sectors is the type of supply chain: convergent, divergent or neutral.

Not all market sectors can be studied in-depth in this thesis therefore two market sectors have to be selected. Market sectors will be selected using the scores on the supply chain characteristics and the availability of knowledge within Capgemini and access to Capgemini clients. The chemicals and high-tech market sector are selected for further research.

5 Outsourcing factors

In chapter 2 theoretical notions were made on outsourcing transport processes. In this chapter the focus is on the concrete factors that are of influence in the transport outsourcing decision. In section 5.1 the factors that may influence the shipper's outsourcing decision will be identified by means of literature study. In section 5.2 the factors are categorized into six categories to make analysis by means of the analytical hierarchy process possible. Later in the research the AHP will be used to determine the weight of these factors. In section 5.3 the relation of the factors and the conceptual model will be stipulated. Finally in section 5.4 research question four will be answered.

5.1 Factors that influence outsourcing decisions

In literature up to 80 factors related to outsourcing can be found. Some of these factors are positively related towards outsourcing other factors negative. The positive factors are reasons, drivers or arguments that plea in favor of outsourcing transport processes. The negative factors are reasons to provide transport process in-house. Here in this section an overview is provided of both the positive and negative factors.

The factors found are shown in appendix 4. The positive factors are listed in table 24 and the negative factors are listed in table 25. These factors are provided with a number for identification purposes (column 1). The N-numbers represent negative factors and P-numbers represent positive factors.

Furthermore it is indicated what the origin of the factors is in the outsourcing decision (column 3). The origin of the factors corresponds with the conceptual model that was presented in section 2.6. In that section it was explained that the factors that are of importance in the outsourcing decision are not only originated at the decision maker, the shipper in this case. Other stakeholders in the presence of the shipper, like the shippers customer and supplier, society and the third party logistic service provider also pose limitations or possibilities that influence the shippers outsourcing decision.

Furthermore it is also already indicated to which category a factor belongs to (column 4). The factors are categorized into the six categories listed below. More on the categorization of the factors will be discussed in section 5.2.

- Profit
- Business performance
- Service quality
- 3PL capabilities
- Monitoring, Information and Traceability
- Legal issues

All factors in the table are accompanied with a reference to the literature in which the factor is mentioned (column 5). Seventeen resources are used to identify the factors, the references to the resources are shown in table 5 below. According to the many factors that were found in different works and the many comparable factors in the list it is concluded that the data saturation point was reached. Studying more literature for more factors will therefore not lead to new unique factors.

Table 5 Sources of the factors

NR	Sources of the factors
1	(Qureshi, Kumar et al. 2007)
2	(Razzaque and Sheng 1998)
3	(Capgemini ^A 2007)
4	(Ploos van Amstel 2008)
5	(Reighelt and Barjis (N.A.))
6	(Brewer, Button et al. 2001)
7	(Bowersox and Closs 1996)
8	(Europa 2005)
9	(Europa 1996)
10	(Europa 2008)
11	(Europa 1993)
12	(Hirsch Ballin 1993)
13	(Europa 2003)
14	(Korthals-Altes 1983)
15	(Europa 2004)
16	(de Ruiters 1981)
17	(TLN 2007)

The choice whether or not to outsource the transport processes is a difficult one. The numerous factors listed in the tables above stipulate the difficulty and the complexity of the decision once again. Note that not all stakeholders contribute factors to the list, factors that originate from the shipper's suppliers are not listed. The reason for that is that each party in the supply chain usually has to manage their outbound supply chain. When the shipper has to manage his outbound supply chain than no factors originated at the inbound supply chain and suppliers will be present.

In the exceptional case that the shipper is responsible for their inbound supply chain than factors that originate at the shippers suppliers will appear in the list. These factors will be comparable with the factors that originate from the customer. It is assumed that the supplier's demands and requirements regarding the transport process will be comparable with the customer's demands and requirements to transport processes.

5.2 Categorization of factors

The factors found in literature will be categorized into six factor categories. The categorization of the factors is needed since the respondents have to indicate which category of factors is important in the outsourcing decision in their market sector. Due to time constraints it is not possible for the respondent to assess every single factor that is listed in the previous section. Furthermore many factors comparable, these factors more or less mean the same but are formulated different. These factors will be listed in one of the six categories.

As mentioned in the previous section the factors are categorized into the following six categories:

- Profit
- Business performance
- Service quality
- 3PL capabilities
- Monitoring, Information and Traceability
- Legal issues

These categories are consistent with the objectives of most commercial companies like shippers. The factors profit, business performance and service quality can also be found in the shippers goal tree that was presented in sub-section 2.1.1. In order to continue business profit has to be made. Profit is very important and is therefore listed as a separate category, note that business performance, service quality, monitoring, information and traceability and legal issues also contribute to profit and the continuity of business. However, for this research it is not specific enough to list all factors under profit.

Good business performance is also essential to continue business and make profit. Furthermore customers' service and quality expectations have to be fulfilled. And for effective business and in order company's information about the core process must be protected and visibility (monitoring, traceability) of transport processes is required.

In the texts below the six categories will be clarified and the relation between the factors and the conceptual model presented in section 2.6 will be made explicit.

5.2.1 Profit

In the profit category all the factors that influence the shippers profit are listed, see table 6. For instance cost reduction, reduction of capital investments and increased productivity. Lower cost and therefore increased profit can be a factor to outsource transport processes to a logistic service provider.

On the other hand some authors foresee an increase in the cost when transport services are outsourced to a third party logistic service provider, such as increase in monitoring cost or doubted cost savings by outsourcing. These factors can be a reason not to outsource transport processes.

The profit factors are all originated at the shipper since this is the party that directly feels the impact of the outsourcing decision on the profit. However, it can be argued that these factors can also be originated at the customer. Cost savings at the shipper can be passed on towards the customer. For this research it conducts too far to include this relation.

Table 6 Factors in the transport outsourcing decision that influence the shipper's profit

NR	Profit factors	Origin	Reference
P1	Cost reduction	Shipper	[1], [2], [3]
P2	Fixed logistics asset reduction	Shipper	[3], [6]
P3	Only invest in core competencies	Shipper	[6]
P4	Reduction of capital investment in facilities	Shipper	[2], [6], [7]
P5	Reduction of capital investment in manpower	Shipper	[2], [6], [7]
P6	No investments in transport activities and resources	Shipper	[4]
P7	Less investments in ICT to support transport processes	Shipper	[4], [6]
P8	Increase productivity	Shipper	[1], [2]
P9	Increase financial ratios like profit/employee ratio	Shipper	[4]
P10	Loss due obsolescence of assets	Shipper	[7]
P11	No (human) resources needed transport processes	Shipper	[4]
P12	No housing needs for transport processes	Shipper	[4]
N1	No cost reduction with outsourcing	Shipper	[3], [4], [6]
N2	High cost of monitoring transport	Shipper	[6]
N3	Difficult to assess the savings made by outsourcing	Shipper	[2]
N4	No real increase in productivity	Shipper	[4]

5.2.2 Business performance

The business performance category includes the factors that influence the shipper's business process, see table 7. Increased productivity, focus on the shipper's core business and quick response to market changes are all of influence to the business performance of the shipper. Therefore these factors can be a reason to outsource transport processes.

On the other hand it can be difficult to change between logistic service providers which makes the business inflexible, or it is difficult to dismiss personnel that was previously involved in the logistic operation. Furthermore it is found to be difficult to bring outsourced services back in-house due to the lack of know-how that emerged. These are all factors that plea not to outsource transport services.

The business performance factors all influence the shipper's business. Therefore these factors are originated at the shipper.

Table 7 Factors in the transport outsourcing decision that influence the shipper's business performance

NR	Business performance factors	Origin	Reference
P13	Increase flexibility (due to the absence of fixed assets)	Shipper	[2]
P14	Less paper work	Shipper	[2]
P15	Possibility to evaluate supplier performance	Shipper	[1]
P16	Outsourcing gives flexibility to react to market changes	Shipper	[4]
P16	Transfer operational and financial risks to 3PL	Shipper	[4]
P18	Decreased order cycle length.	Shipper	[3]
P19	Less damage to products	Shipper	[2]
P20	Quick response to changes	Shipper	[2], [6]
P21	Focus on core business	Shipper	[2], [4], [5], [6], [7]
P22	Simplifying own logistical process	Shipper	[2]
P23	Free up staff	Shipper	[2]
P24	Increased flexibility	Shipper	[6]
P25	Reduce risk due many alternative 3PL's	Shipper	[7]
P26	Competitive advantage	Shipper	[1]
P27	Enhanced value	Shipper	[1]
P28	Increased robustness of operations (back-up)	Shipper	[6]
P29	Productivity enhancement	Shipper	[1], [2]
N5	Difficult to dismiss own employees	Shipper	[2]
N6	Bring outsourced activities back in-house is very hard	Shipper	[4], [5], [6]
N7	Risky to outsource to just one external party	Shipper	[4]
N8	Innovation through in-house expertise	Shipper	[6]
N9	Diluting of core competencies	Shipper	[7]
N10	Difficult to change between 3PL's	Shipper	[2], [5], [6]
N11	Increase risk due few alternative 3PL's	Shipper	[7]
N12	Decrease flexibility due few alternative 3PL's	Shipper	[7]
N13	Inability to select good 3PL	Shipper	[2]
N14	Inability to manage 3PL	Shipper	[2]

5.2.3 Service quality

In the service quality category the factors that contribute to the shipper's service quality towards customers are listed, see table 8. Shorter transit times and a decreased order cycle length can be arguments to transfer transport processes to a 3PL. The inability to select a good 3PL and the inflexibility due to outsourced transport services can be a reason not to outsource transport services.

In the services quality category the origin of the factors is not quite clear. Service quality factors are mainly originated at the customer however there are also service quality factors that are originated at the shipper itself. This is because various departments within a company can be seen as internal shippers and customers.

Improving service to customers and shorter transit times of the goods are clearly factors that are originated at the customer. Factors that are originated at the shipper are for instance, improving the service to own company and shorter transit times.

Some of the factors listed in the service quality category are also listed in the business performance table. Flexibility to react on market changes is improving the business performance of the shipper. But a flexible shipper is also of importance for the customer.

Table 8 Factors in the transport outsourcing decision that influence the shipper's service quality

NR	Service quality factors	Origin	Reference
P30	Reduction of inventory	Shipper	[2]
P31	Shorter transit times	Customer	[2]
P32	Improving service to own company	Shipper	[2]
P33	Improving service to customers	Customer	[1], [2]
P34	Decreased order cycle length.	Customer / Shipper	[3]
P35	Outsourcing gives flexibility to react to market changes	Customer	[4]
N15	Logistics is too important to outsource	Shipper	[3]
N16	Logistic service provider is not trusted to the job	Customer	[3]
N17	Long time to react on market changes (not flexible)	Customer / Shipper	[4]
N18	Inability to select good 3PL	Shipper	[2]
N19	Inability to manage 3PL	Shipper	[2]

5.2.4 3PL Capabilities

In this category the factors that describe the 3PL capabilities are included, see table 9. The 3PL's expertise in transport processes, their good performance and their access to the latest technology and resources can be arguments to outsource transport processes to a 3PL. On the other hand, the lack of confidence or trust in the 3PL's capabilities and the 3PL's inability to understand the shippers goals can be a reason to provide transport processes in-house.

The 3PL capabilities factors reflect what the third party logistic service providers can and cannot do for the shipper. Therefore, the factors listed under 3PL capabilities are factors that are originated at the 3PL.

Table 9 3PL Capability factors in the transport outsourcing decision

NR	3PL Capability factors	Origin	Reference
P36	Acquiring outside expertise	3PL	[2], [5], [6]
P37	Using logistic information system of 3PL	3PL	[2]
P38	Access to latest technology	3PL	[6]
P39	Third party performs better	3PL	[5], [7]
P40	Third party performs cheaper	3PL	[5]
P41	Direct assistance or participation or involvement	3PL	[1]
P42	Third party has the required skills	3PL	[6]
P43	Access to specialized resources	3PL	[7]
N20	Map strategy and resolve problems together with 3PL	3PL	[2]
N21	3PL does not understand clients goals	3PL	[2], [3], [4]
N22	Lack of confidence / trust in 3PL performance (own employees perform better)	3PL	[2], [5]
N23	3PL does not have knowledge of market sector	3PL	[4]

5.2.5 Monitoring, Information, Traceability

This category includes the factors that are related to the monitoring and information with regard to the transport processes, see table 10. Trust and commitment between the third party logistic service provider and the shipper can be a reason to outsource transport processes. Also good coordination between the parties and mutual information sharing can be reasons to outsource transport processes. The loss of touch with important information and the need to share information with 3PLs can be reasons for a shipper to provide in its own transportation.

The monitoring, information and traceability factors are originated at both the shipper and the logistic service provider. That is logical since it concerns a process between two (or more) parties instead of a discrete amount of goods that is delivered.

Table 10 Monitoring, information and traceability factors in the transport outsourcing decision

NR	Monitoring, Information and Traceability factors	Origin	Reference
P44	Commitment /trust	Shipper and 3PL	[1]
P45	Two way information sharing	Shipper and 3PL	[1]
P46	Coordination	Shipper and 3PL	[1]
N24	Need to be in control of the transport process	Shipper and 3PL	[2], [3]
N25	Loss of touch with important information	Shipper and 3PL	[2]
N26	Need to share strategic information makes shipper vulnerable	Shipper and 3PL	[5]
N27	Difficult to control transport processes	Shipper and 3PL	[6]

5.2.6 Legal issues

In the legal category the legal demands and constraints are listed, see table 11. The strict rules for working conditions and the strict safety rules for vehicles can be a reason to leave transport processes at the logistic service provider. It is quite a task to comply with all the rules and regulations that are concerned with transport and logistics, especially for shipper whose main business process is not the transport process.

Obviously these legal factors are originated from regulatory offices in society. In the references examples of rules and regulations are given, hereby it was not the intention to provide an exhaustive list of all the rules and regulations that are applicable in transport and logistics.

Table 11 Legal factors in the transport outsourcing decision

NR	Legal factors	Origin	Reference
P47	Legal constraints for fleet emission	Society	[8], [14]
P48	Regulations regarding vehicle operation	Society	[6], [12], [16]
P49	Regulations regarding product handling	Society	[6]
P50	Rules regarding working conditions	Society	[16], [17]
P51	Rules concerning warehousing	Society	[-]
P52	Rules for transport conditions	Society	[9], [10]
P53	Emission rules for companies	Society	[-]
P54	Rules concerning employer competency	Society	[11]
P55	Safety regulations sea transport	Society	[13], [15]

5.3 Relation to the conceptual model

In section 2.6 the conceptual model was presented. The conceptual model consists of the following supply chain participants: supplier, a shipper and a customer. Additionally there is a third party logistic service provider that possibly provides transport processes for the shipper. Also society is included in the model.

In section 3.3 the conceptual model was extended with a transport outsourcing scale. By means of four transport alternatives the extent of outsourced transport alternatives can be indicated.

The stakeholders in the conceptual model are not independent, the contrary is true. These parties can influence each other's behavior. The relation of these parties with the shipper becomes apparent in the shipper's decision whether or not to outsource transport processes to a third party. As explained in the previous sections many factors play a role in this decision. These factors can be originated at the shipper itself or at one or more of the other stakeholders. The factors of the stakeholders that contribute to the shippers decision on outsourcing transport processes is represented by means of the straight arrows indicated with 'factors'.

Society is the group of stakeholders that are not directly included in the supply chain. Nevertheless these stakeholders do have influence on the supply chain processes and organization of the supply chain mainly via rules and regulations.

It has been shown that many factors can influence the shipper's transport outsourcing decision. In the previous section these factors have been categorized into the following six categories:

- Profit
- Business performance
- Service quality
- 3PL capabilities
- Monitoring, Information and Traceability
- Legal issues

The categorization of the factors is key in this research therefore it is included in the conceptual model, see figure 16 below. With this final addition the conceptual model of the shipper's transport outsourcing decision is completed. In the remainder of the thesis the weight of the categorized factors in and the extent of outsourced transport processes will be studied.

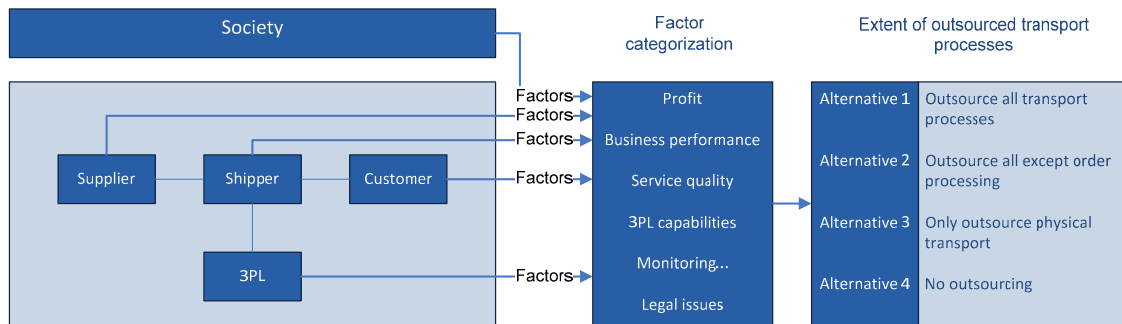


Figure 16 Conceptual model

5.4 Conclusion

In this chapter the factors that influence the outsourcing decision are listed, these factors were found in literature. It is showed that many different types of factors influence the shipper's transport outsourcing decision. To keep the overview and to make analysis by means of the analytical hierarchy process possible these factors are categorized into six categories. These factor categories will be the basis for further analysis in the chemical and high-tech market sector.

With the findings displayed in this chapter sub-question 4 can now be answered.

4 What are the factors originated at the shipper and the other stakeholders that influence the shipper's outsourcing decision?

The factors that are of importance are listed shown in appendix 4, tables 24 and 25. These factors are categorized in the categories profit, business performance, service quality, 3PL capabilities, monitoring, information and traceability and finally legal issues. These factors clearly relate to the stakeholder's capabilities or stakeholder's objectives.

At this stage of the research all the sub questions that can be answered by means of literature and desktop research are answered. The stakeholders are identified, the main concepts are explained, the term transport process is defined, market sectors of in-depth research are selected and the factors that influence the shipper's outsourcing decision are known. With the results of this chapter the conceptual model of the shipper's transport outsourcing decision has been finalized, see figure 16.

The importance or weight of the categorized factors is still unknown. As mentioned before, the importance of factors will presumably vary per market sector and also which transport processes that will be outsourced will be sector dependent. The importance of the factors and how they relate to outsourced processes in the high-tech and chemical market sector will be studied in the remainder of the thesis. The following chapter starts with the discussion of method that will be used to answer the remaining questions.

6 Research Method

In this chapter the methods that will be used to do the field research will be explained and the choice for these methods will be motivated. To gather data from supply chain management experts in the chemicals and high-tech market sectors a combination of interviews and questionnaires will be used. Interviews are used to gather the qualitative data about the underlying factors in the outsourcing decision. Interviews will be discussed in section 6.1. The questionnaires will provide the qualitative data that is needed to establish the weight of the factors in the outsourcing decision. The questionnaires will be elaborated on in section 6.2. In section 6.3 the analytical hierarchy process will be presented as suitable method to analyze the data from the questionnaires. In section 6.4 it will be briefly discussed which alternative methods instead of the AHP are available and it is motivated why these methods are not used in this research. Finally in section 6.5 the methodological sub-question will be answered.

6.1 Interviews

Interviews will be used in two ways in this research. Firstly interviews will be used to get a first idea of the important aspects of the chemicals and high-tech market sector. In these interviews the decomposition of the transport processes (see chapter 3) can be verified with experts. Furthermore, the list of factors can be checked for completeness and a general ranking can be made during the interview. For the verification purpose of the interviews not many interviews are needed. With two interviews the most important flaws will be identified and a general idea of the most important factors will be established. These interviews will be held with Capgemini employees with a specialization in a specific market sector. More about the selection of respondents will be mentioned in sub-section 7.1.1.

Secondly interviews will be used to gather new data in the two market sectors that were selected for further research: chemicals and high-tech market sector. During the interview information is gathered over the organization of transport processes at a specific chemical or high-tech company. Furthermore questions will be asked about interviewees role and responsibilities within the high-tech or chemical company and their experience regarding supply chain management. These questions are important since they determine the validity of the results. More on the interview questions and the development of the interviews will be provided in sub-section 7.2.2. This type of interview will be held with expert active in one of these market sectors, therefore automatically a market sector specific image is generated. The selection of the respondents for these interviews will be explained in sub-section 7.1.2.

There are several positive aspects to interviews as a method to gather data. Firstly interviews are a suitable method to obtain information about the respondents viewpoints and knowledge (Baarda and Goede 2001). Secondly, the interviewee is in the opportunity to respond freely and openly to the questions posed, thereby often telling more than the initial question could aim for (Whitten and Bentley 2007). Thirdly, when the question is not answered completely one can ask the interviewee for more feedback (Whitten and Bentley 2007). Fourthly, the interviewee can be asked what he thinks or does and also the reason why (Baarda and Goede 2001). Fifthly, the questions can be changed and reformulated according to the findings of previous interviews. The interviews become better and more to the point over time. Sixthly, when several interviews are conducted the questions can be adapted to each individual interviewee (Whitten and Bentley 2007). Finally, there are also some practical advantages to interviews, namely the possibility to ask many questions in a short period of time, little non-response and little unanswered questions (Baarda, Goede et al. 2007). An overview of the advantages is provided in table 12 below.

The advantages of interview perfectly suit the two purposes for the interviews, namely to establish a general idea of the markets sectors and the gather new information from the market. In this research qualitative data about outsourcing transport processes is gathered. In order to obtain all relevant information it is important that the respondent can speak freely and is able to ventilate its opinion about the subject. Furthermore the outsourcing decision is studied. Not just the just the outcome of the decision

is of importance but also the reason and motivation behind this outcome. For this research it is therefore key to be able to ask the why-question.

Interviews have drawbacks that have to be kept in mind. Firstly, interviewing is a very time consuming data gathering approach. Time is needed to develop every, more or less, unique interview, to take the interview and to work out the interview (Baarda, Goede et al. 2007). Secondly, the success of the interview is highly dependent on the skills of the interviewer (Whitten and Bentley 2007). Thirdly the reliability of the answers can be a problem due to social desirable answers (Baarda and Goede 2001). Thirdly the reliability can be at stake when the interviewee is unwilling to share possible strategic information. Finally, many interviews have to be conducted to be able to generalize the results due to the subjective nature of interviews. An overview of the disadvantages is provided in table 12 below.

As mentioned earlier, interviews in this research are used for two purposes. Firstly, to get a general idea of the markets sectors. Secondly, to gather market specific information. Not many interviews are needed so therefore the time investments will be moderate. The findings of the interviews are generalized with care to other market sectors.

Table 12 Overview of the advantages and disadvantages to interviews as data gathering method

(Dis)advantages of interviews	Reference
Advantages	
1 Easy to obtain knowledge and viewpoints	Baarda and Goede 2001
2 Interviewee can respond freely and openly	Whitten and Bentley 2007
3 Possibility to ask for more feedback	Whitten and Bentley 2007
4 Possibility to ask the what-question <i>and</i> the why-question	Baarda and Goede 2001
5 Questions can be reformulated over time to improve the interview	-
6 Questions can be adapted for to individual interviewee	Whitten and Bentley 2007
7 Many questions, little non-response, little unanswered questions	Baarda, Goede et al 2007
Disadvantages	
1 Time consuming	Baarda, Goede et al 2007
2 Success depends on interviewers skills	Whitten and Bentley 2007
3 Reliability due to social desirable answers	Baarda and Goede 2001
4 Reliability due to strategic information	Baarda and Goede 2001

When the advantages and disadvantages of the interview method are considered with respect to the purpose of the interviews, it is concluded that interviews are suitable for the purpose. By means of interviews with Capgemini experts the outsourcing factors and the transport processes can be verified prior to the interviews in the market. The interviews with experts active within the high-tech and chemicals market sector provide a good insight in the factors that are important in a specific market sector. The properties that knowledge and viewpoints can be obtained and that the interviewee can respond freely to the questions asked are the most important advantages to use interviews as research method. In addition, the interview provides the possibility to ask for more feedback when the answers of the interviewee are not clear or need extra information. Furthermore the reason behind an outsourcing decision can be identified, not just the decision. Obviously the drawbacks have to be kept in mind especially with the generalization of the findings.

6.2 Questionnaire

In the interviews with experts in the chemicals and high-tech market sector qualitatively information about outsourcing transport processes and the factors that influence the outsourcing decision is collected. Presumably not all the factors in the outsourcing decision are of equal importance. It is assumed that the weight of the factors will differ per market sector and probably per company.

To assess the importance or weight of the factors some quantitative information about the expert's preference is needed. A good method to gather quantitative data is a questionnaire. In this research the

questionnaire will be used in addition to the interview, the questionnaire is in fact a part of the interview. The qualitative information from the interviews will be completed with quantitative information about the importance or weight of the factors that are of importance in the outsourcing decision.

There are several advantages in using questionnaires. Firstly, most questionnaires can be filled out quickly at a moment that suits the respondent. The answers can be returned at the respondents convenience (Baarda and Goede 2001). Secondly, a questionnaire is a relatively inexpensive data gathering method at a large number of persons (Baarda and Goede 2001). Thirdly, these persons can maintain anonymity and therefore it is likely that they provide reliable information instead of 'desirable' answers (Baarda, Goede et al. 2007). Finally, the uniform answer sheets allow quick analysis (Whitten and Bentley 2007). An overview of the advantages is provided in table 13.

A questionnaire also has disadvantages. Firstly the response rate for questionnaires is often low, people do not feel obliged to cooperate in the survey (Baarda, Goede et al. 2007). And, secondly, there is no guarantee that the respondent will answer all the questions (Baarda, Goede et al. 2007). Thirdly, questionnaires are static, there is no possibility to correct respondents misinterpretations and to obtain extra information (Whitten and Bentley 2007). Fourthly, there is no opportunity to observe non-verbal information (Whitten and Bentley 2007). Finally, the development of a good questionnaire is a difficult and time consuming activity (Baarda and Goede 2001). An overview of the disadvantages is provided in table 13.

Table 13 Overview of the advantages and disadvantages to questionnaires as data gathering method

(Dis)advantages of questionnaires	Reference
Advantages	
1 Questions can be answered when it suits the respondent	Baarda and Goede 2001
2 Relatively inexpensive data gathering method	Baarda and Goede 2001
3 Respondents maintain anonymity	Baarda, Goede et al 2007
4 Quantitative and uniform data for analysis	Whitten and Bentley 2007
Disadvantages	
1 Low response rate	Baarda, Goede et al 2007
2 Possible unanswered questions	Baarda, Goede et al 2007
3 No possibility to correct misinterpretations	Whitten and Bentley 2007
4 No possibility to observe non-verbal communication	Whitten and Bentley 2007
5 Developing questionnaire is time consuming	Baarda and Goede 2001

For this research the advantages of a questionnaire outweigh the disadvantages of this method. To find out the weight of the factors that determine the outsourcing decision it is necessary to have uniform data. A questionnaire in which the respondents have to fulfill a ranking task provides this uniform data, this task will be explained in the data gathering chapter (chapter 7). The uniform data property of the questionnaire is the main reason to use this method in addition to the interview. The other advantages like anonymity and the idea that the respondent can answer the questionnaire cannot be benefited from in this situation, since the questionnaire is answered during the interview. The combination of an interview with a questionnaire excludes some of the advantages, however it also cancels out many of the disadvantages to questionnaires. The combination with the interview guarantees a full response and a complete answering of the questionnaire. Furthermore misinterpretations can be corrected and non-verbal communication can be observed. Therefore it is concluded that questionnaires are a good suitable method for this research. The combination of interview and questionnaire will provide the necessary data for this research.

6.3 Analytical Hierarchy Process

In this section the analytical hierarchy process is proposed as the single actor multiple criteria method in this research. First some theoretical notions on the AHP will be made to introduce the method and to

prove the usefulness of the method in this research. Furthermore there is referred to similar applications of the AHP in outsourcing decisions.

6.3.1 Theoretical background of the AHP

The Analytical Hierarchy Process (AHP) is a multi-criteria decision making approach in which the factors that influence the decision are arranged in a hierarchical structure (Saaty 1990). The factors are arranged into a hierarchical structure with the overall goal of the decision problem on top and descending via criteria, sub-criteria to the alternatives in successive levels.

It is good to mention that the AHP is originally developed as a single actor decision making method or tool. In the AHP the weight of the decision criteria and sub-criteria and the final choice for an alternative is made transparent. However, the AHP is applied in so many group decision processes that it appears to be a multi-actor decision support method.

The hierarchical arrangements of goals, criteria, sub-criteria and alternatives in the AHP has two reasons. First it provides an overview of the complex relationships between the elements involved in the decision problem. Secondly it helps the decision maker to assess whether the factors are of similar importance or magnitude, that is needed to compare similar factors accurately (Saaty 1990). The general structure of the decision problem is depicted in figure 17. Note that AHP literature refers to the factors as criteria, sub-criteria and elements. In this study the term factors will be used.

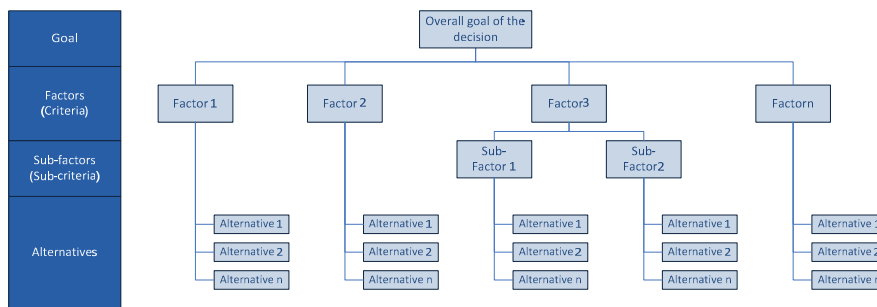


Figure 17 Generic AHP decomposition of a decision problem into overall goal, factors, sub-factors and alternatives to choose from (Saaty 1990)

The factors in the model above all represent a different part of the problem. One of the factors can represent the cost aspects of the decision and another factor can represent the capabilities of the third-party service provider. Sub-factors can be used to clarify a factor or to focus on one or more parts of the overall decision. Obviously the factors that have a more general character are positioned higher in the hierarchy and the more focused factors are placed lower in the hierarchy.

The respondent's task is to pair-wise compare the factors and the alternatives by means of standardized scales. These scales are based on the fundamental scale of absolute numbers (Saaty 1990) and (Saaty 2008)(see appendix 5). By doing that, the weight of each of the factors is determined and finally one of the alternatives can be selected.

So the AHP provides a structured framework for setting priorities on each level of the hierarchy using a process of evaluating each pair of decision factors at a given level on the model for their relative importance with respect to their parent.

The AHP can be subdivided into the following four steps (Saaty 2008):

1. Define the problem and determine the wanted knowledge.
2. Structure the decision problem as a hierarchy. The goal of the decision on top, the factors and sub-factors in the intermediate levels and the alternatives at the bottom.

3. Construct the pair-wise comparison matrices. Every factor in the upper level is compared to factors in the level directly below.
4. The priorities from step 3 are used to weigh the priorities in the level below. This is done for every factor in the level below. Then the weighed values can be used to calculate the overall or global priority or importance. This process is repeated for every alternative at the bottom level.

The result of these four steps is an overview of the priority or weight of each factor in the decision and an overall evaluation of the alternatives.

From the theoretical notions on the AHP it can be concluded that this method suits the purpose of the research. Once the factors are known the weight of these factors can be determined and an alternative, which represents the extent of outsourcing transport processes, can be selected.

6.3.2 Application of the AHP in outsourcing decisions

The AHP is applied in previous research to outsourcing decisions. Kumar and Bisson (Kumar and Bisson 2008) apply the AHP to improve decision making within supply chains. They recognize that due to the growing global economy and competition many manufacturing companies struggle with the decision whether to build their products internally or outsource the production to a third party. In their paper Kumar and Bisson identify the Analytical Hierarchy Process as an ideal multi-objective decision support tool to assist companies in the outsourcing decision. The AHP's possibility to include non-traditional criteria in the decision making process was one of the success factors of the application of the AHP. Furthermore it was found that the AHP was a powerful, structured and flexible method in the outsourcing decision (Kumar and Bisson 2008).

The application of the AHP in the work of Kumar and Bisson is not completely equal to application of the AHP in this research. Kumar and Bisson assess a traditional make-or-buy decision in which the production of physical parts will be outsourced or not. In this research not the production of parts will be outsourced but the provision of a transport service. The subject of outsourcing is different in both analyses, however the structure of the problem into the AHP is the same.

Another difference is that Kumar and Bisson apply the AHP to the decision on which vendor to select. The decision to transfer the production to a third party is already made, now they use the AHP to find the best party to transfer the production to. In this research the focus is not on the vendor selection but on the question before the vendor selection: 'outsource transport processes or not?'. Once again, the subject of the decision is different in the analyses is but the structure of the problem is equal. When one of the vendors in the problem of Kumar and Bisson is replaced with the shippers (capabilities) than the vendor selection problem is changed into an outsourcing decision.

Also Xia and Wu apply the AHP in the supplier selection problem (Xia and Wu 2005). In their work they determine the supplier to buy from and the volume that should be purchased. The structure of the problem is comparable with the supplier selection problem.

In the research of Udo the AHP is used to analyze the information technology outsourcing decision (Udo 2000). Udo's study provides a systematic analysis for evaluating components of the company's IT that may be outsourced to a third party. In his paper the AHP is proposed as a suitable method to analyze the IT outsourcing decision. With the AHP several possible alternatives of outsourcing IT components can be ranked using several criteria. The decision maker adequately evaluate and determine which IT components should be outsourced (Udo 2000).

In the work of Udo the structure of the problem is equal to the structure of the problem in this research. Also the type of process that is possibly outsourced is almost the same. IT processes versus transport processes, both processes are intangible or services, instead of production of physical parts. However Udo makes a decision to which (third) party particular IT components will be transferred whereby the

company's own IT department is one of the possible alternatives. This is the same as providing IT service in-house.

The difference between the work of Kumar & Bisson, Xia & Wu, Udo and this research is that in the first three analyses the focus is on the selection of the third party. The various vendors or third party service providers are the alternatives to choose from. In this thesis the alternatives consist of the possible transport processes to outsource to a logistic service provider. In the four alternatives a variation is made in the outsourced transport processes varying from outsourcing none of transport processes to outsourcing all transport processes to a third party logistic service provider. More information on the development of the transport alternatives will be provided in sub-section 7.2.2.

By taking this approach two questions are answered in one AHP structured problem. The first is the decision whether or not to outsource transport processes and secondly, to which extent transport processes are outsourced. Or, which of the various transport processes are outsourced. From the results of the AHP one can see which categories of factors are important in the decision which transport processes to outsource. Finally, to which specific 3PL the transport processes are transferred is not answered in this research. Insight in the supplier selection problem is not the aim of this study.

6.3.3 Sub-conclusion

In this research the AHP is proposed as a suitable method or technique for analyzing transport process outsourcing decision. AHP can be used to rank possible outsourcing alternatives using multiple factors. In this report the AHP will be used to determine the weight of the outsourcing factors and to rank the various outsourcing alternatives. These alternatives are (logical) combinations of outsourced transport processes. These are combinations of the transport processes that were identified in chapter 3. One of the alternatives can be outsourcing all physical transport activities such as transport, order picking, (un)loading, warehousing and provide the planning activities in-house.

The AHP is used by other authors to analyze outsourcing decisions in various fields of practice. In the previous sub-section three examples of similar analyses were discussed and in both the work of Kumar & Bisson, Xia & Wu and Udo the AHP proved to be a valuable tool to make strategic decisions in outsourcing business processes.

6.4 Alternative research methods

In the previous section the analytical hierarchy process is proposed as a suitable method to analyze the decision on outsourcing transport processes. In this section two alternative methods will be mentioned, Q-methodology and MCDA methods. These methods can be used in similar analyses, however their application fails in this specific research.

The main reason not to use Q-methodology is the high number of respondents needed for a sensible factor analysis on which the method is based. Not many respondents can be found within the limited time for this thesis project. Furthermore it is hard to determine the extent of outsourcing transport processes by means of Q-methodology, the extent of outsourcing is one of the main sub-questions of the research.

For the MCDA methods, the main reason not to apply them is the assumption that there is full insight in the decision makers importance or weight to the decision criteria (Lexicographical method, Goal Programming, ELECTRE methods). In this research one of the main objectives is to find out the weight of the factors (criteria) in the outsourcing decision. Of the MCDA methods discussed the PROMETHEE methods seem to have the best references with respect to the objectives in this research, therefore the PROMETHEE methods are a good second option.

In this section the methods are briefly mentioned and the main reason not to use them in this research is provided. The reader is referred to appendix 6 for an extensive elaboration on alternative methods.

6.5 Conclusion

At the end of this methodological chapter conclusions can be drawn regarding the methodological sub-question 5.

5 Which method can be used to determine the weight of the factors in the outsourcing decision and to find out the extent of outsourcing?

The analytical hierarchy process method is proposed as a good method to determine the weight of the outsourcing factors and to rank the various outsourcing alternatives. AHP can be used to rank possible outsourcing alternatives using multiple factors. Furthermore the extent of outsourcing transport processes can be determined. In addition it is showed that the AHP is applied in many similar decisions by various authors. In many works the AHP proved to be a valuable tool to make strategic decisions in outsourcing business processes.

By using the AHP the factors are related to alternatives. The alternatives consist of transport activities that can be outsourced. So the factors and the extend in which transport processes are outsourced are automatically linked.

It is showed that many alternative multi criteria methods exist, however their application in this research fails. Q-methodology cannot be applied since many respondents are needed for a statistically sound analysis. That many respondents cannot be found in the time for this research. The other multi-criteria techniques are not suitable for this research since they assume that the weight of the criteria (factors) in the decision is known prior to the analysis. In this research the weight of the factors is subject of study.

7 Data gathering

In chapter six, section 6.1, already two types of interviews were distinguished, first the interviews with Capgemini experts in a market sector. These interviews aim at the verification of parts of the work in this report. Secondly there are interviews with experts in supply chain management that are active at companies in the high-tech and chemicals market sector. The aim of these interviews is to establish a market specific view on outsourcing transport processes. There is referred to the two types of interviews as internal interviews and external interviews.

In this chapter the data gathering process will be clarified. Firstly in section 7.1 the selection of respondents for the internal interviews as well as the external will be explained. Secondly in section 7.2 the development of both types of interviews will be explained. This chapter is concluded with a description of the data gathering process.

It is relevant to include the data gathering information in the report since in the initial assignment for this study seven market sectors should be studied and compared. Due to time constraints only two market sectors could be studied. The information in this chapter enables others to extend the study to other market sectors thereby using the same research set up.

7.1 Selection of internal and external respondents

As mentioned before internal as well as external interviews are conducted in this research. The selection procedure and the requirements to the respondents for both types of interview will be discussed in this section.

7.1.1 Respondents for the internal interviews

For the internal interviews persons are needed that are professionally involved in one of these market sectors. Capgemini employees are IT specialists and obviously do not work for an chemical or high-tech company. However their experience with projects in the field of supply chain management at companies in the chemical or high-tech sector are valuable for this research.

The purpose of the internal interview is the verification of the work before external respondents will be approached and the external interview will be developed. By following this approach the main flaws in the work will be corrected before the market specific research is conducted. This will lead to better interviews and more complete results. The verification purpose of the internal interviews is also explained in section 6.1.

The requirements for the respondents for the internal interviews are as follows:

1. The respondent should be employed at Capgemini.
2. The respondent should be knowledgeable in the field of supply chain management.
3. The respondent should have experience with projects in the high-tech or chemical market sector.

The number of respondents does not need to be very high since the purpose of the interview is just to establish a good understanding of the market sector in preparation of the interviews with persons in the market. During these interviews the flaws and misunderstanding about the market sectors can be easily detected.

It has to be emphasized that it is the face validity of the results is leading in this research and not the statistical validity. The respondents' ideas about the initial findings are taken seriously because the respondent is professionally involved in the high-tech or chemical market sector. The validity of the results is not established by means of a statistical solid analysis.

Two interviews are held with Capgemini employees. Capgemini Employee 1 (vice president MRD/ EUC&T) is interviewed about the high-tech market sector. Capgemini Employee 2 (managing consultant Product & Market Solutions) is interviewed about the chemical market sector.

7.1.2 Respondents for the external interviews

For the external interviews respondents that are professionally active in the chemicals or high-tech market sectors are needed. By interviewing these persons a market specific view on outsourcing transport processes is established. These persons can indicate the importance of factors in the outsourcing decision in their market sector.

The requirements for these respondents are rather strict to ensure the face validity of the results. The requirements are listed below:

1. The respondent should be professionally active in the chemical or high-tech market sector.
2. The respondent should be an expert or knowledgeable in the field of supply chain management.
3. The respondent should be responsible for supply chain management in their function.
4. The respondent should be active at a high level in the company they work for.

The respondents in the market are approached via Capgemini account managers or via personal network. The account managers established the first contact between the respondent and the researcher by e-mail. Half a week later the possible candidates were contacted again by telephone or e-mail with the concrete question about their participation in the research about transport outsourcing at shippers.

Seven respondents are found that match the four requirements and that are willing to participate in an interview. Three to four interviews will be held at different companies in each market sector. The number of respondents seems rather low, however it is once again the face validity of the results that is important and the statistical validity is less important. The respondents' opinions and viewpoints on outsourcing transport processes in the high-tech or chemical markets sector are 'believed' because the respondent is an expert in the field of supply chain management. The persons that were interviewed in the market are listed in table 14.

Table 14 Respondents for the external interviews

Sector	Company	Respondent	Function	Date	Approached
Chemicals	Chemical company A	Respondent 1	Manager Logistics Salt	14-10-2008	Via Capgemini
Chemicals	Chemical company B	Respondent 2	European Supply Chain Manager	21-10-2008	Via Capgemini
Chemicals	Chemical company C	Respondent 3	Supply Chain Manager	22-10-2008	Own network
High-Tech	High-Tech company A	Respondent 4	European Transport Director	23-10-2008	Via Capgemini
High-Tech	High-Tech company B	Respondent 5	Logistics Director Europe	17-11-2008	Via Capgemini
High-Tech	High-Tech company C	Respondent 6	Logistics Operations Manager	4-11-2008	Via Capgemini
High-Tech	High-Tech company D	Respondent 7	Senior Director Global Warehousing	23-10-2008	Via Capgemini

7.2 Development of internal and external interviews

In this section the development of both the internal and external interviews is discussed. The questions that will be asked and how these questions contribute to the research is explained in this section.

7.2.1 Development of internal interview

The internal interview is developed to verify the initial ideas about the market sectors and to check if these ideas are compatible with the objective of this research.

Therefore the interview consist of the following three parts:

1. Introduction to the research.
2. Interview questions.
3. Verification of transport processes, IDEF representation and initial list of factors.

The first part of the interview consist of an introduction to the research. The main research question is mentioned and the two main aspects of the question, the factors in the outsourcing decision and the extent of outsourcing, were highlighted.

In the second part of the interview specific questions were asked about the chemicals and high-tech market sector. These questions should provide an idea of the specific market sector and the answers on these questions enable the development of better, and more specific interviews for the external interviews.

- Can we identify other different supply chains within the high-tech market sector?
- For which supply chain is the shipper responsible?
- Which of the transport processes are generally outsourced and which not?
- Which factors or arguments, reasons influence the decision on whether or not to outsource transport processes?
- What is the weight of these factors?
- Is there a trend in outsourcing transport processes?

Thirdly, during the interview the decomposition of the transport processes in the IDEF-diagram will be assessed. Flaws in the structure of the diagram can be detected. Furthermore the initial list of factors will be reviewed, from this exercise an idea of the relevant and less relevant factors will be generated.

During the development of the interview the guidelines for good interviews and questionnaires of Baarda en De Goede were applied (Baarda and Goede 2001) and (Baarda, Goede et al. 2007).

The final interview that is conducted is shown in appendix 7. Both the internal and external interviews are conducted with Dutch speaking respondents, therefore interview in the appendix is in Dutch. The interview is not translated to guarantee a precise reflection of the questions that were leading in the conversation.

7.2.2 Development of external interview

The external interviews are developed to create a market specific view on the two market sectors. Therefore the respondent will be asked to answer a series of open questions and in order to get some quantitative information about the weight of the factors some pair wise comparisons have to be judged.

The interview consists of the following parts:

1. Introduction to the research
2. Open interview questions
3. Determine the weight of the factors in the outsourcing decision

The first part of the interview consist of an introduction to the research. The main research question is mentioned and the three main aspects of the question are stipulated, namely: which factors influence the shipper's transport outsourcing decision, what is the extent of outsourcing transport processes, what is the need for control and information about these processes?

In the second part of the interview specific questions were asked about the professional background of the respondent and outsourcing transport processes in the specific market sector. The questions about the background are important since it determines the validity of the results. To ensure that the same information about every respondent is collected, these questions are a part of the interview. The questions that will be asked are listed below:

- What is your role or function at the company you work for?
- What are your responsibilities in that role / function?

- For how long are you active within the field of supply chain management or logistics?
- Which field of practice were you active prior to your current occupation
- What were your responsibilities in that role or function?
- Are transport processes outsourced to a 3PL at the company you work for?
- In which supply chain are the transport processes outsourced. Or in which supply chain organizes the company transport.
- Which transport processes are outsourced and which transport processes are provided in-house? See also table 1 in appendix 1* with transport processes. (*appendix 1 of the interview)
- What are the factors, reasons, arguments, for this decision?
- When transport processes are transferred to a 3PL, would you like to receive from the 3PL about the transport processes?
- In which cases do you want to receive information?
- Which specific information would you like to receive from your 3PL. (How should the information look like, frequency of the information)
- When transport processes are outsourced, what would it take to provide these transport back in-house?
- Which transport processes would you insource again?
- Are there any important aspects of outsourcing transport processes that we did not discuss?

The third step in the development of the external interviews consist of three sub-steps itself, develop transport outsourcing alternatives, identify factors, and finally make the pair-wise comparisons. The transport outsourcing alternatives were developed in chapter 3. The factors were identified and categorized in chapter 5. These six factor categories are the basis for further analysis.

At this stage of the research only the pair-wise comparisons between the factors with respect to the overall goal and the comparisons between the alternatives with respect to every factor have to be developed. To determine the weight of each factor in the outsourcing decision every factor has to be compared with every other factor. With six factors present in the analysis this leads to $n(n-1)/2$ which equals 15 comparisons to determine the factor weight.

To determine the choice for one of the alternatives all these alternatives have to be compared with respect to the six factors in the decision. Since there are four alternatives in the analysis, 6 comparisons are needed per factor. In total 36 comparisons have to be judged by the respondent.

The respondents rate the comparisons on a scale that is based on the fundamental scale of absolute numbers, see appendix 5. The scale is adjusted to match the specificities of this research. When the original fundamental scale is used the first mentioned factor in the comparison can only be equally important or more important than the factor that is mentioned second in the comparison. The same is true for the comparison of the alternatives, the first mentioned alternative in the comparison can only be equally preferred or more preferred than the factor that is mentioned second in the comparison.

In this research a scale is needed on which the respondent can indicate that a factor or alternative is less important or less preferred. Therefore the scale is extended with a negative side. As a result the original five-point scale is changed into a nine-point scale. The rating scales for the comparison of the factors is depicted in figure 18 and the rating scale for the comparison of the alternatives is depicted in figure 19.

Note that it is a convention of the fundamental scale to only use the odd numbers. The even numbers can only be used when the respondent thinks that the difference between two odd numbers is too big to make a good comparison.

-9	-7	-5	-3	1	3	5	7	9
Extremely unimportant	Very strongly unimportant	Strongly unimportant	Moderately unimportant	Equally important	Moderately important	Strongly important	Very strongly important	Extremely important

Figure 18 Nine-point scale to express the importance of a factor in the transport outsourcing decision

-9	-7	-5	-3	1	3	5	7	9
Extremely not preferred	Very strongly not preferred	Strongly not preferred	Moderately not preferred	Equally preferred	Moderately preferred	Strongly preferred	Very strongly preferred	Extremely preferred

Figure 19 Nine-point scale to express the preference for a transport outsourcing alternative

The experts use these scales to compare factors and the alternatives. An example of a pair-wise comparison is shown in figure 20 below. The question is how much profit and service differ in importance with respect to the overall goal, namely making a decision on outsourcing transport services. In the example below the importance of profit in compared to business performance with respect to the overall goal is indicated with a 7. According to the scale in figure 18 profit is strongly more important than service in the outsourcing decision. The complete external interview including the pair-wise comparisons can be found in appendix 7.

0	Profit	-9	-7	-5	-3	1	3	5	7	9	Business performance
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Figure 20 Example pair-wise comparison task

The combination of the qualitative open questions and the quantitative pair-wise comparisons enables to assess the internal validity of the answers. The answers of the open questions can be compared to the results of the pair-wise comparisons. Furthermore the AHP enables to assess the consistency of the pair-wise comparisons. More on this will be discussed in both chemical and high-tech case study in chapters 8 and 9.

During the development of the external interview the guidelines for interviews and questionnaires of Baarda en De Goede were applied (Baarda and Goede 2001) and (Baarda, Goede et al. 2007).

The final interview that is conducted is shown in appendix 8. Also the external interviews are conducted with Dutch speaking respondents, therefore interview in the appendix is in Dutch. The interview is not translated to guarantee a precise reflection of the questions that were leading in the conversation.

7.3 AHP analysis design in Excel

In this section the AHP analysis design in Microsoft Excel will be discussed. The development of this design is part of the data gathering and data processing process, but the respondents will not be confronted with this part of the research.

At this stage of the research all elements of the hierarchy are known, the factors are identified and categorized in chapter 5 and the alternatives that reflect the extent of transport outsourcing are developed in section 7.2. Now the decision problem can be decomposed into a hierarchy of a goal, factors, sub-factors and the alternatives. The main problem on outsourcing transport processes is the root of the hierarchy, the factors that influence or contribute to the decision are put in the level below the goal, when there are sub-factor these are placed in the level below the factors. The leaf nodes of the hierarchy are the various alternatives. The hierarchy is depicted in figure 21 below.

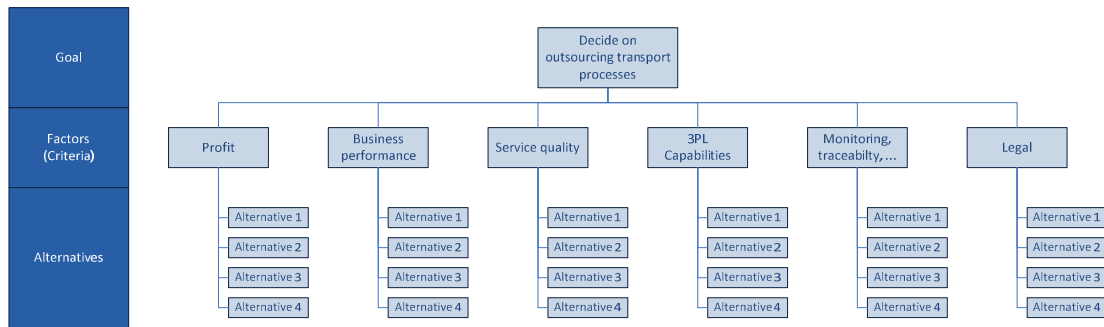


Figure 21 Hierarchic structure of goal, factors and alternatives

In order to complete the AHP structure with indices on the lines some calculations have to be carried out. How these the factor weights and the overall evaluations for the alternatives is calculated will be described in the following sub-sections.

7.3.1 Calculate the weight of the factors

In this sub-section the calculation of the factor weights is described.

The result of the 15 pair-wise comparisons between the factors is a 6 by 6 comparison matrix. The upper left to lower right diagonal has value one since every factor is equally important as itself. The right side of the diagonal consist of the raw scores on the nine-point scale whereby the negative values are quoted as the positive reciprocal value. The left side of the diagonal consist of the reciprocal values of the corresponding cells at the right side. This is logical because when profit is very important in the outsourcing decision compared to business performance, than business performance is very unimportant in the outsourcing decision compared to profit.

For further analysis the standardized comparison matrix needs to be calculated. The standardized comparison matrix is created by dividing the raw scores by de column total of the comparison matrix.

The priority vector of the factors is established by calculating the row average of the standardized comparison matrix. This priority vector of the factors represents the weight of the factors in the outsourcing decision. The priority of the factors can be easily communicated by means of a bar chart, an example of these charts is shown in figure 22. For an example of the calculations described in the text above one is referred to appendix 9.

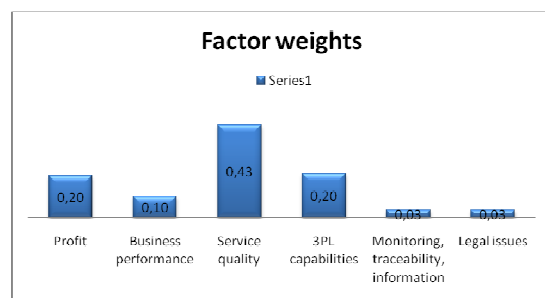


Figure 22 Weight of the factors in the shippers transport outsourcing decision (example).

7.3.2 Calculate the consistency of the pair-wise comparisons of the factors

At this stage the required information about the factor weights is known. However to determine the consistency of the results the consistency ratio needs to be calculated. The consistency ratio is the quotient of the consistency index and the random index, see textbox below (figure 23).

Consistency Ratio: $CR = CI / RI$
 Consistency Index: $CI = (\lambda - n) / (n - 1)$
 Random Index: $RI = \text{Random consistency Index (depending on } n)$
 Number (n): $n = \text{number of items that will be compared}$
 Lambda: $\lambda = \text{average value of consistency vector}$

Figure 23 Elements of the consistency ratio

When factor A is more important than factor B and factor B is more important than factor C, than, based on the transitivity principle, factor A should be indicated as more important than factor C. If not, than the answers are inconsistent. Inconsistency in the answers is due to the scales that are used unavoidable. The following example will illustrate that situation for the factors profit, service quality and business performance. The respondent indicates that profit is very much more important than service quality in the outsourcing decision. That is indicated with a five on the scale that is used. Furthermore, the respondent indicates that service quality is moderately more important than business performance in the outsourcing decision. Indicated with number 3 on the scale. This situation is depicted in figure 24 below.

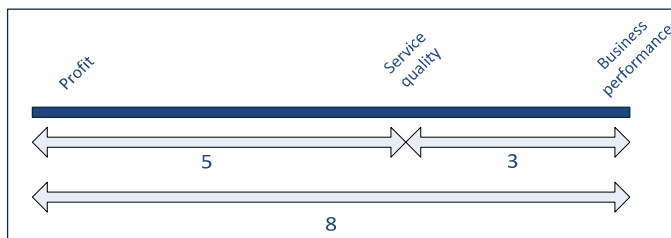


Figure 24 Graphical illustration of inconsistency

In this situation it would be consistent when the respondent indicated that profit was 'eight' important than business performance in the outsourcing decision. However on the scale that is used only odd number were used. The respondent could only indicate 7 or 9 which means that profit is very much more important or extremely much more important than business performance. In this example it is illustrated that inconsistency is automatically introduced due to the scale that is used and some inconsistency is therefore unavoidable.

In literature consistency ratios lower than 0.10 are indicators of consistency (Teknomo 2006). Higher ratios indicate inconsistency in the pair-wise comparisons and therefore these answers should be interpreted with care. In that case the respondent is apparently not able to express his preference for factors or alternatives very well. With inconsistent answers the that conclusions have to be drawn with care.

In order to arrive at the consistency ratio first the weighted sum vector has to be determined. This vector is calculated by multiplying the factor priority vector with the first row of the original pair-wise comparison matrix. Than the factor priority vector is multiplied with the second row of the original pair-wise comparison matrix. This process is repeated for all six rows.

The next step is to determine the consistency vector, this is done by dividing the weighted sum vector by the factor evaluation values that we determined earlier, these values can be found in the priority vector of the vectors. Lambda is now simply the average value of the consistency vector.

The comparison matrix is consistent when Lambda equals the size of the matrix (n). So the CI is the deviation from that situation. The Random Index or Random consistency Index is the CI based on numerous random generated pair-wise comparison matrices. This Random Index acts as a reference for the CI. The CR is in fact the ratio of the CI of the pair-wise comparison matrix and the RI. Now all the information needed to calculate the consistency ratio is known.

The consistency ratio is an indication of the consistency difference of the measured pair-wise comparison matrix with the consistency of random pair-wise comparison matrices. The consistency ratio can take values between zero and one. In terms of percentages the CI can be interpreted as a deviation from the Random Index between 0 and 100 percent. In literature ratios below 0.10 (or 10%) indicate that the pair-wise comparisons were judged consistently. Higher values than 0.10 indicate inconsistent judgment and these results should therefore be interpreted with care. In appendix 9 an example of the calculations discussed in this sub-section are shown.

7.3.3 Calculate priority vectors of the alternatives with respect to each factor

In the previous two sub-sections the weight of the factors in the outsourcing decision and the consistency of the pair-wise comparisons were described. That is just half the exercise, since the evaluation of the four transport outsourcing alternatives has to be made yet. In this section the processing of the pair-wise comparisons of the transport alternative with respect to each of the factors will be discussed. The calculations are somewhat comparable with the calculation of the factor weight but there are differences and therefore the calculations are described here.

The result of the 6 pair-wise comparison of the transport alternatives with respect to the factors is a four-by-four comparison matrix. The upper left to lower right diagonal has value one since every alternative is equally important as itself. The right side of the diagonal consist of the raw scores on the nine-point scale, also here the negative values are quoted as the positive reciprocal value. The left side of the diagonal consist of the reciprocal values of the corresponding cells at the right side. This is logical because when alternative 1 is extremely preferred compared to alternative 4 with respect to, for instance, profit, than alternative 4 is extremely not preferred compared alternative 1 with respect to profit.

For further analysis the standardized comparison matrix needs to be calculated. The standardized comparison matrix is created by dividing the raw scores by the column total of the comparison matrix. The priority vector of the alternative with respect to every single factor is established by calculating the row average of the standardized comparison matrix. This priority vector alternatives represents the preference for an transport outsourcing alternative. The preference for an alternative can be graphically shown in a bar chart. Furthermore the bar chart can show the individual contribution of the factors in the overall evaluation of the four alternatives.

7.3.4 Calculate the consistency of the pair-wise comparisons of the alternatives

In the same way the consistency of the pair-wise comparisons for the factors can be assessed also the consistency of the pair-wise comparison of the alternatives can be assessed.

In order to arrive at the consistency ratio first the weighted sum vector has to be determined. This vector is calculated by multiplying the priority vector of the alternatives with the first row of the original pair-wise comparison matrix. Then the priority vector of the alternatives is multiplied with the second row of the original pair-wise comparison matrix. This process is repeated for all four rows.

The next step is to determine the consistency vector, this is done by dividing the weighted sum vector by the priority vector of the alternatives that was determined earlier. Lambda is now simply the average value of the consistency vector. Now all the information needed to calculate the consistency ratio is known. The interpretation of the consistency ratio for the alternatives is equal to the CR interpretation of the factors. In appendix 9 an example of the calculations is shown.

7.3.5 Overall evaluation of the alternatives

In this sub-section the overall evaluation of the alternatives will be established. In this final step the combination made between the weight of the factors and the evaluation of the alternatives per factor.

First of all a matrix of the factors and the evaluation of the alternatives has to be made, see table 16. This matrix consists only results from earlier calculations, that is the 6 priority vectors of the alternatives. The 'profit column' is in fact the priority vector of the four alternatives with respect to the profit factors. In the third column the priority vector of the alternatives with respect to the business performance factors is shown. The same reasoning goes up for the other columns in table 15.

Table 15 Factor evaluations (=priority vectors of the alternatives with respect to each factor)

	Profit	Business Performance	Service Quality	3PL Capabilities	Monitoring, Information, ...	Legal issues
Alternative 1	0,529361	0,168442	0,174265	0,168442	0,242661	0,174732
Alternative 2	0,314798	0,852324	0,51405	0,852324	0,242661	0,51514
Alternative 3	0,105068	1,308235	1,395589	1,308235	0,242661	0,945124
Alternative 4	0,050772	0,484932	0,939678	0,484932	0,242661	1,411928

The total weighted evaluation, or overall evaluation, of the alternatives is calculated by multiplying the priority vector of the factors with the first row of the factor evaluation matrix. For alternative 2 the priority vector of the factors is multiplied with the second row of the factor evaluation matrix. The same sequence is followed for alternative 3 and 4.

The overall evaluation can be graphically shown in a bar chart, in this chart is the overall evaluation is shown including the individual contribution of each of the six factors. An example of the overall evaluation is shown in figures 25 en 26 below. One is referred to appendix 9 for a complete overview of all calculations.

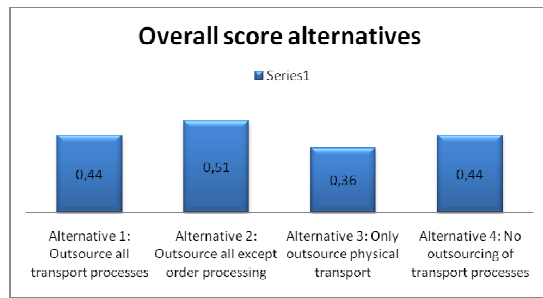
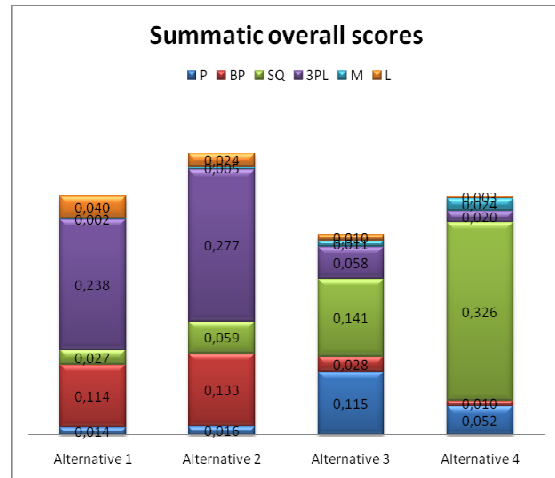


Figure 25 Overall evaluation of the transport alternatives

Figure 26 Overall evaluation of the transport alternatives including the individual contribution of each factor (right graph)



7.4 Data gathering process

In this section insight is provided in the actual data gathering process. In section 7.1 it was already explained which respondents will be selected for the interviews, here in this section how the respondents were approached will be discussed. Next to that practical matters like data recording, verification and confidentiality of the data will be briefly discussed.

The respondents for the internal interviews were approached via Dennis Wereldsma and Pino Melis. These interviews took place at the Capgemini office in Utrecht. The internal interviews were conducted in a relatively informal setting. These conversations were not recorded and no confidential information was exchanged. The worked out interviews were reported back to the respondents for verification.

The respondents for the external interviews were approached via Capgemini account managers for companies in the high-tech or chemical market sector. The account managers introduced the research to those that are knowledgeable in the field of transport and logistics at companies they are responsible for. After the introduction the possible respondents were again contacted by the author either by e-mail, telephone or both.

When positive reaction with respect to the research and the question if they are available for an interview was received then a meeting for an was planned. These meetings took place at the time and location of the respondents preference. This condition make the interviews a time consuming activity, but it prevents any withdrawals of the respondents.

The respondents were provided with the entire interview and background of the research prior to the interview. This gave the respondents the opportunity to prepare for the interview, if they wanted. Furthermore the respondents did have full insight in the process so that surprises and false expectations were prevented.

During the actual interview the respondents were once again briefed about the background of the research and the purpose of the interview. Before the questions were answered the respondents were asked if it was permitted to record the interview on a voice recorder. Recording the interview makes the transcription of the interview much more convenient. Since less errors are made during the transcription, less time will be needed for the verification of the interviews. All respondents gave their consent in about recording the interview.

Prior to the interviews the respondents were also asked and informed about any confidentiality issues. In all the cases it was agreed that the worked out interviews will be sent to the respondent for verification. Only the information in the verified transcription of the interview will be used in the report. Note that the transcription of the interviews does not contain a full interpretation and conclusion of the results.

After all the formal notifications were made the interview was started. As showed in section 7.2 the interview consist of three parts, introduction on the research, open interview questions and pair-wise comparisons.

Most of the respondents are interested in the results of the study and as a favor in return for their time and effort these results will be shared with those who participated in the interviews.

7.5 Conclusion

In this chapter the data gathering process is elaborated on. Thereby sub-question 6 can now be answered.

6 What is the research setup and how can Capgemini conduct research to the shipper's outsourcing decision in the five not selected market sectors?

In this research only two out of the seven interesting market sectors for Capgemini are studied. In this chapter the data gathering process is described in detail to enable others to conduct the research for the automotive, oil & gas, retail, wholesale and pharmaceutical market sectors.

Also in further research one can conduct internal and external interviews. A lot of knowledge is available within Capgemini and this knowledge improves the external interview.

Developing the AHP analysis design in Excel is a onetime effort. Once the design is made it can be used for as many interviews and markets sectors as needed. With a user friendly interface the Excel model can easily be used as decision supporting tool.

The data gathering process described in this chapter provides all the information needed to answer the main research question. The combination of open interview questions and the more quantitative pairwise comparisons of the factors and the alternatives provides the possibility to generate and validate the results at once.

This chapter described the data gathering and data processing process. Thereby the syntheses between the research questions, theory, research methods and expected results is made. In the next chapters all that is learned here can be tested in practice at companies in the chemicals and high-tech market sector.

8 Case study Chemicals Market Sector

In this chapter the results of the interviews for the chemical market sector will be discussed. In section 8.1 background information about the companies that were studied in the chemicals market sector will be given. Secondly, in section 8.2 the results of the open questions in the interviews will be interpreted and discussed. In section 8.3 the results of the pair-wise comparisons and the analysis by means of the Analytical Hierarchy Processes will be assessed. In section 8.4 the consistency of the results will be assessed. Finally, in section 8.5 the main research question can be answered for the chemicals market sector.

8.1 Background chemicals market sector

In this research the chemicals market sector was studied. Obviously due to the time and scope for this research it was not possible to study the entire chemicals market sector. Only a few representative chemical companies could be studied, interviews were conducted at two divisions of AkzoNobel and at Thermphos. In this section background information on these companies is provided. In the discussion of the results the company names will be replaced by chemical company A, chemical company B and chemical company C. The results and the company names are decoupled for confidentiality reasons.

8.1.1 AkzoNobel

AkzoNobel is the largest global producer of paints, coatings and specialty chemicals. That makes AkzoNobel one of the major industry supplier of quality ingredients. The interviews for this research took place within the specialty chemicals part of AkzoNobel, in the divisions Polymer Chemicals and Base Chemicals. The division Polymer Chemicals is concerned with the production of organic peroxides, metal alkyls and co-catalysts. These products are all vital for the production of plastics varying from polyethylene, polypropylene and acrylic to polystyrene and PVC.

The division Base chemicals is concerned with the production of salt and energy, chlor-alkali products, and derivatives such as monochloroacetic acid. Base chemicals are essential for the success of the chemical, detergent, construction, food, paper and plastic industries. The information about AkzoNobel is based on the information in their annual report (AkzoNobel 2007) and their website (Website_AkzoNobel 2008).

8.1.2 Thermphos

Thermphos is one of the world's largest producers of phosphorus, phosphoric acid, phosphates, phosphonates and phosphorus derivatives. Customers around the world rely on our high-quality products for applications in a variety of markets such as pharmaceuticals, hygiene, industrial and household cleaning, food and feed additives, beverages, flame retardants, crop protection and many other applications (Website_ThermPhos 2008).

During the interview the transport process in general was discussed and not the specific supply chain of a specific product or department within Thermphos.

8.2 Results open questions in the chemical market sector

In this section the results of the open questions that were discussed during the interviews in the chemical sector will be presented and interpreted. Since there are different results for the inbound, outbound and internal supply chain, the results will be discussed in separate sub-sections for these three supply chains.

8.2.1 Inbound supply chain

The transport processes in the inbound supply chain are not carried out or managed by the shipper. The transport processes in the shippers inbound supply chain are carried out and managed by the supplier. All the goods that are needed are delivered at the site of the chemical companies by the suppliers. How the suppliers manage these transport processes was not studied. But these suppliers are companies in the chemical sector and therefore their outbound supply chain could be organized and managed in a

comparable manner as the outbound supply chain of the shippers that are studied in this report. Chemical companies are not involved in transport execution in the inbound supply chain. The purchasing department of these companies make sure that the right goods are on site at the right time. During the interviews it was not indicated that the inbound flow of goods was so important that it should be the responsibility of the shipper instead of the supplier.

8.2.2 Outbound supply chain

Based upon the interviews it appeared that the outbound supply chain is generally the supply chain that shippers have to manage. The transport execution activities like, transport, unloading and final delivery are outsourced. In most cases the shipper outsourced these activities to a 3PL and the shipper contracts the 3PL. In other, more exceptional, cases the shipper does not manage their outbound transport execution processes and transport management is left to the customer. This is not real outsourcing as defined in section 2.4.1 since the customer is not a third party. Now in this case it is up to the customers to collect the goods themselves or outsource the transport processes to a 3PL.

In the chemical outbound supply chain warehousing is not a common process. Chemicals are directly transported from the shipper to the customer, often in large quantities whereby warehousing is not needed. Another reason for this direct transportation is the nature of chemical product, that makes them less suitable to store in a warehouse. Chemical products are dangerous, need to be cooled or need special treatment. These characteristics make warehousing very expensive.

The internal supply chain, transport from one (production) site of the chemical company to another site of the company, is treated in the same manner as the transport processes in the outbound supply chain. The volume of internal transport is usually rather low.

Loading the goods on the transport modality is one of the transport execution processes that is provided in-house. There is no third party logistic service provider needed to load these goods, regardless of their form bulk or parts.

The transport planning activities, like order processing, load planning and invoicing, in the outbound supply chain of chemical companies is provided in-house.

The main reasons for outsourcing transport execution activities is the impact it has on profit. The costs of a, more or less, internal transport organization are too high. Chemical companies want to keep their capital available for their main process, that is the production of goods and not the transportation of it. Therefore also the business performance factors are of importance in the transport outsourcing decision. Furthermore, chemical companies want specialists to take care of transporting their products. Their 3PL's are capable enough to provide in these specialized services. During the interviews it was also mentioned that profit is important, however it is also acceptable to spend more money on a capable 3PL that can deliver a good service quality to the customers.

Legal issues and monitoring, information and traceability are seen as the least important factors in the outsourcing decision. First, one should always comply with the rules and regulations whether transport processes are outsourced or not. Secondly, monitoring, information and traceability is something that is expected from a 3PL. Therefore this factor is important in the supplier selection problem and not in the decision on outsourcing transport processes.

The importance of the factors in the outsourcing decision was confirmed by the reversed question: What is needed to take outsourced transport processes back in house? In most cases the respondents answered that when insourcing transport process was a good business case than that could be taken into consideration. All companies indicated that taking back outsourced transport processes was currently not an issue.

During the discussions about the need for information about transport processes once the goods left the site various answers were given. Chemical company A that left the transport up to the customer did not need any information about the transport processes. If something happened during transport than that was an issue between the 3PL and the customer since the shipper did not have any stake in the transport process anymore.

When the shipper was responsible for the delivery of the goods to the customer information about the transport processes was appreciated. 3PL's have to deliver a proof of delivery and when goods are delayed or damaged during the transport process the shippers want to be informed. In practice the information supply falls a bit short. The companies indicated that they would appreciate a more proactive approach of the 3PL in case of exceptions.

8.2.3 Internal supply chain

In the three companies that were studied a separate internal supply chain was not distinguished. In general not many goods are transported from one entity of the chemical company to another entity of the same company. The main flow of goods is from the chemical company directly to the customer.

In the case that there is internal transport than a 3PL is contracted to carry out the transport execution process for chemical company A. The transport planning is provided in-house. At chemical company B and C internal transport is treated in the same way as outbound transport.

8.2.4 Sub-conclusion chemical market sector

Based upon the interviews it turns out that shippers in the chemical sector have to manage their outbound supply chain. The results from this section are therefore only applicable to the outbound supply chain.

Form the interviews it becomes clear that several transport processes are outsourced in the chemical market sector. Chemical companies do not provide for their own physical transportation of goods, they do have to manage their transport processes mostly in the outbound supply chain. How they outsource transport processes and which transport processes are outsourced varies per company. An overview of the transport processes that are outsourced or carried out by the shipper itself is given in table 16.

Table 16 Overview of the outsourced and in-house provide transport processes

ID	Process	Chemicals A		Chemicals B		Chemicals B	
	Transport	Outsource	In-house	Outsource	In-house	Outsource	In-house
1	Transport planning						
1.1	Order processing		V		V		V
1.2	Route planning	V			V	N.A.	N.A.
1.3	Load planning	V		N.A.	N.A.	V	V
1.4	Invoice		V		V		V
2	Transport execution						
2.1	Order picking	N.A.	N.A.		V	N.A.	N.A.
2.2	Loading		V		V		V
2.3	Transport	V		V		V	
2.4	Un-loading	V		V		V	
2.5	Warehousing	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2.6	Loading	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2.7	Transport	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2.8	Un-loading	V		V		V	
2.9	Delivery	V		V		V	
V indicates if the transport process is outsourced or provided in-house N.A. indicates that this transport process is Not Applicable to this company							

Based upon the open questions it can also be concluded that profit, business performance, service quality and 3PL capabilities were the four most important factors in the outsourcing decision. Monitoring, information and traceability and legal issues were not mentioned as the reason to outsource transport processes. With respect to legal issues the notion has to be made that, regardless of the low weight in the outsourcing decision, none of the companies breaks the law. Compliance with the rules and regulations are unavoidable and this is something that is expected from a 3PL. Also monitoring and traceability is not the reason to outsource transport processes. A 3PL's capability to provide visibility on the process is more an important factor in supplier selection.

8.3 Results of Analytical Hierarchy Process in the chemicals market sector

In this section the results of the pair-wise comparisons that were judged during the interviews will be presented and discussed. As mentioned before, the results of these pair-wise comparisons are established by means of the analytical hierarchy process. With this method the weight of the factors in the transport outsourcing decision can be determined.

The results here are only applicable for the supply chain that has to be managed by the shipper, that is the outbound supply chain. Therefore no subdivision into sections inbound, outbound and internal supply chain is made.

8.3.1 Factor weights

During the open questions the most important factor was profit. During the pair-wise comparisons the choice between profit and the other factors appeared to be quite difficult since all factors play a role. Table 17 provides an overview of the factor weights. These weights can take values between 0 and 1. Values close to one represent a high weight of the factor in the transport outsourcing decision. The most important factor is printed in bold. In this table one can therefore see three different 'most important' factors.

At chemical company A the 3PL capabilities is the most important factor to outsource transport processes to a 3PL. Furthermore the positive impact outsourcing has on the company's business performance is one of the most important factors in the outsourcing decision. At chemical company A the profit factor is very low, that indicates that profit is not an important factor in the outsourcing decision. Obviously profit is important in the overall business objectives.

At chemical company B the service quality that is delivered towards customers is the most important factor in the transport outsourcing decision. Chemical company B claims to be a top-supplier in their market segment, to be and to remain a top-supplier service quality is important. This company is willing to spend more money on service and therefore 'lose' some of the profit, that is the reason that profit is not the most important factor. The latter does not mean that profit is not important for chemical company B as it still is a commercial company, however in the transport outsourcing decision profit is of less importance.

In chemical company C profit is the most important reason to outsource transport processes. Outsourcing is simply cheaper than to maintain and run an internal transport company. Next to profit business performance factors, service quality factors and 3PL capabilities are important in the decision whether or not to outsource transport processes. Monitoring and legal issues are least important in the outsourcing decision. For a graphical representation of these results one is referred to the bar charts in appendix 12.

It has to be mentioned that in the cases where profit did not end up first profit is still important as in every commercial company. However, they are willing to trade some profit for a better service quality to customers and a more capable (more expensive) 3PL. However in the specific transport outsourcing decision profit is in some cases less important.

For all three companies one can see a rather low weight for the monitoring, traceability, information and legal factors. Firstly, monitoring is considered as one of the basic capabilities of a third party logistics service provider. 3PL's just have to provide visibility and transparency in the transport process. If a 3PL cannot provide this services than the shippers will find another 3PL that can deliver that service. There are many 3PL's that are capable to transport chemicals so there is sufficient supply of 3PL services. That allows shippers to have high demands. In this view monitoring is a very important criterion in the supplier selection and not an important factor in the transport outsourcing decision.

Secondly, all companies indicate that legal issues are important. They all comply with all rules and regulations. From the factor weights in table 17 it can be concluded that legal issues are not important in the transport outsourcing decision. That is somewhat remarkable since there are many rules and regulations for chemical companies and transportation of chemical goods. To comply with all these rules requires a lot of effort. Based on that, one should expect that legal issues are an important factor to leave transport of chemical goods to a 3PL. Perhaps the respondents interpreted legal in an general context instead of in the specific transport outsourcing context, in that case they must have overlooked the specific implications that legal issues have on the transport processes. This quite logical since all companies outsourced transport execution processes and therefore they are not confronted with these legal issues. The only thing they know is that their business operates in compliance with the rules and regulations. This may be an explanation for the low weight of legal issues in the transport outsourcing decision.

Table 17 Weight of the factors in the transport outsourcing decision at 3 chemical companies

	Chemicals A ¹	Chemicals B	Chemicals C
Profit	0,02	0,20	0,52
Business performance	0,27	0,10	0,14
Service quality	0,12	0,43	0,14
3PL capabilities	0,29	0,20	0,14
Monitoring, traceability, information	0,16	0,03	0,03
Legal issues	0,13	0,03	0,03
Highest factor weights are printed in bold.			

Based on the pair-wise comparisons that were judged during interviews it can be concluded that the factors in the outsourcing decision differs across the companies in the chemical market sector. There is no decisive or most important factor. It can be said that the upper four factors: profit, business performance, service quality and 3PL capabilities are of importance in the transport outsourcing decision. Monitoring and legal issues are not important in this decisions for reasons that were mentioned above.

8.3.2 Overall evaluation

During the interview not only the weight of the factors in the outsourcing decision was established also the extent of outsourcing was determined. As discussed in sub-section 7.2.2 the four transport alternatives represent a scale on which the extent of outsourced transport processes can be indicated. When for instance alternative 3 is preferred most than that is an indication that only the physical transport processes (loading, transport) is outsourced in the chemical market sector. Other processes, such as order processing, transport planning, invoicing, warehousing, are provided in-house.

The overall evaluation of the four transport processes is shown in table 18 below. The table shows the preference for a transport alternative on a zero to one scale. Note that in this overall evaluation of the four transport alternatives the weight of the factors in the outsourcing decision was taken into account. In this table one can see that in the cases there is no convincing best alternative. In the text below the three companies will be discussed.

¹ For confidentiality reasons the names of the companies and the results are decoupled. The results cannot be traced back to one specific company or respondent.

Table 18 Overall evaluation of the transport alternatives at 3 chemical companies

	Chemicals A ²	Chemicals B	Chemicals C
Alternative 1: Outsource all transport processes	-	0,22	0,32
Alternative 2: Outsource all except order processing	-	0,18	0,20
Alternative 3: Only outsource physical transport	-	0,27	0,19
Alternative 4: No outsourcing of transport processes	-	0,33	0,30
Highest overall evaluations are printed in bold.			

The results of chemical company A could not be calculated since the pair-wise comparisons of the four transport alternatives with respect to each factor could not be completed during the interview. This is no problem since chemical company A was not at all involved in transport management in either the inbound or outbound supply chain.

At chemical company B transport alternative 4 is perceived as the best transport alternative. In transport alternative 4 no transport processes as defined in section 3.1 are outsourced. In other words at chemical company B it is preferred to perform all transport process in-house. With a 0.33 score on a zero to 1 scale this outcome is not very decisive. It cannot be concluded that transport alternative 4 is the most preferred transport alternative for chemical company B.

When the bar chart of chemical company B is assessed (figure 27) one can see which factors are of importance in the overall evaluation of the transport alternatives. Service quality to customers is perceived as an important factor to provide transport services in-house. Both alternatives 3 and 4 have relatively many in-house provided transport processes. When all the alternatives are assessed one can see the more transport processes are provided in-house the more important service quality factors become. Profit is the main factor to choose for alternative 3, outsource physical transport and keep the planning in-house. Profit is the second best factor to provide all transport processes in-house, alternative 4. The capabilities of the 3PL is the main factor to outsource transport processes, alternatives 1 and 2. The less transport processes are outsourced the less important 3PL capabilities are. That makes sense since the capabilities of the 3PL are not relevant when transport processes are provided in-house. The importance of business performance is decreasing over when more processes are provided in-house. Legal issues and monitoring, information and traceability are not important factors in the decision to outsource transport processes. In the previous sub-section it was mentioned that these factors are not important in the outsourcing decision. Legal issues are unavoidable whether transport processes are outsourced or not. And monitoring, information and traceability are important in the supplier selection problem and not in the transport outsourcing decision. This was also concluded at the discussion of the open questions.

² At this company the pair-wise comparisons of the four alternatives with respect to every factor could not be completed. Therefore, the overall evaluation of the transport alternatives could not be established.

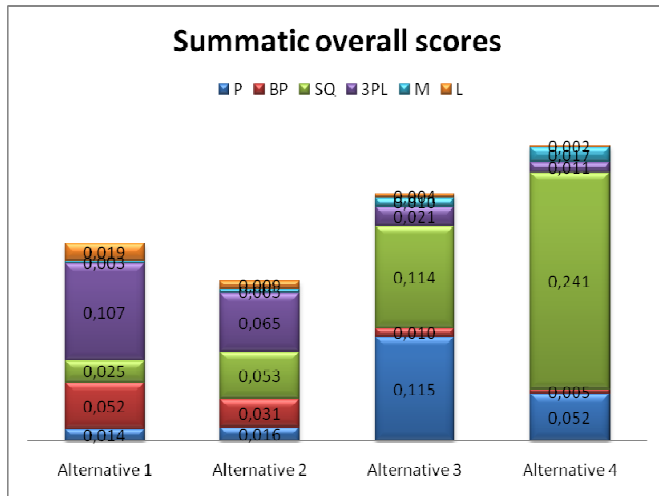


Figure 27 Summative overall evaluation chemical company B

At chemical company C transport alternative 1 is perceived as the best transport alternative. In alternative 1 all transport processes are transferred to a third party logistic service provider. Comparable with the results of chemical company B it cannot be said that alternative 1 is the best alternative since the preference for alternative 1 does not deviate much from the scores on the other three alternatives.

When the bar chart of the result of chemical company C is assessed (figure 28) a complete different image appears, compared with the bar chart of chemical company B. One can clearly see that profit is the main factor to outsource transport processes. Business performance, service quality to customers and 3PL capabilities are important reasons to provide transport processes in-house. The importance of 3PL capabilities for in-house provision of transport services seems remarkable, however the *lack* of specialized capabilities at a 3PL can be an important factor to provide transport processes in-house. Also here legal issues and monitoring, information and traceability are less important factors in the decision to outsource transport processes. These results reflect the viewpoints that were obtained during the open interview questions.

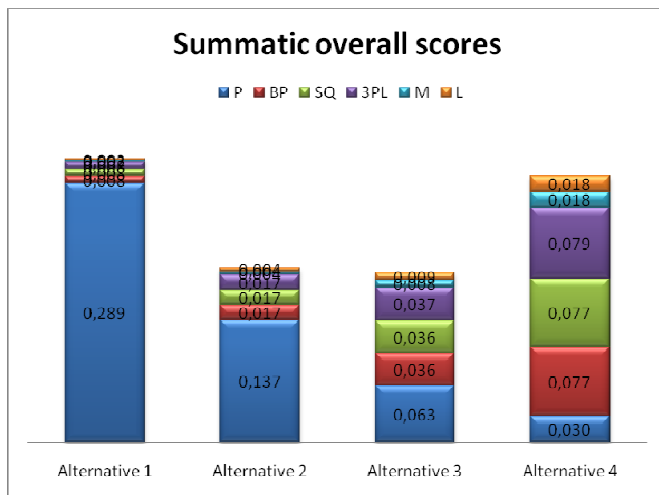


Figure 28 Summative overall evaluation chemical company C

8.3.3 Sub-conclusion

With respect to the overall evaluation of the transport processes, or extent of outsourcing, it can be concluded that there is not one preferred transport alternative. Furthermore there factors on which the preference for an alternative is based varies per chemical company. For one company service quality is the decisive factor to provide transport processes in-house. For another company profit is the most important factor to outsource all transport processes.

8.4 Consistency analysis chemicals market sector

In this sub section the consistency of the results will be discussed. The consistency ratio is an indication for the consistency of the respondents answers. For the calculations needed to arrive at the consistency ratio one is referred to sub-section 7.3.2.

In table 19 below the consistency ratios of the factor evaluation and the alternatives with respect to every factor are shown. One can see that six of the available ratios exceed the 0.10 boundary indicating inconsistent answers. For chemical companies B and C the consistency ratio's of the factors do not exceed the 0.10 threshold value much. The factor evaluations of these companies is therefore considered consistent. For chemical company the 0.10 value is exceeded more, the factor evaluations of this company is not very consistent. This explains the rather strange factor weights as discussed in the previous section.

Notice that all the factor evaluations (row 1 table 19) are slightly more inconsistent than the evaluation of the alternatives with respect to each factor (rows 2 to 7 table 19). Perhaps the number of factors or alternatives that have to be compared is of influence here. The more factors or alternatives have to be compared the more difficult it is to provide consistent answers. This relation is not tested.

The evaluations of each of the alternatives with respect to the six factors are rather consistent. The consistency ratio for three comparison matrices exceeds the 0.10 value. Therefore the comparisons are considered rather consistent.

Table 19 Consistency ratio factors and alternatives at 3 chemical companies

	Chemicals A	Chemicals B	Chemicals C
Factors	0,234	0,184	0,145
Alternatives with respect to profit	-	0,106	0,044
Alternatives with respect to business performance	-	0,132	0,044
Alternatives with respect to service quality	-	0,044	0,044
Alternatives with respect to 3PL capabilities	-	0,086	0,044
Alternatives with respect to monitoring, traceability	-	0,145	0,044
Alternatives with respect to legal issues	-	0,044	0,044
Consistency ratio's that indicate inconsistency (CR>0.10) are printed in bold.			

8.5 Conclusion

At this stage of this chapter the main research question can be answered for the chemicals market sector. This section is sub-divided in the four main aspects of the research question: factors, factor weights, extent of outsourcing and need for information.

What are the factors that determine the shippers decision on outsourcing transport processes in the chemical market sector in The Netherlands, what is the extent of transport outsourcing and what is the need for information about (outsourced) transport processes?

8.5.1 Factors in the transport outsourcing decision

The first part of the main question was already answered in chapter five. Many factors influence the outsourcing decision, these factors can be summarized in the following six categories: profit, business performance, service quality, 3PL capabilities, monitoring, information and traceability and legal issues.

From the open interview questions it becomes clear that several transport processes are outsourced in the chemical market sector. Chemical companies do not provide for their own physical transportation of goods, they do have to manage their transport processes mostly in the outbound supply chain. How they outsource transport processes and which transport processes are outsourced varies per company.

Based upon the open questions it can also be concluded that profit, business performance, service quality and 3PL capabilities were the four most important factors in the outsourcing decision. Monitoring, information and traceability and legal issues were not mentioned as the reason to outsource transport processes.

8.5.2 Factor weights

The weight of the factors in the outsourcing decision was established by means of the analytical hierarchy process. These weights were shown in table 17. In this table it can be concluded that there is no uniform 'most important' factor in the outsourcing decision across the companies that were studied in the chemical market sector.

In chemical company A business performance factors and 3PL capabilities are most important. The business performance category includes factors like quick response to market changes, increased flexibility, simplifying logistical process, focus on core business et cetera. The 3PL capabilities category includes the acquisition of outside expertise, access to specialized resources and the latest technology, better performance of the 3PL compared with in-house service. (See sub-section 5.2 for the categorization of factors).

In chemical company B the service quality to customers is the most important factor in the decision on outsourcing transport processes. This includes for instance shorter transit times, increased flexibility, better service and decreased order cycle length.

Finally in chemical company C profit is the most important factor in the outsourcing decision. This includes cost reduction, less investments in ICT to support transport processes, reduction of capital investments in facilities and manpower and increased cost efficiency.

It is concluded that not one factor is most important or decisive for the entire sector. In the three chemical companies that were subject for the chemicals case study profit, service quality, business performance and 3PL capabilities were factors that were important in the various cases. Legal issues and monitoring, information and traceability were least decisive. These factors are important but more in supplier selection problem and legal point of view.

8.5.3 *Extent of outsourcing*

With respect to the overall evaluation of the transport processes, or extent of outsourcing, it can be concluded that there is not one preferred transport alternative. Furthermore there factors on which the preference for an alternative is based varies per chemical company.

8.5.4 *Need for information*

Chemical companies that leave the transportation of the goods to the customer do not need any information about the transport processes. It is known which goods are loaded, which quantities and when. They do not need any further information as that is simply an issue between the customer and their 3PL. Companies that are their selves responsible for the transport of their products to the customer do need information about the transport processes. They need to know when goods are delivered, furthermore they want information when goods are delayed or damaged in a so called 'exception report'. During the interviews it was indicated that this information was not always received from the 3PL.

9 Case study High-tech Market Sector

In this chapter the results of the interviews for the high-tech market sector will be discussed. In section 9.1 background information about the companies that were studied in the high-tech market sector will be given. Secondly, in section 9.2 the results of the open questions in the interviews will be interpreted and discussed. In section 9.3 the results of the pair-wise comparisons and the analysis by means of the Analytical Hierarchy Processes will be assessed. In section 9.4 the consistency of the results will be assessed. Finally, in section 9.5 the main research question can be answered for the high-tech market sector.

9.1 Background high-tech market sector

In this research also the high-tech market sector was studied. Due to limitations in time and scope of this research it was not possible to study the entire high-tech sector. Only a few representative high-tech companies could be studied, interviews were conducted at Philips, Canon, High-tech company X³ and Samsung. In this section background information on these companies is provided. In the discussion of the results the company names will be replaced by high-tech company A, high-tech company B, high-tech company C and high-tech company D. The results and the company names are decoupled for confidentiality reasons.

9.1.1 Philips

Koninklijke Philips Electronics N.V. is a diversified Health and well-being company, focused on improving people's lives through timely innovations. As a world leader in healthcare, lifestyle and lighting, Philips integrates technologies and design into people-centric solutions, based on fundamental customer insights and the brand promise of "sense and simplicity" (Website_Philips 2008).

Philips' mission is to improve the quality of people's lives through the timely introduction of meaningful innovations. Therefore Philips is divided in three business areas Lighting, Healthcare and Consumer Lifestyle. The interviews were conducted in the Consumer Lifestyle business (Philips 2007).

The Consumer Lifestyle operates in the business areas Connected Displays, Video & Multimedia, Audio & Multimedia, Home Networks, Peripherals & Accessories, Domestic Appliances, Shaving & Beauty and Health & Wellness. It runs manufacturing operations in the Netherlands, Belgium, France, Hungary, Austria, Poland, the USA, Brazil, Argentina, Mexico, China and Singapore (Website_Philips 2008).

9.1.2 Canon

Canon is one of the world's largest brand names in multi functional, copiers, printers, fax machines, photo and video equipment. With Canon products information can be made easily accessible and the communication between people is enhanced (Website_Canon 2008).

The interview took place at Canon Europe which is a subsidiary company of the Japanese Canon Inc. Canon Europe is responsible for Canons performance in the EMEA region. Next to Canon Europe there are two other regional headquarters, Canon America's and Canon Japan.

9.1.3 Company X

Company X is a leading global manufacturer of business digital office equipment, IT-based hardware and software solutions in combination with an advanced range of added value services and supplies. The company achieved a solid presence worldwide as a leading provider of comprehensive document solutions that help organizations maximize productivity while reducing the total cost of ownership (Website_CompanyX 2008).

³ This company wanted to remain anonymous.

The interview was conducted at the supply chain management department of the company.

9.1.4 Samsung

Samsung Electronics is a global leader in semiconductor, telecommunication, digital media and digital convergence technologies. The company has offices in 56 countries. Recognized as one of the fastest growing global brands, Samsung Electronics is a leading producer of digital TVs, memory chips, mobile phones and LCDs. Its involvement and leadership in such a wide variety of IT products make it uniquely positioned to develop innovative and superior digital products. Samsung's vision is to become a leader of the digital convergence revolution. To achieve this goal, the company has transformed its operations, putting digital technology at the core. The underlying strategy for this vision is the company's mission to be a "Digital E-Company" (Samsung 2007).

The interview was conducted at the logistics department of the company.

9.2 Results of the open questions in the high-tech market sector

In this section the results of the open questions that were discussed during the interviews in the high-tech sector will be presented and interpreted. Since there are different results for the inbound, outbound and internal supply chain, the results will be discussed in separate sub-sections for these three supply chains.

9.2.1 Inbound supply chain

In general inbound transport processes are not managed or organized by high-tech companies that were studied in this research. High-tech companies have production facilities outside The Netherlands. The transport goods from these facilities to the European distribution centers is managed by the company's headquarters outside The Netherlands, in Asia for example.

From the interviews it appeared that these high-tech companies, here in Europe and at the point of origin, are not involved in the physical transport of goods from the production facilities to Europe. Transport execution is transferred to a 3PL.

From the point that the goods arrive in the European distribution centers further transport planning and execution is managed by the shippers that were studied. At one company the shipper also managed the transport process from the port of destination, for instance Port of Rotterdam, Port of Amsterdam, Schiphol Airport, to the European distribution centers. The costs of these operations are paid by the headquarters at the point of origin but transport management takes place locally at point of destination. The idea is that locally organized transport is more cost efficient.

9.2.2 Outbound supply chain

The outbound supply chain is in general the supply chain that has to be managed by the shippers that were studied. They have to manage and organize the transportation of the goods from the distribution centers to the customers.

At all four companies that were studied physical transport is outsourced to a 3PL. None of the companies owns their own transport modalities and load units and there are no employees involved with the physical transport from the one location to the other.

Furthermore, during the interview all companies state that as much transport processes as possible are outsourced to a logistic service provider. In these statements transport execution processes are meant since at all companies a part of the transport planning processes is provided in-house. In general the transport planning processes and warehousing is provided in close collaboration with the 3PL. In the texts below the specific arrangements per company will be mentioned.

At high-tech company A order processing and invoicing (of the goods and transport) are processes that are carried out in-house. All the other transport processes (i.e. route planning, load planning, order

picking) is carried out in the warehouse. The logistic service provider in the warehouse takes care of the incoming goods and prepares the outgoing goods. They also contract the carriers that carry out the physical transport.

In this company a clear distinction between transport planning and transport execution processes is made. Transport execution all has been outsourced in a decision made years earlier. It has been found that the outsourcing of transport execution is most cost efficient.

The real discussion and challenge lies in outsourcing transport planning processes. Here there are two decisive reasons to outsource these processes. Firstly, outsourcing leads to an increased business performance since the roles and responsibilities between warehousing and transport are clear. Secondly, outsourcing leads to more visibility. 3PL's have systems that can provide transparency in the transport process and they store all information concerning transportation at one place.

At high-tech company B order processing, route planning and invoicing is provided in-house. Load planning, order picking and loading are carried out in the warehouse. Sometimes warehousing is outsourced to a 3PL and sometimes warehousing is provided in-house. Physical transportation is outsourced to carriers.

An important reason to outsource the transport processes is the fact that transport is not a core activity. High-tech companies should focus on the production and sales of their products. Secondly the decrease cost (therefore increase in profit) is a reason to outsource transport processes. It is not possible for a high-tech company to exploit a transport network efficiently.

Service quality is considered important but not in the decision to outsource transport processes. A 3PL should deliver a good service quality to the high-tech company and their customers as a prerequisite. If they do not provide the expected service level then another 3PL will be contracted. This argument also applies to 3PL capabilities, if there is lack of capabilities then another 3PL would be contracted.

At high-tech company C many transport processes are outsourced however order processing, route planning and invoicing is provided in-house. Load planning, order picking, loading are carried out in the warehouse which is outsourced to a 3PL. On a day-to-day basis the warehouse maintains contact with the carriers that carry out the physical transport. The contracts with these carriers are owned by the high-tech company and not by the 3PL that provides the warehousing process. The situation at high-tech company C is very comparable with the situation at high-tech company A.

Cost efficiency is the most important reason to outsource physical transport. For a high-tech company it is not possible to efficiently exploit a distribution network. By selecting the right 3PL business performance can be improved.

Monitoring, information and traceability is just a service that a 3PL should provide. Also service quality is an aspect that is contractually determined. When a 3PL is selected service targets are set, when these targets are not met then another 3PL has to be selected. Finally the 3PL capabilities are also considered as an important factor in the supplier selection and not in the transport outsourcing decision. This viewpoint is comparable with the viewpoints of companies A and B.

At high-tech company D transport planning processes are carried out in close collaboration with a 3PL. Employees of the high-tech company and the 3PL together carry out the transport planning task. Transport execution processes are outsourced to carriers and warehouse providers. All these parties are controlled by the 3PL-high-tech partnership.

At high-tech D company it is indicated that all six factor categories are important in the outsourcing decision. The most important reason is the fact that transport processes is not the core business of a high-

tech company. Therefore business performance factors are considered important. Furthermore, profit factors are important too. This company does not want to invest capital in transport modalities, warehouses and personnel. Cost efficiency is also important as the company is not able to efficiently exploit a transport and distribution network by itself. 3PL's can maintain an efficient distribution network, that is their core business.

All four companies want information about the transport process in all mentioned events, when the goods are loaded, when the goods pass a hub in the network, when the goods are delivered at the customer and when the goods are delayed or damaged. All companies make use of transport management systems to collect and access this information. In the latter case with respect to delayed or damaged goods pro-active information is needed from the 3PL because customers need to be informed.

9.2.3 Internal supply chain

The companies that were studied all indicated that they did not distinguish a separate internal supply chain besides the inbound and outbound supply chain. When goods are transported from one entity of the high-tech company to another entity than it is treated in the same manner as the outbound supply chain.

9.2.4 Sub-conclusion high-tech market sector

Based upon the interviews it turns out that shippers in the high-tech sector have to manage their outbound supply chain. The results from this section are therefore only applicable to the outbound supply chain.

Based upon the results of the open questions it can be concluded that all the high-tech companies outsource transport execution processes. That is transport from location A to location B and the warehousing process as a whole, the latter includes the handling of the incoming goods, order picking and loading.

Furthermore it can be concluded that the transport planning processes are carried out in close collaboration with the 3PL. The more operational or day-to-day planning is generally transferred to the warehouse provider. Employees of the 3PL make the load plan and arrange carriers. The strategic transport planning processes such as order processing, route planning and invoicing are provided by the shipper itself. The contractual arrangements between the shipper and the carriers are owned by the shipper and not by the warehouse which contacts the carriers on a day-to-day basis. An overview of the transport processes that are outsourced or carried out by the shipper itself is shown in table 20.

Table 20 Overview of the outsourced and in-house provide transport processes

ID	Process	High-tech A		High-tech B		High-tech C		High-tech D	
	Transport	Outsource	In-house	Outsource	In-house	Outsource	In-house	Outsource	In-house
1	Transport planning								
1.1	Order processing	V			V		V	V*	V
1.2	Route planning		V		V		V	V*	V
1.3	Load planning		V	V	V*	V		V*	V
1.4	Invoice	V		V			V	V*	V
2	Transport execution								
2.1	Order picking	V		V		V		V	
2.2	Loading	V		N.A.		N.A.		V	
2.3	Transport	V		N.A.		N.A.		V	
2.4	Un-loading	V		N.A.		N.A.		V	
2.5	Warehousing	V		Partly#	Partly#	Partly#	Partly#	V	
2.6	Loading	V		V		V		V	
2.7	Transport	V		V		V		V	
2.8	Un-loading	V		V		V		V	
2.9	Delivery	V		V		V		V	
	V indicates if the transport process is outsourced or provided in-house N.A. indicates that this transport process is Not Applicable to this company * indicates that the transport process provided in close collaboration with 3PL # indicates that the transport process party outsourced and partly provided in-house								

Cost efficiency, which falls into the profit factor category, is mostly mentioned as the most important reason to outsource transport processes. Also the fact that transport and logistics is not a core process for a high-tech company was frequently mentioned. In some cases service quality was indicated as a reason to outsource transport processes but others see service quality as an important factor in supplier selection but not in the outsourcing decision. The 3PL capability factors and traceability factors are pure supplier selection criteria and, as such, these factors are not important in the outsourcing decision.

Information and control over the transport process is needed and the shippers that were studied all have transport management systems installed. Shippers want information about all the standard events in the supply chain, for instance when the goods are loaded, when the goods pass a hub in the network and when the goods are delivered to the customer. This information should be uploaded into the TMS by the carriers and warehouse providers. Information about exceptional events like delayed or damaged goods needs to be also communicated in a pro-active manner and uploading this information in the TMS.

Finally the need for information and control of the transport processes is initiated by the customers demand for information. Customers demand information about the goods they bought and how these goods are transferred.

9.3 Results of the Analytical Hierarchy Process in the high-tech market sector

In this section the results of the pair-wise comparisons that were judged during the interviews will be presented and discussed. As mentioned before, the results of these pair-wise comparisons are established by means of the analytical hierarchy process. With this method the weight of the factors in the transport outsourcing decision can be determined.

The presented results are only applicable for the supply chain that has to be managed by the shipper, in this case this is the outbound supply chain. Inbound and internal supply chain are not included in this part of the research.

9.3.1 Factor weights

In sub-section 9.2.4 it was concluded that profit factors, business performance factors and service quality factors are important in the transport outsourcing decision. In this sub-section the factor weights are shown in table 21. The weights of the factor can take values between 0 and 1. High values indicate high weights of the factor in the transport outsourcing decision. The most important factor is printed in bold.

In general one can see that the upper three factor categories profit, business performance and service quality have a relatively high weight in the transport outsourcing decision. The factor categories 3PL capabilities, monitoring and legal issues have a rather low weight. These are more factors or criteria for supplier selection. These outcomes are consistent with the results from the open questions.

At high-tech company A the respondent rated the pair-wise comparisons for the outsourcing transport planning as well as the transport execution decision. In outsourcing transport execution profit factors are most important since it is not possible for a high-tech company to both efficiently operate an internal transport organization and to exploit a distribution network. Furthermore 3PL capabilities are important as obviously a 3PL needs to have the right capabilities to take over transport processes. The results are shown in column 2 in table 21.

In outsourcing transport planning processes other factors are of importance. Here the business performance factors are most important. The positive impact that outsourcing has on the business performance is one of the most important reasons to outsource. Furthermore, monitoring factors are important. The idea is that visibility increases when transport processes are outsourced. All information is available at one point, at the 3PL, and only one party has to be contacted when information is required. When transport planning is provided in-house than a part of the information is available in the shippers organization and a part is available at the carriers that provide physical transport. The results are shown in column 1 in table 21.

At high-tech company B, column 3 in table 21, a remarkable high weight for legal issues can be seen. This indicates that legal issues or the rules and regulations for those who are involved in transport and logistics, are the most important reason to transfer transport processes to a 3PL. The validity of this outcome is doubted since during the open questions legal issues were seen as a prerequisite and not as a decision variable. Compliance with rules and regulations is essential for every company but the legal issues are not the reason to outsource transport processes.

When the other factor weights for high-tech company B are assessed one can still see a relatively high weight for business performance and service quality factors. When the 'undeserved' high weight of legal factors is distributed over the five other factors, the factor weights are comparable with the results of the other companies.

At high-tech company C profit, business performance and service quality are factors that are most important in the transport outsourcing decision. The other three factors are less important. From the open questions it was discovered that these factors are criteria for supplier selection. (See table 21, column 4).

When the results for high-tech company D are assessed there are no remarkable outcomes (see table 21 column 5). One again can see business performance and service quality as factors that are most important in the transport outsourcing decision. The other three factors are less important, these factors are criteria for supplier selection.

Table 21 Weight of the factors in the transport outsourcing decision at 4 high-tech companies

	High-tech A P	High-tech A E	High-tech B	High-tech C	High-tech D
Profit	0,11	0,37	0,06	0,24	0,29
Business performance	0,37	0,17	0,11	0,21	0,29
Service quality	0,16	0,10	0,19	0,30	0,19
3PL capabilities	0,06	0,26	0,08	0,13	0,14
Monitoring, traceability, information	0,26	0,06	0,05	0,09	0,07
Legal issues	0,04	0,03	0,51	0,03	0,02
Highest factor weights are printed in bold.					

Based on the pair-wise comparisons that were judged during interviews it can be concluded that the factors in the outsourcing decision are quite comparable throughout the companies that were studied in the high-tech market sector. It can be said that the upper three factors: profit, business performance, service quality are of importance in the transport outsourcing decision. A 3PL should have the right capabilities to be selected as a supplier and the 3PL should provide transparency and visibility within the transport process. That makes these factors criteria for supplier selection. Compliance with the rules and regulations is a basic requirement and not a reason to outsource transport processes.

For a graphical representation of these results one is referred to the bar charts in appendix 14.

9.3.2 Overall evaluation

During the assessment of the pair-wise comparisons not only the weight of the factors in the outsourcing decision was established but also the extent of outsourcing was determined. How this was done is explained in sub-sections 7.2.2 and 8.3.2.

The overall evaluation of the four transport processes is shown in table 22 below. In this overall evaluation of the four transport alternatives the weight of the factors in the outsourcing decision was taken into account. In this table one can see that there are various perceived preferred alternatives. In the text below the companies will be discussed. In addition to the tabulated results in table 22 the bar charts of the summatic overall scores are provided, see figure 29 to 33. These charts clearly show the individual contribution of the factors in the preference for a transport alternative.

Table 22 Overall evaluation of the transport alternatives at 4 high-tech companies

	High-tech A P	High-tech A E	High-tech B	High-tech C	High-tech D
Alternative 1: Outsource all transport processes	0,22	0,17	0,10	0,07	0,20
Alternative 2: Outsource all except order processing	0,45	0,53	0,17	0,52	0,16
Alternative 3: Only outsource physical transport	0,18	0,22	0,36	0,27	0,22
Alternative 4: No outsourcing of transport processes	0,15	0,08	0,37	0,15	0,41
Highest overall evaluations are printed in bold.					

At high-tech company A the respondent judged the comparisons for outsourcing transport planning and transport execution separately. The overall results of these comparisons are not very different but the factor contribution that is the basis for the outcome is different. Transport alternative 2 is clearly most preferred and all transport processes are transferred to a 3PL. Only order processing is kept in-house. Business performance is the most important factor in outsourcing transport planning (see figure 29) and profit is the most important factor in outsourcing transport execution (see figure 30).

At high-tech company B transport alternative 4 appears to be the best transport alternative, that means that all transport processes are carried out by the shipper itself. From figure 31 it becomes clear that legal issues are the driver behind this outcome. In the sub-section 9.3.1 it was already mentioned that the high weight of legal issues is doubted. The second best alternative at high-tech company 2 is alternative 3, in this alternative transport execution is outsourced and transport planning is provided in-house. Profit and

service quality are important factors in that decision. This is more in line with the results of the open questions.

At high-tech company C alternative 2 appears to be the best transport alternative, here all transport planning and execution processes are outsourced and only order processing is carried out by the shipper. Alternative 3 is the second best alternative. The underlying factors for this outcome are profit, business performance and service quality factors. The other factors obviously contribute less to this outcome (see figure 32). Alternatives 1 and 4, in which respectively all transport processes are outsourced and all transport processes are carried out by the shipper, are not preferred.

At high-tech company D transport alternative 4 is perceived as the most preferred alternative. This outcome is based on high contributions of business performance, service quality and monitoring factors (see figure 33). At this company it is believed that a better business performance, service quality and visibility can be provided in-house. Profit factors are the main reason to choose for alternative 1, outsourcing all transport processes.

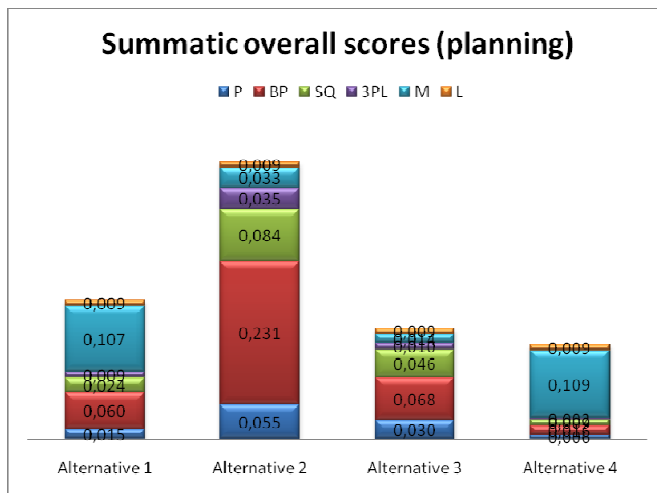


Figure 29 Summatic overall evaluation high-tech company A (transport planning)

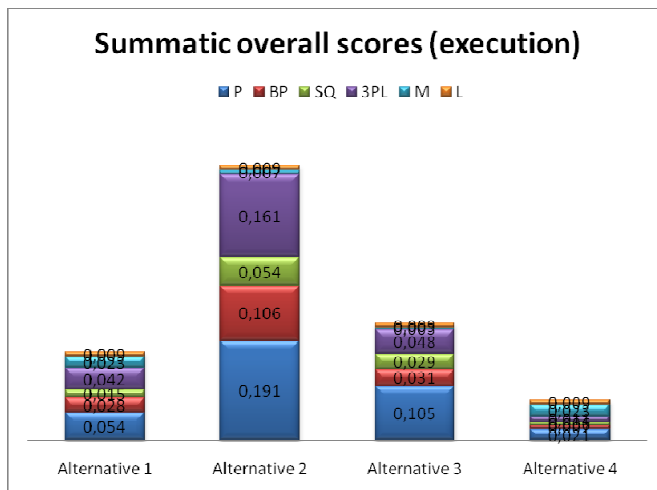


Figure 30 Summatic overall evaluation high-tech company A (transport execution)

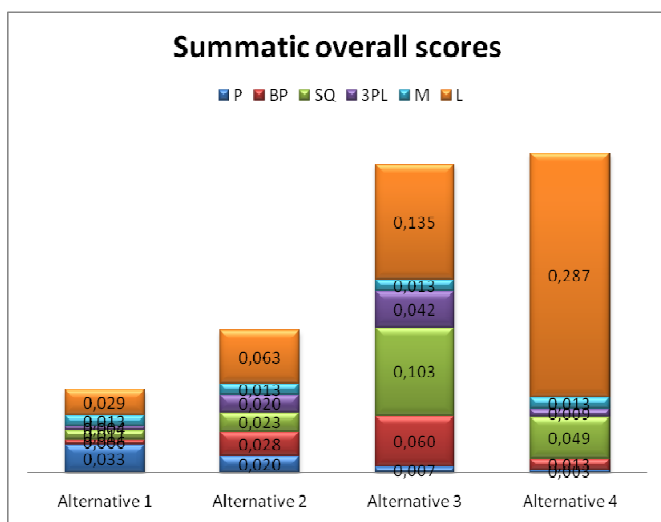


Figure 31 Summatic overall evaluation high-tech company B

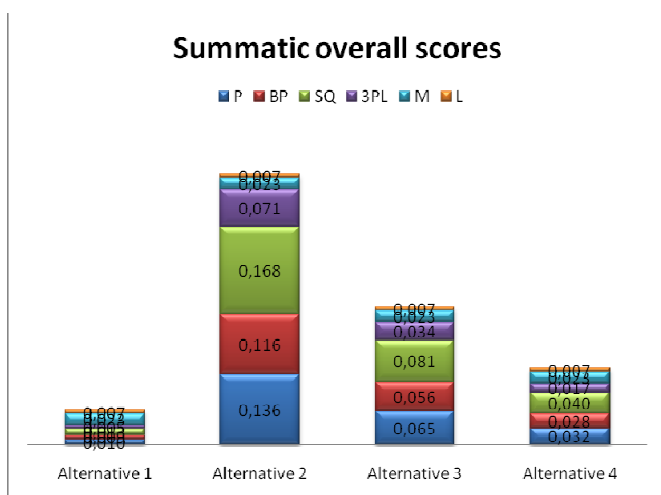


Figure 32 Summatic overall evaluation high-tech company C

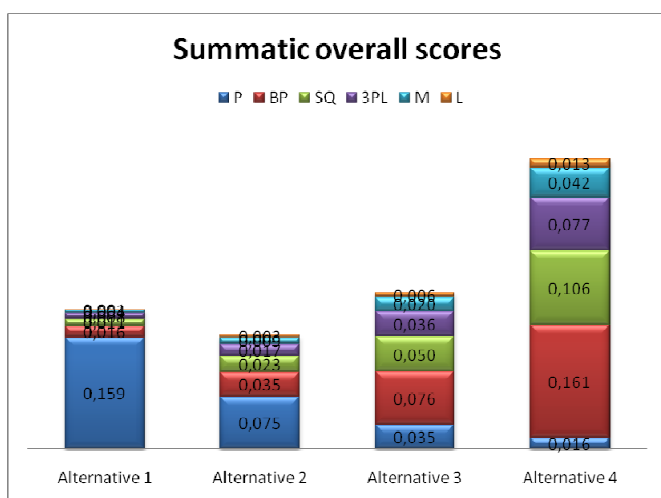


Figure 33 Summatic overall evaluation high-tech company D

9.3.3 Sub-conclusion

Based on the overall evaluations of the four transport alternatives it can be concluded that transport alternative 2 and 3 are preferred mostly. In both alternatives transport execution processes are outsourced and in alternative 3 also a part of the transport planning processes is outsourced. The underlying factors to choose for these alternatives are mostly profit, business performance, service quality and 3PL capabilities factors.

9.4 Consistency analysis high-tech market sector

In this sub section the consistency of the results will be discussed. As mentioned earlier the consistency ratio is an indication for the consistency of the respondents answers. How these ratios are calculated is explained in sub-section 7.3.2.

Below in table 23, the consistency ratios of the factor evaluation and the alternatives with respect to every factor are shown. One can see that six of the available ratios exceed the 0.10 boundary indicating inconsistent answers.

At high-tech company A the pair-wise comparison of the alternatives with respect to the factors 3PL capabilities and monitoring are slightly inconsistent. Perhaps it was not clear how to interpret these factors exactly. Earlier it was concluded that monitoring, information and traceability are not factors in the outsourcing decision but rather criteria in the supplier selection. Furthermore it was already concluded that a 3PL should have the right capabilities for the transport task but that the lack of capabilities is not a reason to insource transport processes again. Instead, another 3PL will be selected. These considerations make it difficult to judge the pair wise comparisons consistently.

At high-tech company B and D only the pair-wise comparisons of the factors are judged slightly inconsistent. It appears to be difficult to compare 6 factors consistently, on the other hand, consistency ratios of 0.179 and 0.240 are not dramatically inconsistent.

The pair-wise comparisons of the alternatives with respect to each of the factors are in most cases based upon an ordering of the four alternatives. When the alternatives are ordered one only has to judge them on the minus nine to nine scale to indicate how strong the preference is. In that case it is easier to provide consistent answers.

Table 23 Consistency ratio factors and alternatives at 3 chemical companies

	High-tech A	High-tech A	High-tech B	High-tech C	High-tech D
Factors	0,046	0,051	0,179	0,080	0,240
Alternatives with respect to profit	0,052	0,052	0,086	0,065	0,044
Alternatives with respect to business performance	0,073	0,073	0,044	0,065	0,044
Alternatives with respect to service quality	0,052	0,052	0,044	0,065	0,044
Alternatives with respect to 3PL capabilities	0,113	0,113	0,044	0,000	0,044
Alternatives with respect to monitoring...	0,147	0,147	0,000	0,000	0,044
Alternatives with respect to legal issues	0,000	0,000	0,044	0,000	0,044
Consistency ratio's that indicate inconsistency (CR>0.10) are printed in bold.					

The evaluations of each of the alternatives with respect to the six factors are rather consistent. Based upon the result above it is concluded that the pair-wise comparisons were not judged very inconsistency. Therefore the slight inconsistency will not influence the results much.

9.5 Conclusion

At this stage of this chapter the main research question can be answered for the high-tech market sector. This section is sub-divided in the four main aspects of the research question: factors, factor weights, extent of outsourcing and need for information.

What are the factors that determine the shippers decision on outsourcing transport processes in the high-tech market sector in The Netherlands, what is the extent of transport outsourcing and what is the need for information about (outsourced) transport processes?

9.5.1 Factors in the transport outsourcing decision

The first part of the main question was already answered in chapter five. Many factors influence the outsourcing decision, these factors can be summarized in the following six categories: profit, business performance, service quality, 3PL capabilities, monitoring, information and traceability and legal issues.

Based upon the results of the open questions it can be concluded that all the high-tech companies outsource transport execution processes. That is transport from location A to location B and the warehousing process as a whole, the latter includes the handling of the incoming goods, order picking and loading.

Furthermore it can be concluded that the transport planning processes are carried out in close collaboration with the 3PL. The more operational or day-to-day planning is generally transferred to the warehouse provider. Employees of the 3PL make the load plan and arrange carriers. The strategic transport planning processes like order processing, route planning and invoicing are provided by the shipper itself.

9.5.2 Factor weights

The weight of the factors in the outsourcing decision was established by means of the analytical hierarchy process. These weights were shown in table 21. Based on the results in the table it can be concluded that the factors in the outsourcing decision are quite comparable throughout the companies that were studied in the high-tech market sector. It can be said that the factors profit, business performance, service quality are of importance in the transport outsourcing decision. A 3PL should have the right capabilities to be selected as supplier and the 3PL should provide transparency and visibility in the transport process. That makes these factors criteria for supplier selection. Compliance with the rules and regulations is a basic requirement and not a reason to outsource transport processes.

9.5.3 Extent of outsourcing

Based on the overall evaluations of the four transport alternatives it can be concluded that transport alternative 2 and 3 are preferred mostly. In both alternatives transport execution processes are outsourced and in alternative 3 also a part of the transport planning processes is outsourced. The underlying factors to choose for these alternatives are mostly profit, business performance, service quality and 3PL capabilities factors.

9.5.4 Need for information

Information about the transport process is needed and the shippers that were studied all have a transport management system installed. Shippers want information about all the standard events in the supply chain, for instance when the goods are loaded, when the goods pass a hub in the network and when the goods are delivered at the customer. This information should be uploaded in the TMS by the carriers and warehousing providers. Information about exceptional events like delayed or damaged goods needs to be communicated in a pro-active manner besides uploading this information in the TMS.

10 Generalization of the results

In this chapter the results of both cases studies will be applied to possible other sectors, in other words the results are applied to another 'population'. First in section 10.1 the results of the chemical market sector will be applied to the oil & gas sector. Secondly the results of the high-tech sector will be applied to the automotive sector in section 10.2. Finally, in section 10.3 it will be assessed if method that was used can be applied to other strategic decisions than transport outsourcing decisions. Here the results are applied to another situation.

10.1 Application of the results to different market sectors

In this section the results of the cases studies will be applied to another population, that is another market sector in this case. In sub-section 10.1.1 the results of the chemicals sector will be applied to the oil & gas sector. In sub-section 10.1.2 the results of the high-tech sector will be applied to the automotive sector.

The generalization of the results will be based on the market sector characteristics that were discussed in chapter 4.

- Scale of the inbound supply chain: global or local
- Scale of the outbound supply chain: global or local
- Time criticality of transport inbound: high, medium or low
- Time criticality of transport outbound: high, medium or low
- Type of goods inbound supply chain: bulk or parts
- Type of goods inbound supply chain: bulk or parts
- Type of supply chain: convergent, divergent or neutral

10.1.1 Chemicals and Oil & Gas

From the analysis in chapter four it appeared that the chemicals market sector and the oil & gas market sector have comparable scores on these characteristics: The scale of the inbound supply chain is global in both market sectors. The scale of the outbound supply chain is local in both sectors. The time criticality in the internal and external supply chain is rather low in both sectors. Type of goods in the inbound and the outbound supply chain is characterized as bulk goods. Finally the supply chains of the chemicals market sector and the oil & gas market sector are both divergent.

Based upon these characteristics it can be concluded that the chemicals market sector is comparable with the oil & gas market sector. Since there are many similarities between the two market sectors it could be possible that the results of the chemical case study also apply in the oil & gas sector.

In that case it can be said that in the oil & gas market sector transport execution processes are generally outsourced to a third party logistic service provider and that transport planning activities are partly outsourced and partly provided by the shipper. Furthermore, factor categories profit, business performance and service quality are important factors in the transport outsourcing decision. 3PL capabilities and monitoring are criteria for supplier selection and legal issues is a prerequisite and not a decision variable.

To prevent jumping to conclusions some differences of both market sectors will be discussed too. And the possible influence of these differences to the factors and factor weight will be discussed.

Oil & gas are products with much more strategic importance than chemical products. The strategic importance of oil & gas can be a reason for a shipper to perform all transport processes in-house because

the third party logistic service provider is not trusted to the job. Therefore the importance of 3PL capabilities can be higher in the oil & gas sector than in the chemicals market sector.

Furthermore the width of oil & gas companies like Shell and Texaco is much bigger when compared with chemical companies. The latter generally transform base chemicals into several chemical products which are sold to customers. Chemical companies provide just one of the many steps in the supply chain. Oil & gas companies, on the other hand, are involved with almost all steps in the supply chain. From field exploration, oil drilling, refining to selling petrol to car drivers. When all these steps are provided in-house than it is illogical to outsource transport processes and thereby creating (extra) interfaces between the shipper and a third party. These interfaces possibly affect the company's business performance, which should result in a higher weight of the business performance factors in the transport outsourcing decision. Since the entire supply chain is controlled by one company the service quality towards customers will be of less importance. This results in a lower importance of service quality factors in the transport outsourcing decision.

The volumes that oil & gas companies transport are much bigger and since the many of the steps of the supply chain are provided in-house much more insight is available in supply and demand throughout the supply chain. Therefore it is for oil & gas companies much easier to efficiently exploit a transport network. Therefore the importance of the profit factors can be lower in the transport outsourcing decision in the oil & gas sector.

Based on the supply chain characteristics that were mentioned at the beginning of this section it can be concluded that the chemicals market sector and the oil & gas sector are comparable and therefore the results from the chemicals market sector can be applied to the oil & gas sector. However, there are also considerations that can result in another weight distribution over the factors and different preferred transport alternatives. It is recommended to conduct in depth study to the factors, weight of the factors and the extent of outsourcing in the oil & gas sector.

10.1.2 High-tech and automotive

The high-tech and the automotive market sectors were assessed to the same criteria is listed at the beginning of this section. From the analysis in chapter four it appeared that the high-tech market sector and the automotive market sector have comparable scores on these characteristics: The scale of the inbound supply chain in both supply chains is global. The scale of the automotive outbound supply chain is characterized global and the high-tech supply chain local and global. The time criticality in both supply chains is medium to low. The goods in the inbound and supply chain of the high-tech and automotive market sectors are semi-bulk or parts. Finally both high-tech and automotive supply chain are characterized as divergent supply chains.

Based on these characteristics it is concluded that the high-tech market sector is comparable with the automotive market sector. Since there are many similarities between the two market sectors it could be possible that the results of the high-tech case study also apply in the automotive sector.

Based upon these similarities it can be said that the factors profit, business performance, service quality are of importance in the transport outsourcing decision in the automotive sector, just like in the high-tech sector. The factors 3PL capabilities, monitoring and legal issues are of less importance. Furthermore all physical transport is outsourced to a 3PL and the transport planning processes are provided in close collaboration with the 3PL.

There are similarities but there are also differences between these market sector. These differences can result in other factors that are important in the transport outsourcing decision in the automotive sector. Or a different weight of the same factors. Furthermore other transport alternatives can be preferred in the automotive sector.

One of the differences between the high-tech and automotive sector is that the latter is more a pull system than a push system. In general cars are built according to a client order, that order initiates action upstream in the supply chain. The high-tech supply chain is more a push system here production facilities produce high-tech equipment and push that volume through the supply chain towards the customers. It is possible that shipper in a pull supply chain organize their own inbound transport. This can result in different weights for service quality factors in the transport outsourcing decision since the supplier's customer is the shipper itself. In addition, more factors can be originated at the suppliers instead of at the customers.

The automotive market sector is also characterized by a just in time production system. In this system there is hardly any stock available through the supply chain, this put enormous pressure on the transport processes. Since there are no stocks practically any delay in the transport process will disrupt the production process. This can increase the importance of 3PL capabilities in the transport outsourcing decision in the automotive sector since in this system 3PL need to be very reliable. Or perhaps the weight of the business process factors will change too since the automotive business processes are highly influenced by the performance of the transport process.

From the supply chain characteristics it can be concluded that there are similarities in the high-tech and automotive supply chain. Therefore it could be that the results of the high-tech sector also apply in the automotive sector. As described in the texts above there are also differences that can lead to other importance of the factors in the automotive sector. So it is advised to conduct research in the automotive sector to establish the weight of the factors.

10.2 Analytical Hierarchy Process in other situations

In this study the AHP is applied in the transport outsourcing decision. In sub-section 10.2.1 it will be discussed if the AHP can be applied in the decision to outsource other business processes. In sub-section 10.2.2 it will be found out if the AHP can be applied in the off-shoring decision.

10.2.1 AHP in the decision to outsource business processes

In this study the transport process is seen as one of the many business process at companies. In this sub-section it will be discussed if the approach that was taken to assess the outsourcing decision for this transport process can be used to assess the outsourcing decision for other business processes.

In section 2.4 a difference was made between outsourcing of services and outsourcing of production. The transport process is a service. The main difference that was indicated in that section is the number of interfaces that needs to be managed. In outsourcing production of parts there is just one interface, namely the interface between the company and the third party. When services are outsourced more interfaces have to be managed, first the relation between the company and the service provider and secondly the relation between the service provider and the customer.

In this study it is proved that the analytical hierarchy process can be used to assess the decision on outsourcing a service to a third party. Therefore it is concluded that the AHP can also be used to decide on outsourcing other service business processes. For example the decision on whether or not to outsource the human resource planning process or the recruitment process can be assessed by means of the AHP. Obviously other factors are of importance and other factor categories have to be developed, but the basic structure of the AHP can be used.

10.2.2 AHP in the off-shoring decision

In this study the AHP is applied in the outsourcing decision. In sub-section 2.4.1 the term outsourcing was compared with off-shoring. The main characteristic of outsourcing was the transfer of business processes outside the organizational borders. The main characteristic of off-shoring was the transfer of business processes outside geographical borders.

Theoretically these characteristics are very comparable, in practice both concepts have very different consequences. However, the decision whether or not to outsource business processes is comparable with the off-shoring decision.

Based on the text above it is concluded that the AHP can be applied in the off-shoring decision. Obviously other factors will play a role in this decision.

10.3 Conclusion

Based on the generalizations made in this chapter it can be concluded that the supply chain characteristics that were presented in chapter 4 provide the opportunity to apply the results of the chemical and high-tech market sector and to other market sectors.

The chemical market sector and the oil & gas market sector shows many similar supply chain characteristics. Therefore it is concluded that the results from the chemicals case study can be applied to the oil & gas sector. However, there are differences between the sectors that are not covered in the supply chain characteristics. These differences can result in other factors that are of importance or another distribution of the factor weights. Therefore it is advised to also study the oil & gas market sector.

Based on the supply chain characteristics from chapter 4 the high-tech market sector shows resemblance with the automotive market sector. Therefore it is concluded that the results from high-tech can be applied to the automotive sector. However the differences between the high-tech market sector and the automotive can result in different weights of the factor categories. Therefore it is advised to also study the automotive market sector.

In chapter four it was already concluded that the market sectors retail, wholesale and pharmaceutical have similar characteristics. These market sectors, however, do not have overlapping characteristics with the market sectors that were studied in this research. Therefore it is not sensible to apply the findings of the chemical and high-tech sector to these three market sectors.

From the texts in section 10.2 it appeared that the AHP can be applied in the decision to outsource other business processes. Furthermore it is argued that the AHP can be applied in the off-shoring decision. Obviously in different applications other factors will be of importance.

11 Conclusions and recommendations

In this thesis the factors that influence the shipper's transport outsourcing decision is studied. For companies in the chemicals and high-tech sector these factors are identified, the weight or importance of these factors is determined and the preferred transport alternative is selected. In this chapter a conclusion will be drawn and recommendations for further research will be suggested. First, in section 11.1 conclusions will be drawn with respect to the main research questions and sub-questions. Secondly, in section 11.2 recommendations for further research will be suggested.

11.1 Research questions

In this section the main research question and sub-questions will be answered. First the main research question that was presented in chapter one will be mentioned. Secondly each sub-question will be mentioned and answered, these answers lead to the answer on the main research question.

The main research question for this research is formulated as follows:

What are the factors that determine the shippers decision on outsourcing transport processes in the various market sectors in The Netherlands, what is the extent of transport outsourcing and what is the need for information about (outsourced) transport processes?

This main research question is sub-divided into six sub-questions that cover different aspects of the main question.

1 What are the main concepts in transport management and which parties are involved in the transport outsourcing decision?

In chapter 2 insight has been provided in the important concepts in this research. In this research transport processes are looked upon as one of a company's business processes, just like other processes as sales, production and procurement. In accordance with Mintzberg and Porter transport processes are classified as a company's primary process, transport processes are key to a company's performance. The shipper should therefore make sure that these processes are performed well, either by the shipper itself or by a 3PL.

As mentioned, transport is one of the primary processes. The decision whether or not to outsource transport processes has high consequences for the company, it has long term implications, is hard to reverse and includes uncertainty. Therefore it is concluded that the outsourcing decision is a strategic decision for which a formal decision method is needed.

Besides the shipper itself, four other (groups of) stakeholders that can influence the shippers outsourcing decision have been identified, namely the shipper's supplier and customer, the third party logistic service provider and society. Despite it is the shipper's transport outsourcing decision one has to be aware of the influence that other stakeholders have on this outsourcing decision. In the conceptual model the relations between all the stakeholders and the relation or influence that the stakeholders have on the outsourcing decision is graphically shown.

2 Which sub-processes can be identified in the overall 'transport process' and what is the relation between these sub-processes?

The term transport process is broken down into two sub-processes: transport planning and transport execution. These sub-processes are broken down into the following sub-sub-processes: order processing, load planning, route planning, invoicing, order picking, loading, transportation, unloading, warehousing and final delivery.

The mutual relations between the transport processes are graphically shown in an IDEF diagram (see appendix 2). This diagram also shows the controls of the processes and the mechanisms. These mechanisms represent actor roles. Which specific actor, shipper or 3PL, is going to perform these processes is subject of this research.

3 What are the characteristics of the seven market sectors that are interesting for Capgemini and how can two market sectors for further in-depth analysis be selected.

Capgemini is active in various markets sectors. For this research the following seven market sectors are identified and described: automotive, high-tech, chemicals, oil & gas, retail, wholesale and pharmaceutical.

The seven market sectors are described using four transport specific characteristics. These characteristics are the scale of the inbound and outbound supply chain, which may be local or global. The time criticality is also a distinctive supply chain characteristic of a market sector. Finally the type of goods in the inbound and outbound supply chain are used as a supply chain characteristic.

Not all market sectors can be studied in-depth in this thesis and therefore two potentially most interesting market sectors have to be selected. Market sectors will be selected using the scores on the four supply chain characteristics and the availability of knowledge within Capgemini and access to Capgemini clients. The high-tech market sector and the chemicals market sector are selected for further research since these sectors differ according to the four supply chain characteristics and there is good access to clients in these sectors.

4 What are the factors originated at the shipper and the other stakeholders that influence the shipper's outsourcing decision?

Literature study to factors in the outsourcing decision resulted in a list of 80 factors (see appendix 4, tables 24 and 25). In order to take away the overlap and to make analysis by means of the AHP possible, these factors are categorized into the following six categories: profit, business performance, service quality, 3PL capabilities, monitoring, information and traceability and finally legal issues. These factors have a clear origin at the stakeholders that were defined earlier.

5 Which method can be used to determine the weight of the factors in the outsourcing decision and to find out the extent of outsourcing?

The analytical hierarchy process method has proved to be a good method to determine the weight of the outsourcing factors and to rank the various outsourcing alternatives. AHP may be used to rank possible outsourcing alternatives using multiple factors. Furthermore the extent of outsourcing transport processes can be determined by means of ranking four transport alternatives. In addition it has been shown that the AHP is applied in many similar decisions by various authors. In many works the AHP proved to be a valuable tool to make outsourcing decisions and many other strategic decisions in business.

It has been shown that many alternative multi criteria methods exist, however their application in this research fails. Q-methodology cannot be applied since many respondents are needed for a statistically sound analysis. That many respondents are not available in the time for this research. The multi-criteria techniques that were discussed are not suitable for this research since they assume that the weight of the criteria (factors) in the decision is known prior to the analysis. In this research the weight of the factors is subject of study.

6 What is the research setup and how can Capgemini conduct research to the shipper's outsourcing decision in the five not-selected market sectors?

In this research only two out of the seven interesting market sectors for Capgemini have been studied in depth. The research setup that was used is described in detail to enable others to conduct the research for the automotive, oil & gas, retail, wholesale and pharmaceutical market sectors.

Firstly a literature study to identify the factors in the outsourcing decision is carried out and a categorization is made. This is a onetime effort since the factor list can be used in other studies. Secondly interviews in combination with a questionnaire are held in the market. The results from this step provide the market specific view on the outsourcing decision. Thirdly the AHP analysis design in Excel has to be developed. This is a onetime effort, once the design is made it can be used for as many interviews and markets sectors as needed. With a user friendly interface the Excel model can easily be used as decision supporting tool.

The results of the open interview questions combined with the results of the questionnaire provide all the information needed to answer the main research question. The combination of open interview questions and the more quantitative pair-wise comparisons of the factors and the alternatives provides the possibility to generate and validate the results at once. The results of the questionnaire can be put into perspective by the information from the interview.

At this point of the concluding chapter all research questions have been answered. These answers and the information that is retrieved in both case studies can now be used to answer the main research question that was stated at the beginning of this section.

Answer on the main research question

Based upon the interviews it turns out that shippers in the chemical sector and high-tech sector have to manage their outbound supply chain. The conclusions are therefore only applicable to the outbound supply chain.

For the chemicals market sector it is concluded that not one factor is most important or decisive for the entire sector, see table 17. In the three chemical companies that were subject for the chemicals case study profit, service quality, business performance and 3PL capabilities were factors that were important in the various cases. Legal issues and monitoring, information and traceability were least decisive. These factors are important but more in the supplier selection problem and legal point of view.

With respect to the overall evaluation of the transport alternatives, or extent of outsourcing, it can be concluded that there is not one preferred transport alternative, see table 18. The preference for a transport alternatives varies per company. Furthermore the factors on which the preference for an alternative is based varies per chemical company, figures 27 and 28.

Chemical companies that leave the transportation of the goods up to the customer do not need any information about the transport processes. It is known which goods are loaded, which quantities and when. They do not need any further information as that is simply an issue between the customer and their 3PL. Companies that are responsible for the transport of their products to the customer their selves, do however need information about the transport processes. They would like to know when goods are delivered. In addition when the goods are delayed or damaged they would like this information presented in a so called 'exception report'. During the interviews it was indicated that this information was not always received from the 3PL.

For the high-tech market sector it is concluded that the factors in the outsourcing decision are quite comparable throughout the companies that were studied in the high-tech sector, see table 21. It can be said that the following factors; profit, business performance, service quality are of importance in the

transport outsourcing decision. The other factors 3PL capabilities, monitoring and legal issues are of less importance. A 3PL should have the right capabilities to be selected as supplier and the 3PL should provide transparency and visibility in the transport process. That makes these factors criteria for supplier selection. Compliance with the rules and regulations is a basic requirement and not a reason to outsource transport processes.

Based on the overall evaluations of the four transport alternatives it can be concluded that transport alternative 2 is preferred mostly, see table 22. In alternative 2 transport execution processes are outsourced and also a part of the transport planning processes is outsourced. The underlying factors to choose for these alternatives are mostly profit, business performance, service quality and 3PL capabilities factors, see figures 29 to 33.

Information and control over the transport process is seen as necessary and the shippers that were studied all had a transport management system installed. Shippers need information about all the standard events in the supply chain, such as when the goods are loaded, when the goods pass a hub in the network and when the goods are delivered at the customer. This information should be uploaded in the TMS by the carriers and warehousing providers. Information about exceptional events, such as delayed or damaged goods, needs to be communicated in a pro-active manner besides having this information uploaded in the TMS.

11.2 Conceptual model

Throughout this research a conceptual model of the shipper's transport outsourcing decision is developed and used. It can be concluded that this model proved to be very useful during the research. It provided a clear overview of all the aspects that were of importance in the study in only one diagram.

The transport outsourcing decision is a decision that the shipper has to make. The model shows that besides the shipper other stakeholders influence the decision too, namely suppliers, customers, 3PL's and society.

The stakeholders' influence in the shipper's transport outsourcing decision is represented by factors. The model showed the origin of these factors. Many factors were found in literature and to make analysis by means of the AHP possible these factors are categorized into six categories.

The scale on which the extent of outsourced transport processes is measured is also shown in the conceptual model. The model therefore clearly depicts the relation between the various parts of the research and it provides for structure in the research.

Additionally the conceptual model goes beyond transport outsourcing decisions only. It can be applied in other decision problems since all decisions have stakeholders involved. These stakeholders and their influence on the decision can be mapped in this model. In every decision problem there are factors (decision variables) involved. Identification and possible categorization of these factors is an action that may be useful in every decision. Finally all decisions have alternatives to choose from. Structured analysis of these alternatives is essential to make a good decision.

11.3 Generalization

Based on the generalizations made in chapter 10 it can be concluded that the supply chain characteristics that were presented in chapter 4 provide the opportunity to apply the results of the chemical and high-tech market sector and to other market sectors.

The chemical market sector and the oil & gas market sector show many similar supply chain characteristics. Therefore it may be concluded that the results from the chemicals case study can be applied to the oil & gas sector. However, there are differences between the sectors that are not covered

in the supply chain characteristics. These differences possibly result in other factors that are of importance or another distribution of the factor weights. Therefore it is advised to also study the oil & gas market sector.

Based on the supply chain characteristics from chapter 4 the high-tech market sector shows resemblance with the automotive market sector. Therefore it is concluded that the results from high-tech can be applied to the automotive sector. However the differences between the high-tech market sector and the automotive can result in different weights of the factor categories.

In chapter four it was already concluded that the market sectors retail, wholesale and pharmaceutical have similar characteristics. These market sectors, however, do not have overlapping characteristics with the market sectors that were studied in this research. Therefore the findings of the chemical and high-tech sector may not be applied to these three market sectors.

Furthermore it appeared that the AHP can be applied in the decision to outsource other business processes. Additionally it is argued that the AHP can be applied in the off-shoring decision. Obviously in different applications other factors will be of importance.

11.4 Recommendations for further research

This thesis research was conducted in limited time and therefore the scope of the research was limited. Not everything could be studied in depth. In this section recommendations for further research will be presented.

Not all seven market sectors that are interesting for Capgemini could be studied in the time available for this research. To obtain a complete view on outsourcing transport processes in all seven market sectors it is recommended to conduct this study also in the automotive, oil & gas, retail, wholesale and pharmaceutical market sectors. The setup of this research as described in detail in chapter 7 can be used as a basis for the extended study.

In chapter 3 the term transport process was defined and a decomposition of the sub-processes was made. The number of sub-processes was sufficient for this study but the decomposition was not exhaustive. Much more detail can be added to the decomposition of the transport process. If in further studies more detailed information is needed about for instance which transport processes exactly have been outsourced than it is recommended to include more detail in the decomposition of the transport process. Furthermore it is advised to make a market specific decomposition of the transport processes. The decomposition is used during the interview, a market specific decomposition makes the transport process more recognizable for the respondent.

In chapter 4 all seven market sectors are assessed according to four transport specific supply chain characteristics. Based on these characteristics two market sectors were selected these characteristics were the bases for the generalization in chapter 10. It is recommended to assess the market sectors to more characteristics. This will improve the understanding of a market sector and it improves the quality of the generalization of the results.

Finally, the results of this study are mainly based on seven interviews. Earlier in this report it was already mentioned that the results are therefore not statistically significant and merely reflect the viewpoints of several supply chain managers. In order to make the results more generally applicable it is recommended to conduct more interviews in the market sectors that will be studied. Furthermore it may be considered to apply Q-methodology to obtain a statistically valid analysis.

12 Reflection

In this chapter there is looked back upon the research project after the research project is finished. In this chapter it is identified which parts of the research were good and what could have been better. In section 12.1 the research method and results will be discussed. In section 12.2 the literature used in this research will be reflected. Finally, in section 12.3 the research process will be discussed. The notions in this chapter improve further research.

12.1 Reflection on method and results

In this section there is looked back on the research method and results. First the reflection on the research method will be discussed and secondly the results will be discussed.

12.1.1 Research method

In the research a combination of qualitative and quantitative methods is used. For the data gathering a combination of interview and questionnaire is used. The open and free atmosphere setting of a spoken interview gave the opportunity to ask why certain choices regarding outsourcing of transport processes are made and what the underlying factors were. A qualitative idea of the market sectors was could created. To determine the weight of the factors in the outsourcing decision a questionnaire was filled out during the interview. The analytical hierarchy process was used to analyze the scores on the pair-wise comparisons from the questionnaire.

In my opinion this combination proved to be very useful in this research. The factors found in literature were verified in by means of the spoken interview. In addition new market specific factors could be identified. The weight of these categorized factors, quantitative by definition, could be measured by means of the pair wise comparisons of the AHP. This combination of methods provides the answer to the main research question.

The method and research approach used in this thesis project proved to be useful. The main research question is answered for the chemical and high-tech market sector. The research method and research approach could be used to answer the main research question for the five remaining market sectors: automotive, oil & gas, retail, wholesale and pharmaceutical.

On the other hand the AHP output is very detailed and reflects the specific view of one respondent. Perhaps the results are too specific for a company or individual supply chain manager to generalize theses results for the entire chemical or high-tech market sector.

When one is of the opinion that these generalization difficulties and the level of quantitative detail of the AHP is a problem and when the extent of outsourcing transport processes is of less importance, than Q-methodology is proposed as a suitable alternative method. The factors that influence the outsourcing decision can be sorted. Many more respondents are needed to ensure the statistical validity of the results.

Another point of attention with regard to the AHP is the scale used to judge the pair wise comparisons. The minus nine to nine scale is perhaps somewhat too detailed for the purpose of the research and is therefore sensitive to inconsistencies. When for instance A is moderately preferred over B and B is moderately preferred over C than A should be at least be strongly preferred over C. Certainly not equally preferred and certainly not moderately preferred but the respondent can also indicate that A is Very strongly or extremely more preferred over C. These choices make it hard to consistently judge up to 15 pair-wise comparisons and it becomes more difficult when the negative side of the scale is included.

Ranking the factor categories and ranking the transport alternatives with respect to the six factor categories can be a solution. However, the results drop from interval level to ordinal level since by means

of ranking it can be indicated that a factor or alternative is better than another alternative or factor but not how much better.

12.1.2 Results

Literature study resulted in many factors that influence the (transport) outsourcing decision. In order to prevent much overlap in all individual factors and in order to create a workable AHP structure these factors were categorized into six categories. The categories are designed to match the shippers business objectives, however the choice for these specific six categories is made by the researcher. Also the assignments of the individual factors to the factor categories is made by the researcher.

Presumably other authors develop other categories and perhaps choose for less or more categories. Furthermore the assignment of the individual factors to the categories can be different in other studies. Obviously when the factor categories change also the distribution of the factor weights over the categories will change.

The subject of the research were the factors that influence the transport outsourcing decision. For companies this is a strategic decision. Every researcher in the field of a company's strategy should take (social) desired answers and strategic behavior by the respondents.

In this research desired or strategic answering was overcome by combining interview methods with the questionnaire. The open questions provided insight in the factors that were important and the respondents viewpoint towards transport outsourcing. In the pair-wise comparisons (questionnaire) the exact weight of the factors was established. By combining these methods the answers can be compared and the internal validity of the entire interview, open questions and pair-wise comparisons, can be assessed. At the same time strategic answering can be detected since it is quite difficult to consistently provide strategic answers in both the open questions and the pair-wise comparisons.

At one of the high-tech companies a very high weight for the legal issue factors can be witnessed while during the open questions it appeared that legal factors were not very important in the transport outsourcing decision. Perhaps the term 'legal' in the pair-wise comparisons triggered the following strategic answer: Legal is most important no matter to which factor it is compared. Since none of these companies wants to be related with illegal behavior. The intention of the question was not to indicate legal or illegal behavior, the question was meant to find out to what extent compliance with rules and regulations is a reason to outsource or insource transport processes.

In the previous sub-section it was already indicated that due to the limited number of respondents the results are perhaps not generally applicable in the entire chemical and high-tech market sector. The similar characteristics of the chemical supply chain and the oil & gas supply chain and the high-tech and automotive supply chain provided the possibility to generalize the results. It was concluded that the results of the chemical sector can be applied in the oil & gas sector and that the results of the high-tech sector can be applied to the automotive sector. Here it has to be mentioned that due to the limited number of respondents the application of the results to other sectors than chemicals and high-tech is limited. This can be solved by conducting more interviews as suggested in the recommendations.

12.2 Conceptual model

Developing a conceptual model of the situation under study certainly proved to be a good idea. Thinking about the structure of the model itself is a good exercise. As a researcher one has to take a step back by first analyzing the research context before start working on the problem (of Capgemini) itself.

The structure of the conceptual model is at some points comparable with the structure of the AHP, both structures contain for instance factors and alternatives. The conceptual model however provides

complete and systematic overview of decision problem. Additionally the conceptual model is method independent.

The development of the conceptual model and answering the main research question are not sequential activities. With the insights obtained from developing the model one can progress with the research. The other way around is also possible; the certain aspects of the research also contribute to the development of the conceptual model. That is also the reason why the complete conceptual model cannot be presented at once at the beginning of the research.

When the conceptual model is finalized it provides structure and clarity during the research. In one diagram an overview is provided in the stakeholders, stakeholders' influence to the decision, the factors (categories) and the alternatives in the decision.

The current model is unidirectional, only the influence that stakeholders have on the decision is shown. However one can think of a situation in which stakeholders B, C and D become involved in the decision problem due to the decision of stakeholder A. The model therefore can be extended with an extra light blue box in which the stakeholders that are affected by a decision can be depicted. Or double headed arrows can be used from the stakeholders to the decision and v.v. By incorporating the consequences of a decision into the conceptual model these consequences are thought over prior to the actual decision. This may lead to better decision making.

12.3 Literature

In this section there is reflected on the literature used in this research.

Outsourcing business processes is not a new concept. In fact, thinking about whether to buy or to make products was already done in ancient times. Also the term logistics can be traced back to the ancient Greek. Between then and now much is written about these concepts by many authors.

With this in mind a lot of literature should be available for this research. However, to find the right literature is still quite a task. Not every author that includes the terms outsourcing, AHP, business process, transport process, decision making, logistics and supply chain management in the keywords is leading in the field. Furthermore not all the work of key authors is freely accessible. With these remarks kept in mind it is believed that the quality of the sources used in this report is good.

For the definition of the main theoretical concepts and methods it is tried to refer to the work of key authors in the field. For the supply chain management aspects Brewer, Button & Hensher, Bowersox & Closs and Coyle, Bardi & Langley are assessed. In the texts about business processes there is referred to Davenport, Mintzberg and Porter. With respect to decision making and decision theory references are made to Keen & Sol and Keeny & Raiffa. Finally in the theoretical notions on the research methods the work of Saaty, Whitten & Bentley and Baarda & De Goede is referred to.

Many more references are made, for instance to prove successful application of a research method in various similar or different cases. Or to indicate the origin of the many factors that can be of influence in the transport outsourcing decision.

Finally, for starting researchers it is sometimes difficult to assess whether or not a paper is considered leading in the field and which authors can be seen as key authors. Of course the number of times that the paper or author is cited gives an indication about the leading-ness of the author and paper. However, recent paper that reflect the latest insight in the matter are not cited yet. Older papers are obviously more frequently cited, is that because the paper is considered leading in the field or just because the paper is older?

12.4 Reflection on (research) process

In this section there is looked back on the (research) process. First the planning of the research will be assessed and how the planning affected the process. Secondly the selection of the market sectors with respect to the planning will be discussed. Finally the selection of respondents in relation to the process will be discussed.

12.4.1 Planning

In the initial planning which was presented during the kick-off meeting the thesis project including the final presentation should have been finished at the end of December 2008. The research was finished at the end of January 2009 and exceeded the planned time by one month. The 99% version of final report including the conclusions of the research were however delivered halfway December.

The reason for this delay is threefold. Firstly quite a lot of time is spent on the research proposal and the theoretical part of the thesis. A good basis will save a lot of misunderstanding and extra time later in the process.

Secondly, the time it takes to find and contact respondents and schedule the interviews was somewhat underestimated. Both parts are related because a good theoretical background is needed to 'know what you want to know' and select and contact the respondents according to that. I did not took the risk to contact respondents on beforehand and end up respondents that are less suitable for the research. That would have cost a lot of time and effort to correct or should influence the quality of the results a lot.

A third reason for delay is the fact that it is quite difficult to determine the moment that the theoretical part is 'finished'. Is it ever finished? When is the theoretical part finished enough to proceed with the data gathering and analysis of the data? The research (sub) questions can be used to determine the moment to start with the practical part of the research, however there is always an extra paper, book or viewpoint to incorporate in the study. The reasons above delayed the process, nevertheless the quality of the project is improved.

The planning of the formal meetings during the project, kick-off, mid-term and green-light meeting of the graduation committee was good. During each of these meetings a substantial part of the research was evaluated and useful comments for the further steps were posed. All the meetings took place at critical points of the project, for instance the point that a shift had to be made from proposal to the 'real' project or from theoretical part of the research to the more practical part. Accelerated planning of the meetings would be less effective since less progress could be evaluated and the project was not ready for a shift yet. Delayed planning of the meetings would be ineffective too, critical shifts in the project would be delayed while the actual status of the report would not be improved anymore.

The various individual meetings were planned according to the questions that emerged during the project. The flexibility in the planning of those meetings is appreciated very much. As a result of that these meetings were all useful and beneficial for the project.

12.4.2 Selection of market sectors

Much time is spent in the selection of a market sector for in-depth research. A choice for one of the market sectors was needed since Capgemini would study all seven market sectors in one thesis project. Due to time constraints that was not possible. Perhaps it would have been better for the research process to a priori select a market sector that was of most interest for Capgemini.

When the choice for a market sector was made at the start of the research than one could focus on the different supply chain types within one market. One or more of these supply chain types could been studied and compared. More interviews would have been held in one market sector and a more valid and complete idea of one market would be established.

12.4.3 Selection of respondents

For this research seven interviews are conducted, three in the chemical market sector and four in the high-tech market sector. The number of respondents is rather low. This is not a problem, however it had to be kept in mind during the generalization of the results to the entire market sector or even to other market sectors.

The number of respondents is low because during the research it proved to be quite difficult to find the right respondents. The requirements to which the respondents had to comply were strict: they had to be active in the high-tech or chemical market sector, they had to be expert or knowledgeable in supply chain management in the company they work for. Furthermore they had to be responsible for supply chain management and logistics at a decision making level in their company. To ensure the face validity of the results these strict requirements could not be loosened.

To make the results more widely applicable further study with more respondents should be conducted within the chemical or high-tech market sectors. This study can be extended to the other market sectors in which Capgemini is active in: automotive, oil & gas, retail, wholesale and pharmaceutical.

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Transport Management from a Shipper's Perspective

Appendices

Appendices

Appendix 1 IDEF modeling technique

The IDEF modeling technique is designed to model activities, processes, actions and decisions of an organization or system in a non-departmentized and non-temporal manner (Mayer, Painter et al. 1992). The IDEF technique is derived from the Structured Analysis and Design Technique (SADT) modeling language.

IDEF models assist in analysis of and communication about the functions of a system. The analyst is forced to think about all the processes and sub-processes and their relations during the analysis of the system. The relatively simple graphical representation makes the IDEF model ideal for communication about the system.

Using IDEF models results in organized representation of the activities and important relations in the researched system. Because the IDEF model breaks processes down to the basic sub-processes the final representation is therefore not hindered by organizational boundaries or personal bias. The correct functioning system elements can be exactly pinpointed, just like the system flaws (Mayer, Painter et al. 1992).

The IDEF representation is depicted below in figure 34. The IDEF model in this figure is build out of five basic elements: process, input, output, control and mechanism. The process is always depicted as a block, this process transforms the input into output. The input and the output of the process are depicted as arrows into and out of the process. Logically the output label cannot be the same as the input label. The process needs to be controlled, the controls are depicted as arrows at the upper side of the process. Finally the process also needs tools, means, support or mechanisms. These mechanisms are depicted at the lower side of the process block.

The output of the one process can be the input of the other process, but it is also possible that the output of a process is the control for another process.

In this research the IDEF representation of the transport process is useful since it helps to indicate which transport process is outsourced and which transport process is carried out by the shipper itself.

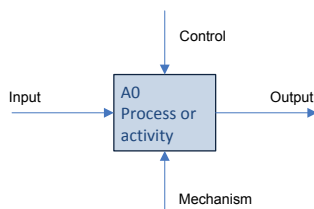


Figure 34 Basic IDEF representation

Appendix 2 IDEF decomposition of transport process

In this appendix the decomposition of the transport process that is used in this report is described and it is graphically shown how these transport processes are related.

The overall term transport process is divided in transport planning and transport execution. Transport planning consists of the following four processes: order processing (A1.1), route planning (1.2) load planning (A1.3) and invoice (A1.4).

During the order processing external orders are processed into an internal order and a freight bill that will accompany the goods through the supply chain. The internal orders function as input for load planning as well as route planning. Logically the output of load and route planning are respectively a load plan and a route plan. These processes need employees and planning tools like route and planner software as mechanisms.

Transport execution is broken down to the sub-processes order picking (A2.1), loading (A2.2), transport (A2.3), Unloading (A2.4), value added service (warehousing) (A2.5), loading (A2.2), transport (2.3) and unloading (2.6). During the order picking processes the goods that need to be delivered to a customer are consolidated and prepared for shipment. Then the consolidated goods are loaded into a mode of transport. This mode of transport transports the goods to another geographical location. That can be a warehouse whereas the goods are temporarily stored and value added services are performed or the delivery to the customer is made directly. Value added services can be various activities, customs clearing can be arranged in intercontinental transports, the goods can be forwarded, the goods can be repacked, instruction leaflets can be added et cetera. When the goods are stored extra load, unload and transport processes have to be carried out.

Many of the controls for the transport processes are made in the planning process. Order picking will be controlled by the freight bill, loading will be controlled by the load plan and transport will be controlled by the route plan. The freight bill also controls the unloading process at the warehouse or final customer because it states which goods have to delivered at which location.

Various mechanisms are used to execute the transport processes. Order picking needs an order picker to consolidate the goods to shipments. Furthermore this person needs a reach truck to collect the goods that are stored in a warehouse. The loading process needs a forklift and a transport modality to be loaded, this can be a truck. The same mechanisms are needed when unloading the transport modality at the warehouse or at the customer. For the transport process obviously a transport modality is needed and personnel to operate the modality. The warehousing process needs a warehouse.

The decomposition of the transport process is shown in figure 35 on the next page.

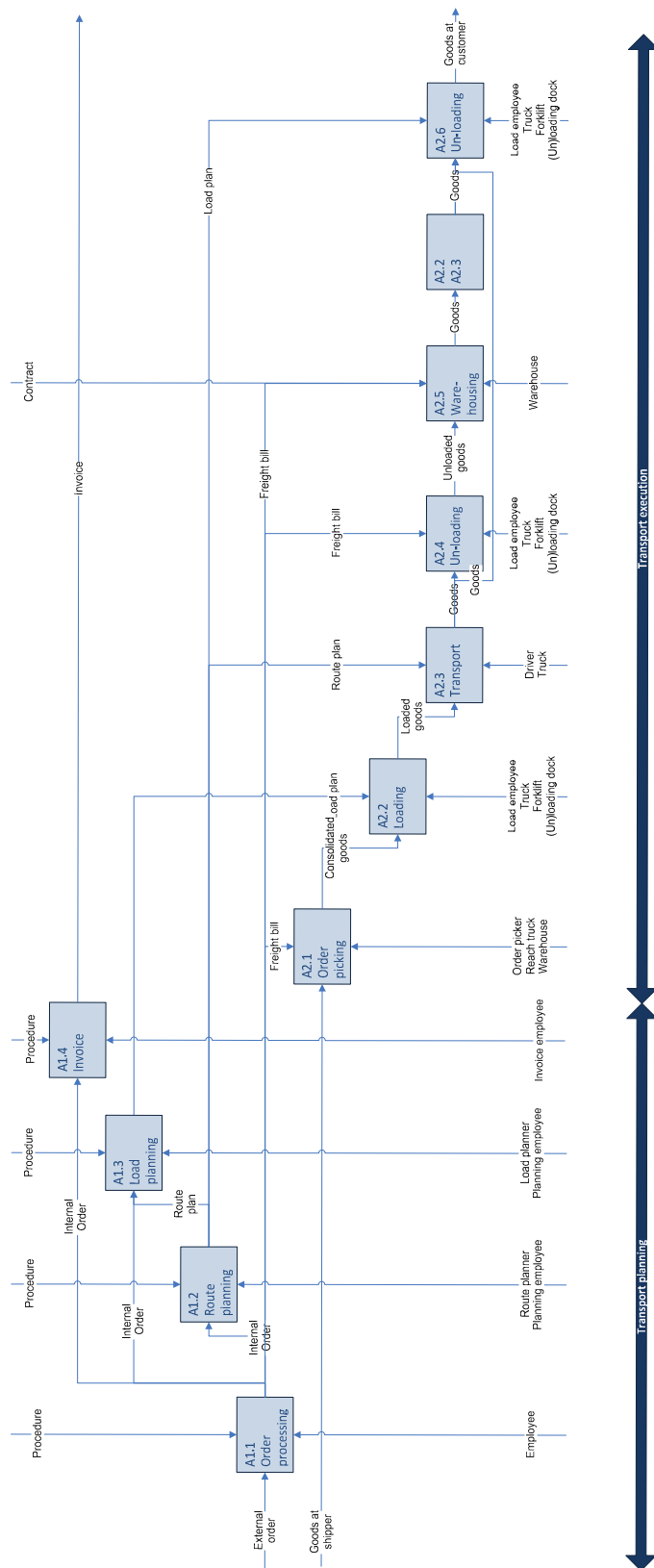


Figure 35 IDEF decomposition of the transport process

Appendix 3 Diagrams market sectors

In this appendix a schematic representation of the following seven market sectors is shown: automotive, high-tech products, chemicals, oil & gas, retail, wholesale and pharmaceuticals. The diagrams are accompanied with a short description of each market sector. The description and figures are intended to provide a general idea of the market sector supply chain. They are not meant to provide full insight in all market sector specificities. All the representations below are based upon the Capgemini TMS for shipper research conducted in May 2008 (Capgemini^A 2008).

Automotive market sector

The automotive market sector is a typical assembly sector, many parts for over the world are combined to complete products. The inbound supply chain is characterized by many global suppliers. The outbound supply chain is relatively simple. Both the inbound and outbound scale is global. The goods through the supply chain are parts and semi-bulk. The Time criticality is low to medium.

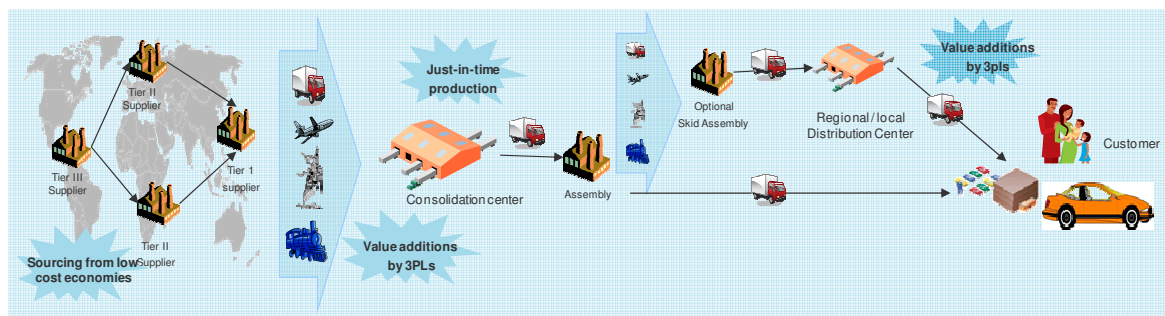


Figure 36 Automotive market sector (Capgemini^A 2008)

High-tech market sector

The high-tech market sector is rather comparable with automotive. Many parts from all over the world are assembled to complete products. The outbound supply chain consists of multiple local and wholesalers and retailers. The time criticality is medium for both supply chains. The type of goods through the supply chain are parts.

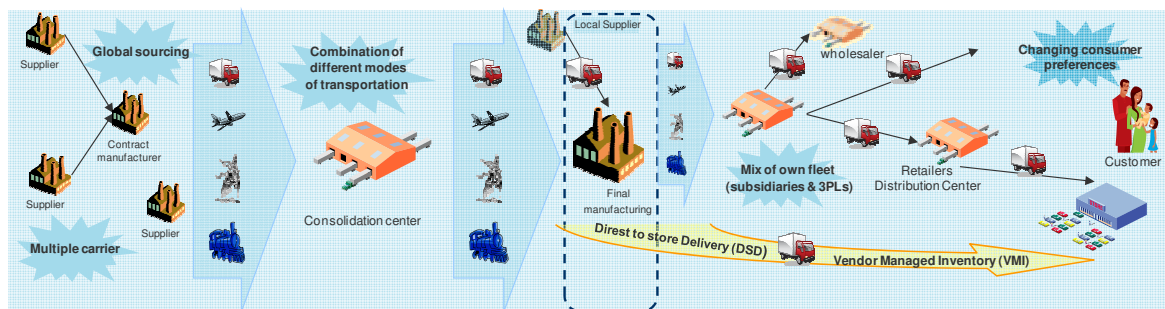


Figure 37 High-tech market sector (Capgemini^A 2008)

Chemical market sector

The inbound supply chain of chemicals is relatively simple, containing basic chemicals. These are processed into a large variety of chemical products. The inbound supply chain is on a global scale, outbound is more on a local scale. The time criticality of the goods is rather low and the goods are transported as bulk goods, but also smaller shipments occur.

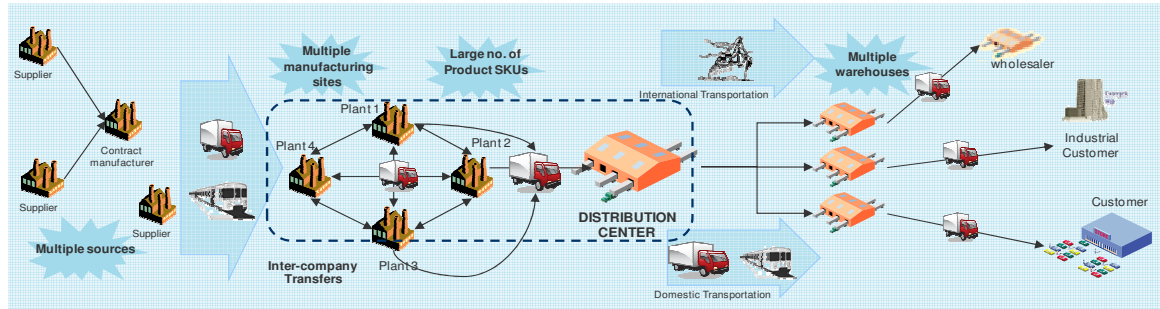


Figure 38 Chemical market sector (Capgemini^A 2008)

Oil & Gas market sector

Oil and gas market sector is characterized by a relatively simple inbound supply chain containing crude oil and gas. The outbound is a variety of products. Both supply chains handle bulk goods which score low on time criticality.

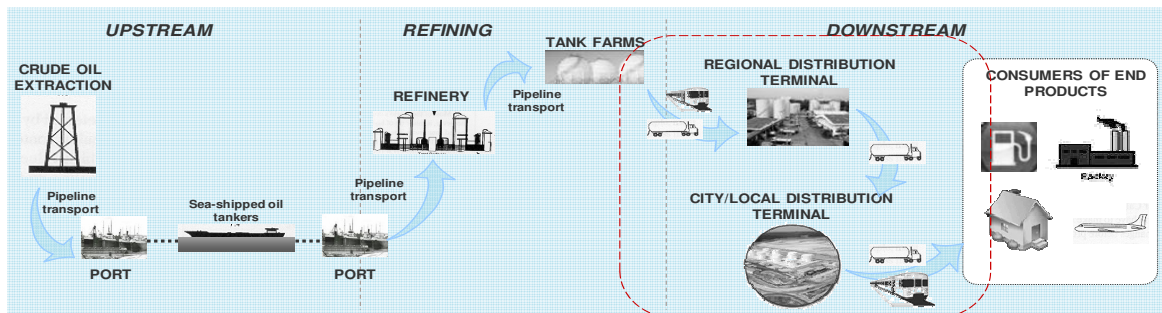


Figure 39 Oil & Gas market sector (Capgemini^A 2008)

Retail market sector

The inbound supply chain of the retail sector consists of many suppliers. The outbound supply chain is also quite complex with many hubs and customers. The scale of the retail sector is local. The type of goods is part goods. The time criticality in both inbound and outbound supply chain is high.

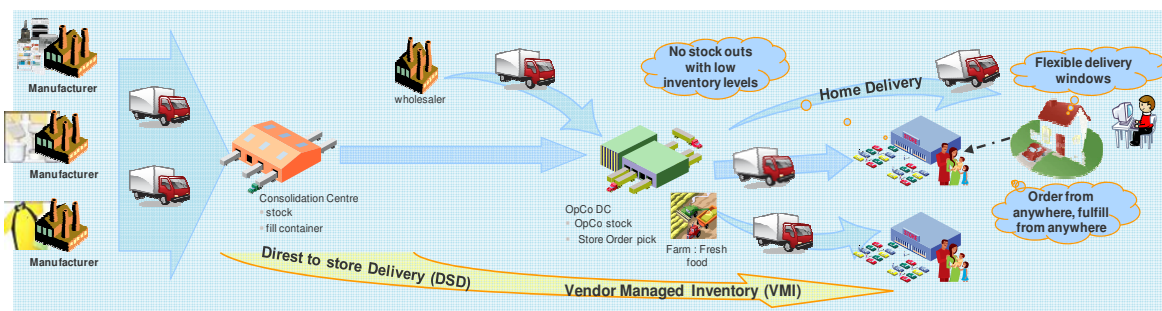


Figure 40 Retail market sector (Capgemini^A 2008)

Wholesale market sector

The wholesale market sector is comparable with the retail sector. The inbound supply chain is however local and global, the outbound supply chain is local. The goods score medium to high on time criticality. The goods are parts or semi-bulk.

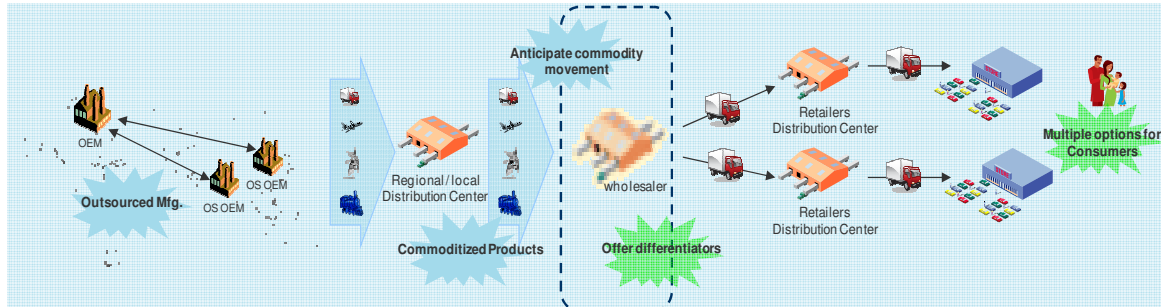


Figure 41 Wholesale market sector (Capgemini[^] 2008)

Pharmaceutical market sector

In the pharmaceutical market sector basic chemicals and biologics are processed into drugs. The inbound system is therefore quite simple. The outbound system is far more complicated because of safety and security issues. The time criticality is medium to high and the type of goods is parts to semi-bulk.

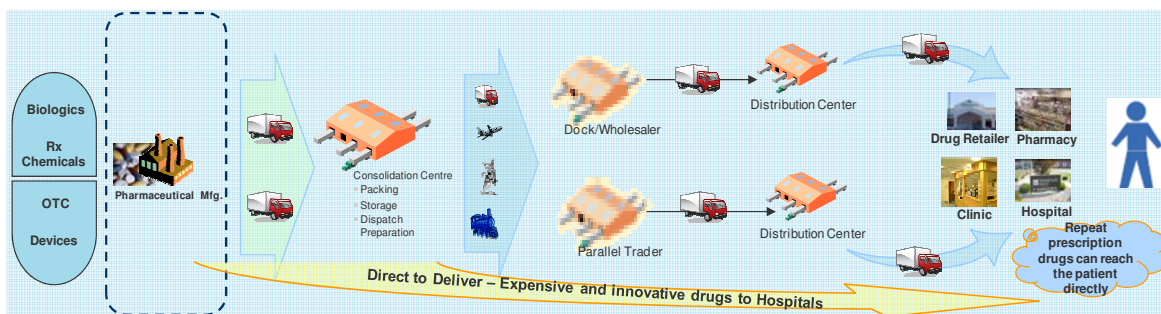


Figure 42 Pharmaceutical market sector (Capgemini[^] 2008)

Appendix 4 Factors in the transport outsourcing decision

In this appendix the factors that may influence the transport outsourcing decision are listed. The positive factors are listed in table 24 and the negative factors are listed in table 25. These factors are provided with a number for identification purposes (column 1). The N-numbers represent negative factors and P-numbers represent positive factors.

Furthermore it is indicated what the origin of the factors is in the outsourcing decision (column 3). The origin of the factors can be one of the stakeholders in the decision, namely: the shipper, the shipper's supplier and customer, the 3PL and society.

It is also already indicated to which category a factor belongs to (column 4). The factors are categorized into the six categories namely: Profit, Business performance, Service quality, 3PL capabilities, Monitoring, Information and Traceability and Legal issues.

All factors in the table are accompanied with a reference to the literature in which the factor is mentioned (column 5). Seventeen resources are used to identify the factors, the references to the resources are shown in table 26 below.

Table 24 Positive factors in the transport outsourcing decision

NR	Positive Factor	Origin	Cat	Reference
P1	Cost reduction	Shipper	P	[1], [2], [3]
P2	Fixed logistics asset reduction	Shipper	P	[3], [6]
P3	Only invest in core competencies	Shipper	P	[6]
P4	Reduction of capital investment in facilities	Shipper	P	[2], [6], [7]
P5	Reduction of capital investment in manpower	Shipper	P	[2], [6], [7]
P6	No investments in transport activities and resources	Shipper	P	[4]
P7	Less investments in ICT to support transport processes	Shipper	P	[4], [6]
P8	Increase productivity	Shipper	P	[1], [2]
P9	Increase financial ratios like profit/employee ratio	Shipper	P	[4]
P10	Loss due obsolescence of assets	Shipper	P	[7]
P11	No (human) resources needed transport processes	Shipper	P	[4]
P12	No housing needs for transport processes	Shipper	P	[4]
P13	Increase flexibility (due to the absence of fixed assets)	Shipper	BP	[2]
P14	Less paper work	Shipper	BP	[2]
P15	Possibility to evaluate supplier performance	Shipper	BP	[1]
P16	Outsourcing gives flexibility to react to market changes	Shipper	BP	[4]
P16	Transfer operational and financial risks to 3PL	Shipper	BP	[4]
P18	Decreased order cycle length.	Shipper	BP	[3]
P19	Less damage to products	Shipper	BP	[2]
P20	Quick response to changes	Shipper	BP	[2], [6]
P21	Focus on core business	Shipper	BP	[2], [4], [5], [6], [7]
P22	Simplifying own logistical process	Shipper	BP	[2]
P23	Free up staff	Shipper	BP	[2]
P24	Increased flexibility	Shipper	BP	[6]
P25	Reduce risk due many alternative 3PL's	Shipper	BP	[7]
P26	Competitive advantage	Shipper	BP	[1]
P27	Enhanced value	Shipper	BP	[1]
P28	Increased robustness of operations (back-up)	Shipper	BP	[6]
P29	Productivity enhancement	Shipper	BP	[1], [2]
P30	Reduction of inventory	Customer	SQ	[2]
P31	Shorter transit times	Customer	SQ	[2]
P32	Improving service to own company	Customer	SQ	[2]
P33	Improving service to customers	Customer	SQ	[1], [2]

P34	Decreased order cycle length.	Customer	SQ	[3]
P35	Outsourcing gives flexibility to react to market changes	Customer	SQ	[4]
P36	Acquiring outside expertise	3PL	3PL	[2], [5], [6]
P37	Using logistic information system of 3PL	3PL	3PL	[2]
P38	Access to latest technology	3PL	3PL	[6]
P39	Third party performs better	3PL	3PL	[5], [7]
P40	Third party performs cheaper	3PL	3PL	[5]
P41	Direct assistance or participation or involvement	3PL	3PL	[1]
P42	Third party has the required skills	3PL	3PL	[6]
P43	Access to specialized resources	3PL	3PL	[7]
P44	Commitment /trust	Shipper and 3PL	MIT	[1]
P45	Two way information sharing	Shipper and 3PL	MIT	[1]
P46	Coordination	Shipper and 3PL	MIT	[1]
P47	Legal constraints for fleet emission	Society	L	[8], [14]
P48	Regulations regarding vehicle operation	Society	L	[6], [12], [16]
P49	Regulations regarding product handling	Society	L	[6]
P50	Rules regarding working conditions	Society	L	[16], [17]
P51	Rules concerning warehousing	Society	L	[-]
P52	Rules for transport conditions	Society	L	[9], [10]
P53	Emission rules for companies	Society	L	[-]
P54	Rules concerning employer competency	Society	L	[11]
P55	Safety regulations sea transport	Society	L	[13], [15]
P = Profit BP = Business performance SQ = Service quality 3PL = Capabilities 3PL MIT = Monitoring, Information, Traceability L = Legal issues				

Table 25 Negative factors in the transport outsourcing decision

NR	Negative Factor	Origin	Cat	Reference
N1	No cost reduction with outsourcing	Shipper	P	[3], [4], [6]
N2	High cost of monitoring transport	Shipper	P	[6]
N3	Difficult to assess the savings made by outsourcing	Shipper	P	[2]
N4	No real increase in productivity	Shipper	P	[4]
N5	Difficult to dismiss own employees	Shipper	BP	[2]
N6	Bring outsourced activities back in-house is very hard	Shipper	BP	[4], [5], [6]
N7	Risky to outsource to just one external party	Shipper	BP	[4]
N8	Innovation through in-house expertise	Shipper	BP	[6]
N9	Diluting of core competencies	Shipper	BP	[7]
N10	Difficult to change between 3PL's	Shipper	BP	[2], [5], [6]
N11	Increase risk due few alternative 3PL's	Shipper	BP	[7]
N12	Decrease flexibility due few alternative 3PL's	Shipper	BP	[7]
N13	Inability to select good 3PL	Shipper	BP	[2]
N14	Inability to manage 3PL	Shipper	BP	[2]
N15	Logistics is too important to outsource	Customer	SQ	[3]
N16	Logistic service provider is not trusted to the job	Customer	SQ	[3]
N17	Long time to react on market changes (not flexible)	Customer	SQ	[4]
N18	Inability to select good 3PL	Customer	SQ	[2]
N19	Inability to manage 3PL	Customer	SQ	[2]
N20	Map strategy and resolve problems together with 3PL	3PL	3PL	[2]
N21	3PL does not understand clients goals	3PL	3PL	[2], [3], [4]
N22	Lack of confidence / trust in 3PL performance (own	3PL	3PL	[2], [5]

	employees perform better)			
N23	3PL does not have knowledge of market sector	3PL	3PL	[4]
N24	Need to be in control of the transport process	Shipper and 3PL	MIT	[2], [3]
N25	Loss of touch with important information	Shipper and 3PL	MIT	[2]
N26	Need to share strategic information makes shipper vulnerable	Shipper and 3PL	MIT	[5]
N27	Difficult to control transport processes	Shipper and 3PL	MIT	[6]
P = Profit BP = Business performance SQ = Service quality 3PL = Capabilities 3PL MIT = Monitoring, Information, Traceability L = Legal issues				

Table 26 Sources of the factors

NR	Sources of the factors
1	(Qureshi, Kumar et al. 2007)
2	(Razzaque and Sheng 1998)
3	(Capgemini ^A 2007)
4	(Ploos van Amstel 2008)
5	(Reighelt and Barjis (N.A.))
6	(Brewer, Button et al. 2001)
7	(Bowersox and Closs 1996)
8	(Europa 2005)
9	(Europa 1996)
10	(Europa 2008)
11	(Europa 1993)
12	(Hirsch Ballin 1993)
13	(Europa 2003)
14	(Korthals-Altes 1983)
15	(Europa 2004)
16	(de Ruiter 1981)
17	(TLN 2007)

Appendix 5 Fundamental scale of absolute numbers

In this appendix the fundamental scale of absolute numbers is shown (Saaty 1990) and (Saaty 2008). Respondents will use a rating scale that is derived from this fundamental scale in the pair-wise comparison of outsourcing factors and alternatives. The used scales are depicted in figure 43 and 44 below the table.

Table 27 The fundamental scale of absolute numbers (Saaty 1990, Saaty 2008)

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgment slightly favor on activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor on activity over another
6	Strong plus	
7	Very strong or demonstrated importance	Experience and judgment very strongly favor on activity over another
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible affirmation
Reciprocals of above	If activity <i>i</i> has one of the above non-zero numbers assigned to it when compared with activity <i>j</i> , then <i>j</i> has the reciprocal value when compared with <i>i</i> .	
1.1 -1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.

-9	-7	-5	-3	1	3	5	7	9
Extremely unimportant	Very strongly unimportant	Strongly unimportant	Moderately unimportant	Equally important	Moderately important	Strongly important	Very strongly important	Extremely important

Figure 43 Nine-point scale to express the importance of a factor in the transport outsourcing decision

-9	-7	-5	-3	1	3	5	7	9
Extremely not preferred	Very strongly not preferred	Strongly not preferred	Moderately not preferred	Equally preferred	Moderately preferred	Strongly preferred	Very strongly preferred	Extremely preferred

Figure 44 Nine-point scale to express the preference for a transport outsourcing alternative

Appendix 6 Alternative research methods

In this appendix an extensive overview of alternative research methods is provided, Q-methodology and MCDA methods. These methods have properties that could make them useful in research to factors in the outsourcing decisions. However the application of these methods fails in this specific research.

Since this thesis also serves as a guide to study the other five market sectors that are interesting for Capgemini it is sensible to include the considerations on alternative methods in the report.

Q-methodology

Q-methodology is a method to systematically study subjective matters like a person's viewpoints, opinion, beliefs, attitudes et cetera (van Exel and de Graaf 2005). In studies that use Q-methodology the respondents (P-set) are presented with a sample of statements (Q-set). The respondent's task is to rank-order the statements according to their individual preference into a forced quasi normal distribution. This task is usually carried out in two stages, first a raw sort into three categories and secondly a fine sort for each of the three categories. When the respondent's task is finished his personal viewpoint is revealed (van Exel and de Graaf 2005).

The individual rankings of all the respondents are then subject to factor analysis. Correlation between the profiles of respondents indicate similar viewpoints (van Exel and de Graaf 2005). The results of the Q-methodology study can be used to describe the populations viewpoints with respect to a certain aspect. Therefore Q-methodology can explore peoples preferences, viewpoints, motives and goals, these aspects all can influence one's behavior (van Exel and de Graaf 2005). Using Q-methodology subjective and qualitative elements can be quantitatively analyzed, therefore the method is characterized as qualiquantological by Stenner and Watts (Watts and Stenner 2005).

The properties of Q-methodology described above seem to be suitable in this research to the factors that influence the shippers decision on outsourcing transport processes. The shippers preferences, viewpoints, motives and goals motives, or factors as they are called in this research, with respect to the transport outsourcing decision can be explored. However, there are some drawbacks to the method that makes it unsuitable for this research.

Since the respondents individual rating will be subjected to factor analysis the number of respondents, or P-set, should be big enough to allow sensible statistical analysis. A general rule of thumb for the P-set is 40 to 60 individuals (Watts and Stenner 2005). Successful studies with less than 40 respondents were carried out but P-sets less than 20 do not make sense in the factor analysis (Hair, Black et al. 2006). This amount of respondents will not be available in this research. Specific respondents needed in this research, they should be active and knowledgeable in the field of supply chain management or logistics (see subsection 7.1.2). And they should work for companies in the high-tech or chemical market sector in The Netherlands. Not many respondents which suit this profile can be found in the time span of this research.

Furthermore with Q-methodology the factors that are important in the outsourcing decision can be ranked. The importance of the factors in the outsourcing decision can be found out with Q-methodology however the extent of outsourcing cannot be determined by means of this method. While the extent of outsourcing or the identification of the outsourced transport processes is an important aspect of the research. These two limitations of Q-methodology make this method not suitable for this research and therefore Q-methodology will not be used.

Examples of the application of Q-methodology in transport decisions and in the identification of stakeholders perspectives and views can be found in respectively (Rajé 2007) and (Raadgever, Mostert et al. 2008) and (Hall 2008).

Multi Criteria Decision Analysis

Multi Criteria Decision Analysis (MCDA) problems are choice, ranking, classification or description problems in which alternatives are considered by several different important aspects or dimensions (Pruyt 2006). MCDA methods are those methods that are used for single actor *and* multiple objective decision making. There are many MCDA methods available, therefore only a few of these methods will be discussed here to stipulate their possible application in the transport outsourcing problem.

Within the wide array of MCDA methods the support for the decision maker differs. In general MCDA methods assist the decision maker in the following three problems: choice problem, sorting problem and ranking problem (Pruyt 2006).

A general disadvantage of MCDA can be the mathematically ill-defined and unstructured nature. As a result there are many different and complex MCDA techniques and methods available which makes the field hard to oversee (Pruyt 2006).

Here the following MCDA methods will be briefly discussed, Lexicographical Method, Utility Functions, Goal Programming, ELECTRE methods and PROMETHEE methods. The possible applicability of these methods to the transport outsourcing decision will be assessed. At the end of this appendix an overview of these methods will be presented and references for further reading will be suggested. See table 26.

Lexicographical method

In the Lexicographical method predefined strategies are compared to the predefined criteria of which the ordering is known prior to the comparisons. The strategies are compared to the most important criterion. In the second step the retained strategies are compared to the second important criterion. This process continues until all criteria are used or until one strategy remains (Pruyt 2006). When strategy X scores high on an important criterion than strategy X is automatically preferred to other strategies, regardless of the scores of X on the other criteria (Keeny and Raiffa 1993). For an application of the Lexicographical method one is referred to (Contreras and Mármol 2007).

The Lexicographical method assumes full insight in the importance or weight of the criteria prior to the application of the method. In this research the weight of the criteria, or factors as they are called, the importance of the factors is unknown. That makes Lexicographical method unsuitable for this research.

Utility functions

In utility function methods as for instance Multi Attribute Utility Theory (MAUT) maximize the utility function of alternatives. With utility methods an underlying utility function is assumed that aggregates all criteria. The various criteria are put into a single utility function thereby transforming the multi criteria problem in a single criterion problem (Pruyt 2006). Another assumption of utility methods is that the decision maker is able to specify its preferences or utility for an alternative (Pruyt 2006). For applications of MAUT one is referred to (Lagoudis, Lalwani et al. 2006), (Canbolat, Chelst et al. 2007) and (Tsamboulas 2007).

Utility functions require quantitative data about the tradeoffs between the criteria and alternatives. In this research much quantitative information is not available. The quantitative data requirements of the utility methods is the main argument not to use this method in this research.

Goal Programming

With the Goal Programming method all the criteria that matter in the decision are provided with a target value or goal. All the alternatives or strategies are mapped in the space of the criteria. The strategy that has the smallest deviation from the goal is the best strategy. The assumption of this method is that the decision maker is able to express a goal for each criterion. A disadvantage is that the goal programming method can produce outcomes that are not Pareto efficient, while the general idea in the field of decision making is that a rational actor does not choose a Pareto inefficient solution (Pruyt 2006). For more

information and applications of Goal Programming one is referred to the work of (Charnes and Cooper 1975), (Ignizio 1981), (Tamiz, Jones et al. 1998), (Romero 2001) and (Romero 2004).

The assumption that decision makers can assign the proper weight to the criteria in the goal programming model is debated. In this study the weights of the factors that determine the outsourcing decision are unknown and therefore they are subject of study.

ELECTRE methods

The ELECTRE methods consists four methods ELECTRE I to ELECTRE IV. For the purpose of this sub-section it conducts too far to discuss them all in detail, therefore the general characteristics of the ELECTRE methods will be briefly discussed. The ELECTRE methods can be used in choice, ranking and sorting problems. By means of pair-wise comparisons of the strategies the preference relation of the strategies is build. The ELECTRE methods assumes that the strategies, criteria weights and threshold values are known a priori (Pruyt 2006). For more material on the ELECTRE methods one is referred to (Mousseau, Slowinski et al. 2000), (Figueira and Roy 2001) and (Merad, Verdel et al. 2004).

The assumption is that the decision maker knows the weights of the criteria prior to the application of the ELECTRE method. In this research the weights of the factors are not known, that makes the ELECTRE methods less suitable for this research. Furthermore the ELECTRE methods are not characterized by simplicity and that makes the communication with the users of the model unnecessary difficult.

PROMETHEE methods

In the family of PROMETHEE methods the weights between the criteria and the quantitative and qualitative input data is discussed. Every strategy is compared with every criterion, based on these pair-wise comparisons the strategies are outranked per criterion. Strategy X can outrank strategy Y on criterion z. Based on these outranking an ordering is made between in the strategies. For more information and applications of the PROMETHEE method one is referred to (Brans and Vincke 1985), (Brans, Vincke et al. 1986), (Mareschal and Brans 1988), (Abu-Taleb and Mareschal 1995) and (Le T no and Mareschal 1997).

The PROMETEE methods are comparable with the AHP method that will be used in this research. Therefore this method could be applied successfully to the analysis of the outsourcing decision in this research. However just one method will be applied in this research and that is the analytical hierarchy process. The PROMETHEE methods would be a good second choice.

In literature a successful combination of AHP and the PROMETHEE methods is proved in (Macharis, Springael et al. 2004) and (Dagdeviren 2008).

Concluding remarks on the alternative methods

In this appendix two alternative research methods are discussed, Q-methodology and some MCDA methods. Both methods have major drawbacks that make them not suitable in this specific research. The main reason not to use Q-methodology is the high number of respondents needed for a sensible application of the method. Not many respondents can be found within the limited time for this thesis project. Furthermore it is hard to determine the extent of outsourcing transport processes by means of Q-methodology, the extent of outsourcing is one of the main sub-questions of the research.

For the discussed MCDA methods, the main reason not to apply them is the assumption that there is full insight in the decision makers importance or weight to the decision criteria (Lexicographical method, Goal Programming, ELECTRE methods). In this research one of the main objectives is to find out the weight of the factors (criteria) in the outsourcing decision. Of the MCDA methods discussed the PROMETHEE methods seem to have the best reference to the objectives in this research, therefore the PROMETHEE methods are a good second option.

Table 28 Alternative research methods and references to additional reading

Alternative research methods	Reference
Q-methodology	van Exel and de Graaf 2005 Watts and Stenner 2005 Rajé 2007 Raadgever, Mostert et al. 2008
Lexicographical method	Pruyt 2006 Keeney and Raiffa 1993 Contreras and Mármol 2007
Utility functions (MAUT)	Pruyt 2006 Lagoudis, Lalwani et al. 2006 Canbolat, Chelst et al. 2007 Tsamboulas 2007
Goal programming	Charnes and Cooper 1975 Ignizio 1981 Tamiz, Jones et al. 1998 Romero 2001 Romero 2004 Pruyt 2006
ELECTRE methods	Mousseau, Slowinski et al. 2000 Figueira and Roy 2001 Merad, Verdel et al. 2004
PROMETHEE methods	Brans and Vincke 1985 Brans, Vincke et al. 1986 Mareschal and Brans 1988 Abu-Taleb and Mareschal 1995 Le Teno and Mareschal 1997
AHP combined with PROMETHEE	Dagdeviren 2008 Macharis, Springael et al. 2004

Appendix 7 Internal interview

In this appendix the entire internal interview is shown. The questions and background information were used as guidelines during the conversation. Respondents did receive these questions prior to the actual interview.

Interview

Naam

Datum

Locatie

Het onderzoek

Het afstudeeronderzoek moet inzicht geven in de factoren die de beslissing om transportprocessen uit te besteden beïnvloeden bij verladers in Nederland. En welke transportprocessen uitbesteed worden.

Twee elementen zijn hierin belangrijk:

1. De factoren en hun gewicht
2. Mate van uitbesteden

Ten eerste zijn we geïnteresseerd in de factoren oftewel redenen, argumenten, die van invloed zijn op de beslissing om transport uit te besteden. Lagere transportkosten, een betere service naar klanten en de focus op de eigen core-business kunnen bijvoorbeeld factoren zijn om transport aan een logistieke dienstverlener over te laten. Gebrek aan informatie over het transport proces en het gebrek aan kennis van de logistieke dienstverlener kunnen factoren zijn om transport juist niet uit te besteden. Waarschijnlijk zijn niet al deze factoren even belangrijk in de uitbestedingsbeslissing daarom moet ook het gewicht van deze factoren worden vastgesteld.

Ten tweede is de mate van uitbesteden van belang. Welke transportprocessen voert de verlader zelf uit en welke transportprocessen worden uitbesteed aan een logistieke dienstverlener. De verlader kan bijvoorbeeld zelf de planning van de transporten verzorgen en het fysieke transport uitbesteden.

De mate van uitbesteden en de factoren die daaraan ten grondslag liggen verschillen waarschijnlijk per markt sector. Capgemini wil het bovenstaande graag uitgezocht hebben voor de zeven marktsectoren waarin ze actief is: automotive, high-tech, oil&gas, chemicals, retail, wholesale en pharmaceutical. In dit onderzoek ontbreekt het aan de tijd om dit uit te zoeken voor alle marktsectoren daarom is er afgebakend naar chemicals en high-tech.

Op basis van literatuur zijn algemene uitbestedingsfactoren geïdentificeerd, zie bijlage tabel 2 en 3. En er is een decompositie gemaakt van het transportproces om te kunnen beoordelen welke deelprocessen uitbesteed worden en welke niet, zie bijlage figuur 1.

Interviewvragen

Het doel van het interview is om een goed beeld te krijgen van de high-tech marktsector. De onderstaande vragen moeten een sector specifiek beeld van de high-tech marktsector.

1. Zijn er binnen de high-tech marktsector nog veel verschillende supply chains te onderscheiden?

Met andere woorden, kan de high-tech supply chain als één geheel beschouwd worden of moet er rekening gehouden worden met een veelheid aan verschillende supply chains en bij behorende transportmodellen? Is bijvoorbeeld de printer supply chain fundamenteel anders dan de PC supply chain?

2. Voor welke supply chain is de verlader doorgaans verantwoordelijk?

Zijn de verladers in het high-tech marktsector verantwoordelijk voor alleen hun outbound supply chain of ook voor de inbound supply chain?

3. Welke van de transportprocessen zijn uitbesteed en welke niet?

Het transportproces kan worden opgedeeld in verschillende deelprocessen, welke van deze deelprocessen worden doorgaans uitbesteed en welke worden door de verlader zelf uitgevoerd. De verschillende transportprocessen zijn weergegeven in de bijlage, tabel 1. En een decompositie van het gehele transportproces is weergegeven in de bijlage, figuur 1.

4. Welke argumenten, redenen, factoren spelen een rol bij de beslissing om sommige transportprocessen wel of niet uit te besteden?

Er zijn verschillende factoren denkbaar die invloed hebben op de beslissing om transportprocessen uit te besteden. En andersom zijn er factoren denkbaar die ervoor pleiten transport zelf uit te voeren. Een overzicht van de positieve en negatieve factoren is weergegeven in de bijlage, tabel 2 en 3.

5. Wat is globaal het belang van deze factoren?

Niet al deze factoren zullen even belangrijk zijn in de uitbestedingsbeslissing. Welke van de factoren zijn nu belangrijk en welke minder of niet?

6. Is er een trend waarneembaar in het uitbesteden van transport processen?

Zien we binnen de high-tech sector een trend in het uitbesteden van transportprocessen. Wordt er meer uitbesteed of worden transportprocessen weer meer door de verlader uitgevoerd.

Tot slot, in dit document zijn factoren genoemd en is er een decompositie van de transportprocessen weergegeven. Wellicht ontbreken er factoren die wel belangrijk zijn of zijn er transportprocessen niet in het model opgenomen. Welke aanpassingen moeten er gemaakt worden zodat het overeen komt met de high-tech sector?

Vervolg van het onderzoek

Met deze informatie kan ik vervolgens een goede vragenlijst ontwikkelen om de verschillende factoren en hun belang in de uitbestedingsbeslissing in de markt te meten. De respondenten zullen paarsgewijs factoren vergelijken en uitbestedigsalternatieven beoordelen.

Appendix 8 External interview

In this appendix the external interview is shown. The questions and background information were used as guidelines during the conversation. The respondents did receive these questions prior to the actual interview.

Interview

Naam

Datum

Locatie

Introductie

In dit document is het volledige interview en de achtergrondinformatie van het afstudeeronderzoek opgenomen. Het afstudeeronderzoek wordt uitgevoerd als afsluitende opdracht van de studie Technische Bestuurskunde aan de Technische Universiteit Delft. Het onderzoek wordt uitgevoerd bij en voor Capgemini.

Het interview bestaat uit drie delen. Introductie op het onderzoek, interview vragen en het vergelijken van factoren en uitbestedingalternatieven. Het eerste deel is een geschreven toelichting op het onderzoek. De hoofdvraag van het onderzoek wordt genoemd. Dit interview draagt bij aan de beantwoording van de hoofdvraag.

Het tweede deel bestaat uit een interview waarin een aantal vragen beantwoord worden. De eerste vragen gaan over de geïnterviewde zelf, wat is zijn rol binnen het bedrijf. Dit is belangrijk om te weten om dat dit mede de validiteit van de resultaten bepaalt. De verdere vragen gaan over het uitbesteden van transportprocessen. Uit deze vragen moet duidelijk worden welke transportprocessen uitbesteedt en wat de achterliggende reden daarvoor is.

In het derde deel van het interview wordt het gewicht van de categorieën van factoren op de uitbestedings-beslissing vastgesteld. Er kunnen verschillende factoren van invloed zijn op de uitbestedingsbeslissing maar waarschijnlijk is het belang van die factoren niet in elke marktsector of bedrijf gelijk. Door de factoren en de mate van uitbesteden paarsgewijs te vergelijken kan dit gewicht worden bepaald.

Om de drie onderdelen te ondersteunen is een aantal bijlagen toegevoegd. Als het nodig is kunnen deze bijlagen gedurende het interview gebruikt worden om het één en ander te verduidelijken.

De tijd die voor het interview gereserveerd is bedraagt ongeveer een uur. Geschat wordt dat er ongeveer 30 minuten nodig zijn om de interviewvragen door te nemen. Voor het beoordelen van de vergelijkingen is eveneens ongeveer 30 minuten nodig. Het vooraf doornemen van dit document zal ongeveer 15 minuten in beslag nemen.

Deel I: Het onderzoek

In het afstudeeronderzoek staat de volgende onderzoeksvraag centraal:

What are the factors that determine the shippers decision on outsourcing transport planning and execution in the various market sectors in The Netherlands and what is the need for information about these processes and the need to control these processes?

Deze hoofdvraag wordt beantwoordt voor twee van de marktsectoren waarin Capgemini actief is, namelijk de high-tech en de chemicals marktsector. Uiteindelijk kan er ook een vergelijking tussen de twee marktsectoren gemaakt worden.

Het onderzoek moet inzicht over de volgende drie punten:

1. Welke factoren beïnvloeden de beslissing van verladers in de high-tech sector om transportprocessen uit te besteden aan een logistieke dienstverlener.
2. Wat is de mate van uitbesteding. Of welke van de verschillende transportprocessen worden wel uitbesteed en welke niet.
3. Hoeveel controle, informatie of inzicht wil de verlader hebben op het transportproces.

Ten eerste zijn we geïnteresseerd in de factoren oftewel redenen, argumenten, drivers, die van invloed zijn op de beslissing om transport uit te besteden. Lagere transportkosten, een betere service naar klanten en de focus op de eigen *core-business* kunnen bijvoorbeeld factoren zijn om transport aan een logistieke dienstverlener over te laten. Gebrek aan informatie over het transport proces en het gebrek aan kennis van de logistieke dienstverlener kunnen factoren zijn om transport juist niet uit te besteden. Waarschijnlijk zijn niet al deze factoren even belangrijk in de uitbestedingsbeslissing daarom willen we ook het gewicht van deze factoren vaststellen.

Ten tweede is de mate van uitbesteden van belang. Welke transportprocessen voert de verlader zelf uit en welke transportprocessen worden uitbesteed aan een logistieke dienstverlener. De verlader kan bijvoorbeeld zelf de planning van de transporten verzorgen en het fysieke transport uitbesteden.

De mate van uitbesteden en de factoren die daaraan ten grondslag liggen verschillen waarschijnlijk per markt sector. Capgemini wil het bovenstaande graag uitgezocht hebben voor de zeven marktsectoren waarin ze actief is: automotive, high-tech, oil&gas, chemicals, retail, wholesale en pharmaceutical. In dit onderzoek ontbreekt het aan de tijd om dit uit te zoeken voor alle marktsectoren daarom is er afgebakend naar de marktsectoren chemicals en high-tech.

Op basis van literatuur zijn algemene uitbestedingfactoren geïdentificeerd en deze zijn gecategoriseerd in een zestal categorieën: profit, business performance, service quality, 3PL capabilities, monitoring/traceability and legal issues. In deel drie van het interview worden deze categorieën toegelicht.

Deel II: Interviewvragen

Vragen over de achtergrond van de geïnterviewde.

1. Wat is uw rol / functieomschrijving bij het bedrijf waar u voor werkt?
2. Wat zijn uw verantwoordelijkheden in deze rol of functie?
3. Hoe lang bent u al werkzaam binnen supply chain management of logistiek?
 - ☐ korter dan 1 jaar
 - ☐ tussen 1 en 2 jaar
 - ☐ tussen 3 en 4 jaar
 - ☐ tussen 5 en 6 jaar
 - ☐ langer dan 6 jaar
4. In welke professioneel gebied was u werkzaam voor deze functie?
5. Wat waren uw rol en verantwoordelijkheden in die functie?

Vragen over transportuitbestedingen bij het bedrijf waar u voor werkt?

15. Zijn er binnen het bedrijf waar u voor werkt transport processen uitbesteed aan een logistieke dienstverlener?
 - ☐ ja
 - ☐ nee
 - ☐ gedeeltelijk
16. In welke supply chain zijn de transportprocessen uitbesteedt. Of in welke supply chain organiseert het bedrijf waar u voor werkt de transportprocessen?
 - ☐ inbound supply chain
 - ☐ outbound supply chain
 - ☐ zowel de inbound als de outbound supply chain
 - ☐ anders, namelijk _____
17. Welke transportprocessen zijn uitbesteedt en welke transportprocessen worden nog in-house uitgevoerd? (Zie ook tabel 1 in bijlage 1 waarin transportprocessen zijn weergegeven.)
18. Kunt u aangeven wat de achterliggende reden, argumenten, factoren zijn om juist die transportprocessen uit te besteden?
 - ☐ increase in profit
 - ☐ increase business performance
 - ☐ service quality
 - ☐ 3PL capabilities
 - ☐ monitoring transport
 - ☐ legal issues
19. Als transportprocessen uitbesteedt zijn, wilt u dan nog informatie krijgen over deze transportprocessen van de logistieke dienstverlener?
 - ☐ ja
 - ☐ nee
20. In welke gevallen wenst u informatie?
 - ☐ als de goederen geladen zijn
 - ☐ elke keer als de goederen een hub in het transport netwerk passeren
 - ☐ als de goederen afgeleverd worden
 - ☐ als de goederen vertraagd zijn
 - ☐ als de goederen verloren of beschadigd zijn
 - ☐ anders, namelijk _____

21. Welke informatie wilt u ontvangen van uw logistieke dienstverlener? (Hoe moet de informatie eruit zien, frequentie van informatie ontvangen)
22. Als de transportprocessen uitbesteedt zijn, wat zou er voor nodig zijn om ze weer in-house uit te gaan voeren?
 - ☐ gekwalificeerd personeel
 - ☐ increase in profit
 - ☐ increase business performance
 - ☐ service quality
 - ☐ 3PL capabilities
 - ☐ monitoring transport (meer informatieve over transport / beter IT system)
 - ☐ legal issues (minder regelgeving)
 - ☐ anders, namelijk _____
23. Welke transportprocessen zou u weer insourcen?
24. Zijn er nog punten waar we het nog niet over gehad hebben maar die u wel belangrijk acht op het gebied van transportuitbestedingen?
 - _____
 - _____
 - _____
 - _____

Deel III: Vergelijken van uitbestedingfactoren

In de literatuur over supply chain management en zijn veel factoren gevonden die de uitbestedingbeslissing kunnen beïnvloeden. Het gaat te ver om voor alle individuele factoren het gewicht te bepalen daarom zijn deze factoren in de volgende zes categorieën verdeeld: profit, business performance, service quality, 3PL capabilities, monitoring/traceability en legal issues. Deze categorieën zullen hieronder toegelicht worden. Een overzicht van de losse factoren die binnen een categorie vallen zijn weergegeven in bijlage 3.

Profit: Onder profit worden alle factoren gerekend die invloed hebben op de winst van de verlader. Het gaat dan om bijvoorbeeld kosten voor personeel, kosten voor ruimte, minder investeringen et cetera. De lagere kosten kunnen een reden zijn om transportprocessen over te laten aan een logistieke dienstverlener.

Business performance: Onder business performance worden de factoren gerekend die invloed hebben op de kwaliteit van het bedrijfsproces van de verlader. Een hogere productiviteit van personeel, kortere doorlooptijd van orders, focus op de core business zijn factoren die hieronder vallen.

Service quality: Onder service quality level worden de factoren gerekend die bijdragen aan de serviceverlening richting klanten van de verlader. Een kortere doorlooptijd van kan een reden zijn om transport uit te besteden.

Legal issues: Hieronder worden de wettelijke eisen en beperkingen gerekend die invloed hebben op de beslissing om transport uit te besteden of niet. De regels rondom transport condities of emissie eisen aan vervoermiddelen kunnen een reden zijn om transport uit te besteden.

Monitoring, traceability , information: Hieronder worden de factoren gerekend die met de monitoring en informatie rondom transport te maken hebben. Het gebrek aan informatie over de transportprocessen kan een reden zijn om deze processen niet uit te besteden.

3PL Capabilities: In deze categorie vallen de factoren die wat zeggen over de capaciteiten van de logistieke dienstverlener. Het goede informatiesysteem van een 3PL kan een reden zijn om van zijn diensten gebruik te maken. Maar andersom kan het gebrek aan vertrouwen in de prestaties van de 3PL een reden zijn om het transport zelf te doen.

In dit onderdeel van het interview worden de gecategoriseerde factoren die de uitbestedingbeslissing beïnvloeden paarsgewijs vergeleken. Het gewicht of het belang van de factor in de beslissing kan hiermee worden vastgesteld. Voor deze vergelijkingen wordt een 9-punts schaal gebruikt, zie figuur 1.

Vervolgens worden de verschillende uitbestedingalternatieven beoordeeld per gecategoriseerde factor, met behulp van dezelfde 9-punts schaal. Dat wil zeggen, de vier alternatieven worden vergeleken op basis van kosten, business performance, service quality, 3PL capabilities, monitoring/traceability en legal issues. Met behulp van deze vergelijkingen kan later worden bepaald voor wel uitbestedingalternatief gekozen wordt.

Voor het vergelijken wordt een 9-punts schaal gebruikt De schaalverdeling is hieronder weergegeven in figuur 1. Bij het beoordelen van de verschillen worden alleen de oneven nummers te gebruikt. Alleen als het verschil erg klein is kunnen de even nummers gebruikt worden in de beoordeling.

-9	-7	-5	-3	1	3	5	7	9
Extremely unimportant	Very strongly unimportant	Strongly unimportant	Moderately unimportant	Equally important	Moderately important	Strongly important	Very strongly important	Extremely important

Figuur 1 Negen-punts schaal om het belang van de factoren te meten

Voorbeeldvergelijking

Een voorbeeld van een paarsgewijze vergelijking is hieronder weergegeven, zie figuur 2. De vraag die hier gesteld wordt is in hoeveel de profit factoren belangrijker zijn dan service factoren met betrekking tot het hoofddoel, namelijk het maken van een uitbestedingsbeslissing voor transportprocessen. In dit voorbeeld is profit met een 7 gewaardeerd, profit wordt in dit voorbeeld heel erg veel belangrijker gevonden dan service (in de beslissing om transport uit te besteden).

0	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.2: outsource all except order processing
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Figuur 2 Voorbeeldvergelijking factoren

In de volgende 15 vergelijkingen wordt het gewicht van de gecategoriseerde factoren bepaald. Het lijken misschien veel verschillende vergelijkingen maar slechts 6 categorieën worden vergeleken.

- profit
- business performance
- service quality
- 3PL capabilities
- monitoring, traceability, information
- legal issues.

Paarsgewijze vergelijking van de gecategoriseerde factoren

1	Profit	-9	-7	-5	-3	1	3	5	7	9	Business performance
2	Profit	-9	-7	-5	-3	1	3	5	7	9	Service quality
3	Profit	-9	-7	-5	-3	1	3	5	7	9	3PL Capabilities
4	Profit	-9	-7	-5	-3	1	3	5	7	9	Monitoring, information, traceability
5	Profit	-9	-7	-5	-3	1	3	5	7	9	Legal
6	Business performance	-9	-7	-5	-3	1	3	5	7	9	Service quality
7	Business performance	-9	-7	-5	-3	1	3	5	7	9	3PL Capabilities
8	Business performance	-9	-7	-5	-3	1	3	5	7	9	Monitoring, information, traceability
9	Business performance	-9	-7	-5	-3	1	3	5	7	9	Legal
10	Service quality	-9	-7	-5	-3	1	3	5	7	9	3PL Capabilities
11	Service quality	-9	-7	-5	-3	1	3	5	7	9	Monitoring, information, traceability
12	Service quality	-9	-7	-5	-3	1	3	5	7	9	Legal
13	3PL Capabilities	-9	-7	-5	-3	1	3	5	7	9	Monitoring, information, traceability
14	3PL Capabilities	-9	-7	-5	-3	1	3	5	7	9	Legal
15	Monitoring, information, traceability	-9	-7	-5	-3	1	3	5	7	9	Legal

In de volgende 36 vergelijkingen worden de 4 uitbestedingalternatieven vergeleken met de 6 categorieën met factoren. De vier uitbestedingalternatieven worden hieronder toegelicht:

Alternatief 1: In dit alternatief worden alle transportprocessen uitbesteedt aan een logistieke dienstverlener.

Alternatief 2: In alternatief 2 worden de meeste transportprocessen aan de logistieke dienstverlener overgelaten. Alleen order processing wordt nog uitgevoerd door de verlader.

Alternatief 3: In alternatief 2 wordt alleen het fysieke transport uitbesteed aan de logistieke dienstverlener. De verlader zorgt zelf voor de planning en de administratieve afhandeling.

Alternatief 4: In alternatief 4 worden geen transportprocessen uitbesteed aan een logistieke dienstverlener. De verlader zorgt zelf voor de transport planning en transport executie van het transport.

Een overzicht van de uitbestedingalternatieven is weergegeven in tabel 1 hieronder.

Tabel 1 Uitbestedingsalternatieven

Alternative	Shipper	3PL
1	(None)	Order processing Route/load planning Invoice Order picking (Un)loading Transport Value added services (warehousing, customs) Delivery
2	Order processing	Route/load planning Invoice Order picking (Un)loading Value added services (warehousing, customs) Transport Delivery
3	Order processing Route/load planning Invoice Order picking (Un)loading Value added services (warehousing, customs)	Transport Delivery
4	Order processing Route/load planning Invoice Order picking (Un)loading Transport Value added services (warehousing, customs) Delivery	(None)

De vraagstelling bij de volgende vergelijkingen is ongeveer vergelijkbaar met de vergelijkingen van de factoren. Nu gaat het niet om het belang maar om de voorkeur voor een bepaald uitbestedingalternatief. De aangepaste schaalverdeling is hieronder weergegeven in figuur 3.

-9	-7	-5	-3	1	3	5	7	9
Extremely not preferred	Very strongly not preferred	Strongly not preferred	Moderately not preferred	Equally preferred	Moderately preferred	Strongly preferred	Very strongly preferred	Extremely preferred

Figuur 3 Negen-punts schaal om de voorkeur voor een uitbestedingalternatief aan te geven

Voorbeeldvergelijking

In figuur 4 hieronder wordt een voorbeeldvergelijking weergegeven. De vraag die de voorbeeldvergelijking gesteld wordt is als volgt: Hoe waardeert u alternatief 1 'outsource all transport processes' in vergelijking met alternatief 2 'outsource all transport processes except order processing' ten opzichte van de invloed die het proces op de winst heeft?

De voorbeeldvergelijking is gewaardeerd met een -5. Dat wil zeggen: alternatief 1 'outsource all transport processes' sterk minder gewaardeerd dan alternatief 2 'outsource all transport processes except order processing' als alleen de invloed op de winst bepalend is. (Andersom kan dus gezegd worden dat alternatief 2 sterk meer gewaardeerd wordt dan alternatief 1)

0	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.2: outsource all except order processing
---	---	----	----	----	----	---	---	---	---	---	--

Figuur 4 Voorbeeldvergelijking uitbestedingalternatieven

Vergelijking van de uitbestedingalternatieven in relatie tot profit

1	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.2: outsource all except order processing
2	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
3	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
4	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
5	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
6	Alt.3: only outsource physical transport	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing

Vergelijking van de uitbestedingalternatieven in relatie tot business performance

1	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.2: outsource all except order processing
2	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
3	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
4	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
5	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
6	Alt.3: only outsource physical transport	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing

Vergelijking van de uitbestedingalternatieven in relatie tot service quality

1	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.2: outsource all except order processing
2	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
3	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
4	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
5	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
6	Alt.3: only outsource physical transport	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing

Vergelijking van de uitbestedingalternatieven in relatie tot 3PL capabilities

1	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.2: outsource all except order processing
2	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
3	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
4	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
5	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
6	Alt.3: only outsource physical transport	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing

Vergelijking van de uitbestedingalternatieven in relatie tot monitoring, traceability and information

1	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.2: outsource all except order processing
2	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
3	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
4	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
5	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
6	Alt.3: only outsource physical transport	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing

Vergelijking van de uitbestedingalternatieven in relatie tot legal issues

1	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.2: outsource all except order processing
2	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
3	Alt. 1: outsource all transport processes	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
4	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.3: only outsource physical transport
5	Alt.2: outsource all except order processing	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing
6	Alt.3: only outsource physical transport	-9	-7	-5	-3	1	3	5	7	9	Alt.4: no outsourcing

Vervolg van het onderzoek

Op dit punt van het interview zijn alle vragen en paarsgewijze vergelijkingen beantwoord. De antwoorden kunnen gebruikt worden om het belang van de factoren in de uitbestedingbeslissing en de mate van uitbesteding te bepalen.

De bijlagen bij het interview worden weergegeven op de hierop volgende pagina's. Als het nodig is kunnen deze gebruikt worden tijdens het interview.

Hartelijk dank voor uw medewerking aan het interview,

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Bijlagen

- Tabel transportprocessen
- Transportprocessen IDEF schema
- Overzicht gecategoriseerde factoren

Appendix 9 AHP analysis design in Excel

In this appendix an example of the calculations that were carried out in the application of the analytical hierarchy process. First the calculations needed to determine the weight of the factors is described and illustrated with Excel screenshots.

Pair-wise comparison matrix of the factors

The result of the 15 pair-wise comparisons between the factors is a 6 by 6 comparison matrix. The upper left to lower right diagonal has value one since every factor is equally important as itself. The right side of the diagonal consist of the raw scores on the nine-point scale whereby the negative values are quoted as the positive reciprocal value. The left side of the diagonal consist of the reciprocal values of the corresponding cells at the right side. This is logical because when profit is very important in the outsourcing decision compared to business performance, than business performance is very unimportant in the outsourcing decision compared to profit.

Factor	P	BP	SQ	3PL	M	L
P	1,00	7,00	0,20	0,33	7,00	7,00
BP	0,14	1,00	0,20	0,20	5,00	5,00
SQ	5,00	5,00	1,00	5,00	7,00	7,00
3PL	3,00	5,00	0,20	1,00	5,00	5,00
M	0,14	0,20	0,14	0,20	1,00	1,00
L	0,14	0,20	0,14	0,20	1,00	1,00
Sum column	9,428571	18,4	1,885714	6,933333	26	26

Figure 45 Pair-wise comparison matrix of the categorized factors

Standardized comparison matrix of the factors

For further analysis the standardized comparison matrix needs to be calculated. The standardized comparison matrix is created by dividing the raw scores by de column total of the comparison matrix.

Factor	P	BP	SQ	3PL	M	L
P	0,106061	0,380435	0,106061	0,048077	0,269231	0,269231
BP	0,015152	0,054348	0,106061	0,028846	0,192308	0,192308
SQ	0,530303	0,271739	0,530303	0,721154	0,269231	0,269231
3PL	0,318182	0,271739	0,106061	0,144231	0,192308	0,192308
M	0,015152	0,01087	0,075758	0,028846	0,038462	0,038462
L	0,015152	0,01087	0,075758	0,028846	0,038462	0,038462

Figure 46 Standardized pair-wise comparison matrix of the categorized factors

Priority vector of the factors

The priority vector of the factors is established by calculating the row average of the standardized comparison matrix. This priority vector of the factors represents the weight of the factors in the outsourcing decision.

P	0,196516
BP	0,09817
SQ	0,431993
3PL	0,204138
M	0,034591
L	0,034591

Figure 47 Priority vector of the factors

Consistency analysis of the factors

At this stage the factor weights are known. However to determine the consistency of the results the consistency ratio needs to be calculated. The consistency ratio is the quotient of the consistency index and the random index.

In order to arrive at the consistency ratio first the weighted sum vector has to be determined. This vector is calculated by multiplying the factor priority vector with the first row of the original pair-wise comparison matrix. Then the factor priority vector is multiplied with the second row of the original pair-wise comparison matrix. This process is repeated for all six rows.

P	1,522431
BP	0,599383
SQ	3,410392
3PL	1,716848
M	0,219431
L	0,219431

Figure 48 Weighted sum vector of the factors

P	7,747117
BP	6,10555
SQ	7,894545
3PL	8,410236
M	6,343537
L	6,343537

Figure 49 Consistency vector of the factors

The next step is to determine the consistency vector, this is done by dividing the weighted sum vector by the factor evaluation values that we determined earlier, these values can be found in the priority vector of the vectors. Lambda is now simply the average value of the consistency vector. Now all the information needed to calculate the consistency ratio is known.

Lambda	7,140754
n	6
CI	0,228151
RI	1,24
CR	0,183993

Figure 50 Consistency ratio (CR) and its elements

Table 29 Random Index

n	Random Index
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41

Pair-wise comparison matrix of the alternatives

The second part of this example consists the calculations that determine the priority of each alternative with respect of the six factors. The exercise below shows how the priority of the alternatives is determined with respect to profit. The calculations need to be carried out for each of the factors.

The result of the 6 pair-wise comparison of the transport alternatives with respect to the factors is a four-by-four comparison matrix. The upper left to lower right diagonal has value one since every alternative is equally important as itself. The right side of the diagonal consist of the raw scores on the nine-point scale, also here the negative values are quoted as the positive reciprocal value. The left side of the diagonal consist of the reciprocal values of the corresponding cells at the right side. This is logical because when alternative 1 is extremely preferred compared to alternative 4 with respect to, for instance, profit, than alternative 4 is extremely not preferred compared alternative 1 with respect to profit.

Profit	A1	A2	A3	A4
A1	1	1	0,142857	0,2
A2	1	1	0,2	0,2
A3	7	5	1	5
A4	5	5	0,2	1
Sum column	14	12	1,542857	6,4

Figure 51 Pair-wise comparison matrix of the alternatives with respect to profit

Standardized comparison matrix of the alternatives

For further analysis the standardized comparison matrix needs to be calculated. The standardized comparison matrix is created by dividing the raw scores by the column total of the comparison matrix.

Profit	A1	A2	A3	A4
A1	0,071429	0,083333	0,092593	0,03125
A2	0,071429	0,083333	0,12963	0,03125
A3	0,5	0,416667	0,648148	0,78125
A4	0,357143	0,416667	0,12963	0,15625

Figure 52 Standardized comparison matrix of the alternatives with respect to profit

Priority vectors of the alternatives

The priority vector of the alternative with respect to every single factor is established by calculating the row average of the standardized comparison matrix. This priority vector alternatives represents the preference for an transport outsourcing alternative.

A1	0,069651
A2	0,07891
A3	0,586516
A4	0,264922

Figure 53 Priority vector of the alternatives with respect to profit

Consistency analysis of the alternatives

In the same way the consistency of the pair-wise comparisons for the factors can be assessed also the consistency of the pair-wise comparison of the alternatives can be assessed. The only difference is a n of 4 instead of 6.

Overall evaluation of the alternatives

The final step is to determine the overall evaluation of the alternatives will be established. In this step the combination made between the weight of the factors and the evaluation of the alternatives per factor. First of all a matrix of the factors and the evaluation of the alternatives has to be made. This matrix consists only results from earlier calculations, that is the 6 priority vectors of the alternatives.

	P	BP	SQ	3PL	M	L
A1	0,069651	1,16398	0,062789	1,16398	0,07023	1,16398
A2	0,07891	1,356357	0,13623	1,356357	0,13623	0,708209
A3	0,586516	0,285772	0,326844	0,285772	0,326844	0,28974
A4	0,264922	0,099793	0,75434	0,099793	0,682912	0,099793

Figure 54 Factor evaluations (=all 6 priority vectors of the alternatives)

The total weighted evaluation, or overall evaluation, of the alternatives is calculated by multiplying the priority vector of the factors with the first row of the factor evaluation matrix. For alternative 2 the priority vector of the factors is multiplied with the second row of the factor evaluation matrix. The same sequence is followed for alternative 3 and 4.

A1	0,435386
A2	0,513606
A3	0,364174
A4	0,435174

Figure 55 Overall evaluation of the alternatives

Appendix 10 Sample worked out interview

In this appendix an example of a worked out interview is shown. These results were sent back to the respondents for verification. Only the results from the verified interviews were used in the report.

Interview

Naam

Datum

Lokatie

Introductie

Als introductie is kort gesproken over het doel van het onderzoek en de hoofdvraag die in het onderzoek beantwoordt wordt. Het interview bestaat uit een aantal open vragen en een aantal paarsgewijze vergelijkingen. Het interview zal ongeveer een uur duren.

Na de introductie maar vóór het daadwerkelijke interview is toestemming gevraagd om het gesprek op te nemen. De reden voor het opnemen van het gesprek is dat dit de uitwerking achteraf veel eenvoudiger maakt. Toestemming is verleend.

Voor het interview is ook de vertrouwelijkheid van de informatie besproken. De uitwerking van het interview wordt ter verificatie voorgelegd aan de geïnterviewde. De uitwerking kan dan gecontroleerd worden op vertrouwelijke, onjuiste en onvolledige informatie. Alleen de informatie uit de geverifieerde uitwerking wordt gebruikt in het afstudeerrapport.

Interviewvragen

Vragen over de achtergrond van de geïnterviewde.

1. Wat is uw rol / functieomschrijving bij het bedrijf waarvoor u werkt?

Europees supply chain manager.

2. Wat zijn uw verantwoordelijkheden in deze rol of functie?

Verantwoordelijk voor de Europese supply chain. Tussen de 6 fabrieken in Europa en de klanten.

3. Hoe lang bent u al werkzaam binnen supply chain management of logistiek?

Sinds 2002, dus tussen de 5 en 6 jaar.

4. In welke professioneel gebied was u werkzaam voor deze functie?

Techniek en logistiek.

5. Wat waren uw rol en verantwoordelijkheden in die functie?

Engineer consultant in het technisch logistieke vlak.

Vragen over transportuitbestedingen bij het bedrijf waarvoor u werkt

6. Zijn er binnen het bedrijf transport processen uitbesteed aan een logistieke dienstverlener?

Ja

7. In welke supply chain zijn de transportprocessen uitbesteedt. Of in welke supply chain organiseert het bedrijf waarvoor u werkt de transportprocessen?

Inbound niet. De stoffen die wij nodig hebben voor onze processen worden bij ons afgeleverd. Dus op die manier laten we het transport over aan onze leverancier. Dit zijn vooral bulktransporten van specifieke grondstoffen en dat laten we aan de klant over. De risico's en de kosten die veroorzaakt worden doordat grondstoffen niet of laat geleverd worden zijn niet zo groot dat we daarom het inbound transport zelf willen verzorgen. Fabrieken kunnen makkelijk stil gelegd worden, al is dat natuurlijk wel vervelend.

Outbound transportprocessen zijn gedeeltelijk uitbesteed. Het fysieke transport is uitbesteed aan een logistieke dienstverlener, de planning van de transporten en de training van de chauffeurs doen wij zelf.

Interne transport wordt hetzelfde benaderd als het outbound transport. Eigen fabrieken worden opgenomen in de routes die naar klanten gereden worden.

8. Welke transportprocessen zijn uitbesteed en welke transportprocessen worden nog in-house uitgevoerd? (Zie ook tabel 1 in bijlage 1 waarin transportprocessen zijn weergegeven.)

De uitbesteedde en zelf uitgevoerde transportprocessen zijn weergegeven in tabel 1 hieronder.

Een apart load planning proces is bij ons niet te onderscheiden dat valt gewoon binnen de transportplanning. Wij betalen ook zelf de transportkosten, dat laten we niet over aan de klant. Behalve bij hele lange transporten naar Rusland of Iran dan wordt het transport door de ontvanger geregeld, dat is vaak goedkoper en eenvoudiger. Zoveel vervoerders rijden niet op Iran.

Warehousing komen we ook weinig tegen we leveren bijna altijd direct naar de klant. Warehousing is namelijk erg duur voor chemische en gekoelde goederen.

Tabel 1 Transport processen uitbesteden of in-house verzorgen

ID	Process	Outsource (v8)	In-house (v8)
0	Transport		
1	Transport planning		V
1.1	Order processing		V
1.2	Route planning		V
1.3	Load planning		nvt
1.4	Invoice		V
2	Transport execution		
2.1	Order picking		V
2.2	Loading		V
2.3	Transport	V	
2.4	Unloading	V	
2.5	Warehousing	nvt	
2.6 / 2.2	Loading	nvt	
2.7 / 2.3	Transport	nvt	
2.8 / 2.4	Unloading	V	
2.9	Delivery	V	

9. Kunt u aangeven wat de achterliggende reden, argumenten, factoren zijn om juist die transportprocessen uit te besteden?

De specifieke eisen die het product stelt aan het vervoer is de reden om het transport uit te besteden. De logistieke dienstverlener is goed in staat om dit te doen. We hebben een goede relatie of partnership met onze logistieke dienstverlener. Bovendien bespaart het ook veel kosten om het uit te besteden, dus profit is ook een belangrijke reden om transport uit te besteden.

Bij het transport van producten is bij ons de aard van het product erg belangrijk. Het zijn producten die gevaarlijk zijn, als ze bijvoorbeeld in contact komen met water of lucht dan kunnen ze spontaan ontbranden of exploderen. En sommige producten moeten op lage temperatuur gehouden worden omdat ze anders eenzelfde reactie vertonen.

Het gaat over de volgende producten:

- Initiatoren
- Catalysatoren ofwel alkylen wordt getransporteerd in cylinders onder stikstof tot ISO tanks
- Peroxides, ambiente peroxides (stabiel en veilig bij kamertemperatuur, kan dus met het normale groupagevervoer mee) en temperatuur gecontroleerde peroxides (koelen tot -20 in koelcellen en koelwagens)

Deze producten zijn nodig bij de productie van plastic zoals PVC, polyethyleen, polipropyleen. Eigen lijk heb je bij de productie van alle soorten plastics wel stoffen van ons nodig.

Deze stoffen vallen onder de noemer speciaal chemie. Dit zijn kleinere meer verschillende stoffen in kleinere hoeveelheden. We zien hier ook minder bulk transporten.

De combinatie van de gevaarlijke chemicaliën en de koeling van de stoffen maakt transport bij ons een gespecialiseerde aangelegenheid. Veiligheid is daarbij één van de belangrijkste criteria.

De uitvoering van het transport is uitbesteed. De planning wordt bij ons zelf uitgevoerd en ook de training van de chauffeurs van de logistieke dienstverlener wordt door ons verzorgd. Dit om ervoor te zorgen dat iedereen weet met wat voor stoffen hij te maken heeft en welke actie moet worden ondernomen bij calamiteiten.

Planning gaat ook veel verder dan het bestellen van een vrachtauto in een bepaald tijdvenster. Peroxides zijn kleine verpakkingen, pallets. De stoffen vallen onder de vuurwerk regels, dus klanten kunnen niet zomaar hun magazijn vol zetten met peroxides. Just In Time leveren is dus heel belangrijk, maar ook met een hoge frequentie aanleveren van kleine hoeveelheden. Vrachtauto's rijden dus routes langs verschillende klanten in Nederland of Europa. En omdat het vooral onze klanten zijn en onze producten plannen wij die routes zelf.

Peroxides kunnen ook moeilijk met andere vrachten gecombineerd worden.

Vraag: Wat is de overweging om het transport niet helemaal zelf uit te voeren, dus met eigen personeel op de vrachtauto en eigen materieel. Dit is nog maar een kleine stap?

We willen niet de taak en verantwoordelijkheid hebben om de retourvracht te regelen voor lege vrachtauto's. Daar zijn logistieke dienstverleners wel beter in, zij hebben vaak een specialisatie in een bepaalde regio en ze hebben daar ook een netwerk van klanten waarvoor ze goederen richting Nederland vervoeren. En dat hebben wij niet en dat willen we ook niet, we zijn een chemicaliën producent en geen vervoerder. Het is voor ons dus voordeliger om het transport uit te besteden omdat we anders veel geld kwijt zijn aan lege retour vrachten.

Vroegen deden we de planning niet zelf, tegenwoordig wel en daarmee hebben we veel besparingen gerealiseerd. Wij hebben namelijk een goed inzicht hebben in de orders. Wij kunnen veel betere combinaties maken met onze producten dan een logistieke dienstverlener. En we kunnen onze klanten beïnvloeden zodat het transport efficiënt verloopt, door te vragen of er een dag eerder of later geleverd kan worden. In dit planningsproces werken we natuurlijk wel intensief samen met de vervoerder.

Profit is belangrijk maar we betalen ook liever iets meer aan een logistieke dienstverlener waarvan we weten dat hij zijn werk goed doet. Kwaliteit, service en veiligheid is ons handelsmerk richting onze klanten. En als er maar iets gebeurt dan staat het met grote letters in de krant.

Verder zijn de polymeerfabrieken van onze klanten niet zo makkelijk af te regelen en daarom hebben we een betrouwbare logistieke dienstverlener nodig. Service, kwaliteit en veiligheid naar onze klanten toe, wij zijn een top-supplier naar onze klanten.

10. Als transportprocessen uitbesteedt zijn, wilt u dan nog informatie krijgen over deze transportprocessen van de logistieke dienstverlener?

Nadat de stoffen bij ons geladen zijn willen we uiteraard nog veel weten. We vragen van onze logistieke dienstverlener een proof of delivery, elektronisch. Hebben ze op tijd geleverd. Op basis daarvan vindt ook de performance evaluatie plaats.

Monitoring is niet een belangrijke hoofdreden om uit te besteden of niet. Het is een onderdeel van transport, het hoort er gewoon bij.

11. In welke gevallen wenst u informatie?
- Als de goederen geladen zijn: dit doen we zelf dus daar hebben we informatie over.
 - Elke keer als de goederen een hub in het transport netwerk passeren: niet van toepassing want we leveren direct naar de klant.
 - Als de goederen afgeleverd worden: Ja
 - Als de goederen vertraagd zijn : Ja
 - Als de goederen verloren of beschadigd zijn: Ja
12. Welke informatie wilt u ontvangen van uw logistieke dienstverlener? (Hoe moet de informatie eruit zien, frequentie van informatie ontvangen)

We willen weten wanneer de goederen zijn aangekomen en hoe laat. On time delivery. En of het goed is aangekomen.

13. Als de transportprocessen uitbesteedt zijn, wat zou er voor nodig zijn om ze weer in-house uit te gaan voeren?

Als het economisch een goede case is dan kunnen we zelf vrachtauto's kopen en het transport verzorgen. Dit doen we overigens in landen in Zuid Amerika waar we geen logistieke dienstverleners kunnen vinden die aan onze kwaliteit- en veiligheidseisen kunnen voldoen.

14. Welke transportprocessen zou u weer insourcen?

Alleen het fysieke transport kan nog in-house genomen worden, maar dat is niet aan de orde.

15. Zijn er nog punten waar we het nog niet over gehad hebben maar die u wel belangrijk acht op het gebied van transportuitbestedingen?

Geen onderwerpen gemist, alle belangrijke punten waren aan de orde gekomen.

Deel III: Vergelijken van uitbestedingfactoren

In dit deel zijn de paarsgewijze vergelijkingen tussen factoren die een rol spelen in de transport uitbestedingbeslissing beoordeeld. De antwoorden van de geïnterviewde zijn hieronder in tabelvorm weergegeven. Zie tabellen 2 tot en met 8.

Tabel 2 is ingevuld door de geïnterviewde.

Tabel 2 Score paarsgewijze vergelijking van de factoren in de beslissing om transport processen uit te besteden

1	Profit	Is very strongly more important compared to	Business performance
2	Profit	Is strongly unimportant compared to	Service quality
3	Profit	Is moderately unimportant compared to	3PL capabilities
4	Profit	Is very strongly more important compared to	Information, monitoring
5	Profit	Is very strongly more important compared to	Legal
6	Business performance	Is strongly unimportant compared to	Service quality
7	Business performance	Is strongly unimportant compared to	3PL capabilities
8	Business performance	Is strongly more important compared to	Information, monitoring
9	Business performance	Is strongly more important compared to	Legal
10	Service quality	Is strongly more important compared to	3PL capabilities
11	Service quality	Is strongly more important compared to	Information, monitoring
12	Service quality	Is very strongly more important compared to	Legal
13	3PL capabilities	Is strongly more important compared to	Information, monitoring
14	3PL capabilities	Is strongly more important compared to	Legal
15	Information, monitoring	Is equally important compared to	Legal

Tabel 3 is ingevuld door de geïnterviewde.

Tabel 3 Score paarsgewijze vergelijking alternatieven ten opzichte van profit factoren

1	Alternatief 1	Is equally preferred compared to	Alternatief 2
2	Alternatief 1	Is very strongly not preferred compared to	Alternatief 3
3	Alternatief 1	Is strongly not preferred compared to	Alternatief 4
4	Alternatief 2	Is strongly not preferred compared to	Alternatief 3
5	Alternatief 2	Is strongly not preferred compared to	Alternatief 4
6	Alternatief 3	Is strongly preferred compared to	Alternatief 4

Tabel 4 is ingevuld door de interviewer op basis van de volgende uitspraak 'hoe meer transportprocessen er uitbesteed worden hoe beter dat is voor de business performance'. Dus alternatief 1 preferred over alternatief 2, alternatief 2 preferred over alternatief 3, alternatief 3 preferred over alternatief 4.

Tabel 4 Score paarsgewijze vergelijking alternatieven ten opzichte van business performance factoren

1	Alternatief 1	Is moderately preferred compared to	Alternatief 2
2	Alternatief 1	Is strongly preferred compared to	Alternatief 3
3	Alternatief 1	Is very strongly preferred compared to	Alternatief 4
4	Alternatief 2	Is strongly preferred compared to	Alternatief 3
5	Alternatief 2	Is very strongly preferred compared to	Alternatief 4
6	Alternatief 3	Is moderately preferred compared to	Alternatief 4

Tabel 5 is ingevuld door de interviewer op basis van de volgende uitspraak 'hoe meer transportprocessen er uitbesteed worden hoe slechter dat is voor de service quality'. Dus alternatief 1 is less preferred dan alternatief 2, alternatief 2 is less preferred dan alternatief 3, alternatief 3 is less preferred dan alternatief 4.

Tabel 5 Score paarsgewijze vergelijking alternatieven ten opzichte van service quality factoren

1	Alternatief 1	Is moderately not preferred compared to	Alternatief 2
2	Alternatief 1	Is strongly not preferred compared to	Alternatief 3
3	Alternatief 1	Is very strongly not preferred compared to	Alternatief 4
4	Alternatief 2	Is moderately not preferred compared to	Alternatief 3
5	Alternatief 2	Is strongly not preferred compared to	Alternatief 4
6	Alternatief 3	Is moderately not preferred compared to	Alternatief 4

Tabel 6 is ingevuld door de interviewer op basis van de volgende uitspraak 'Hoe beter de 3PL capabilities hoe meer transportprocessen uitbesteed worden'. Dus alternatief 1 preferred over alternatief 2, alternatief 2 preferred over alternatief 3, alternatief 3 preferred over alternatief 4.

Tabel 6 Score paarsgewijze vergelijking alternatieven ten opzichte van 3PL capabilities factoren

1	Alternatief 1	Is moderately preferred compared to	Alternatief 2
2	Alternatief 1	Is strongly preferred compared to	Alternatief 3
3	Alternatief 1	Is very strongly preferred compared to	Alternatief 4
4	Alternatief 2	Is moderately preferred compared to	Alternatief 3
5	Alternatief 2	Is strongly preferred compared to	Alternatief 4
6	Alternatief 3	Is moderately preferred compared to	Alternatief 4

Tabel 7 is ingevuld door de interviewer op basis van de volgende uitspraak: 'Hoe meer transport processen je uitbesteed, hoe minder de controle en informatie over die processen'. Dus alternatief 1 is less preferred dan alternatief 2, alternatief 2 is less preferred dan alternatief 3, alternatief 3 is less preferred dan alternatief 4.

Tabel 7 Score paarsgewijze vergelijking alternatieven ten opzichte van monitoring, information and traceability factoren

1	Alternatief 1	Is moderately not preferred compared to	Alternatief 2
2	Alternatief 1	Is strongly not preferred compared to	Alternatief 3
3	Alternatief 1	Is very strongly not preferred compared to	Alternatief 4
4	Alternatief 2	Is moderately not preferred compared to	Alternatief 3
5	Alternatief 2	Is strongly not preferred compared to	Alternatief 4
6	Alternatief 3	Is moderately not preferred compared to	Alternatief 4

Tabel 8 is ingevuld door de interviewer op basis van de volgende uitspraak 'hoe meer transporten uitbesteed worden hoe beter je aan de wet en regelgeving kunt voldoen'. Dus alternatief 1 preferred over alternatief 2, alternatief 2 preferred over alternatief 3, alternatief 3 preferred over alternatief 4.

Tabel 8 Score paarsgewijze vergelijking alternatieven ten opzichte van legal factoren

1	Alternatief 1	Is moderately preferred compared to	Alternatief 2
2	Alternatief 1	Is strongly preferred compared to	Alternatief 3
3	Alternatief 1	Is very strongly preferred compared to	Alternatief 4
4	Alternatief 2	Is moderately preferred compared to	Alternatief 3
5	Alternatief 2	Is strongly preferred compared to	Alternatief 4
6	Alternatief 3	Is moderately preferred compared to	Alternatief 4

Resultaten

In tabel 9 is het gewicht van de factoren in de transport uitbestedingsbeslissing weergegeven. De service quality die naar klanten geleverd wordt is de belangrijkste reden om het transport uit te besteden. Het kunnen voldoen aan wet en regelgeving en monitoring, traceability en information zijn relatief onbelangrijke factoren in de beslissing om transportprocessen uit te besteden.

In tabel 10 is de overall evaluatie van de verschillende transportalternatieven weergegeven. Alternatief 2 waarin alleen order processing in-house wordt uitgevoerd en alle andere transport processen uitbesteed aan een logistieke dienstverlener is het alternatief dat het meest gewaardeerd wordt.

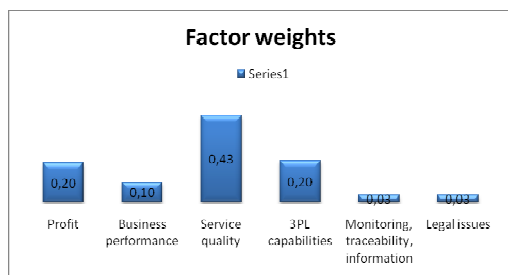
Deze resultaten zijn ook grafisch weergegeven in staafgrafieken, zie figuur 1 tot en met 3.

Tabel 9 Gewicht van de factoren in de transport uitbestedingsbeslissing

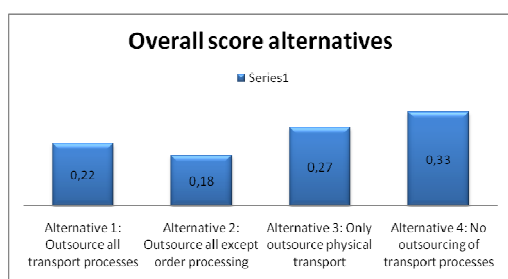
Weight of the categorized factors in the decision on outsourcing transport processes	
Profit	0,20
Business performance	0,10
Service quality	0,43
3PL capabilities	0,20
Monitoring, traceability, information	0,03
Legal issues	0,03

Tabel 10 Overall evaluatie van de transport alternatieven

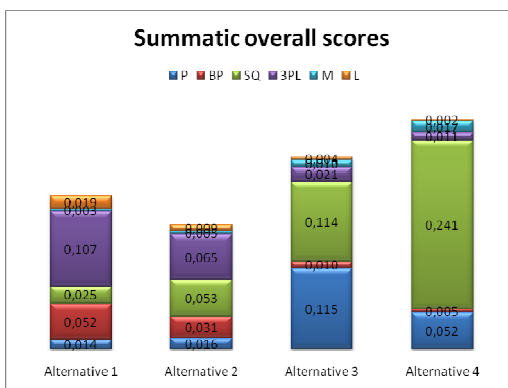
Overall evaluation of the transport alternatives	
Alternative 1: Outsource all transport processes	0,22
Alternative 2: Outsource all except order processing	0,18
Alternative 3: Only outsource physical transport	0,27
Alternative 4: No outsourcing of transport processes	0,33



Figuur 5 Gewicht van de factoren in de transport uitbestedingbeslissing



Figuur 6 Overall score van de transport alternatieven



Figuur 7 Score van de alternatieven met individuele bijdrage van de factoren

Vervolg van het onderzoek

De resultaten van dit interview worden, nadat ze geverifieerd zijn door de geïnterviewde, opgenomen in het afstudeerrapport. Het interview draagt daarmee bij aan het beantwoorden van de hoofdvraag van het onderzoek:

What are the factors that determine the shippers decision on outsourcing transport planning and execution in the various market sectors in The Netherlands and what is the need for information about these processes and the need to control these processes?

Hartelijk dank voor uw medewerking aan het interview,

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Appendix 11 Summary of the chemical interviews

In this appendix a summary of the interviews in the chemical market sector is shown. The summarized answers are tabulated, for easy comparison of the answers of the different respondents. The rows represent the questions, the columns represent the respondents.

For confidentiality reasons the names of the companies and the results are decoupled. The results cannot be traced back to one specific company or respondent.

	Respondent 1, Chemical Company A	Respondent 2, Chemical Company B	Respondent 3, Chemical Company C
Question 1:	Manager Logistics Salt	Europees supply chain manager bij Polymer Chemicals.	Supply chain manager.
Question 2:	Leiding geven aan de club die zich bezighoudt met transport planning. Alle beslissingen rondom alle logistieke zaken lopen via mij.	Verantwoordelijk voor de Europese supply chain. Tussen de 6 fabrieken in Europa en de klanten.	Verantwoordelijk voor de organisatie van het interne en outbound transport van Thermphos. De outbound logistiek bestaat uit transport vanuit de Europese vestigingen naar bestemmingen wereldwijd. De interne logistiek tussen de vestigingen is heel beperkt. Niet verantwoordelijk voor de inbound logistiek en de inkoop van grondstoffen.
Question 3	Langer dan 6 jaar in de logistiek actief. De laatste twee jaar op deze functie bij zout.	Sinds 2002, dus tussen de 5 en 6 jaar.	Vanaf 2001 werkzaam in de transport en logistiek. Dus langer dan 7 jaar.
Question 4	Verskillende functies gehad waar het logistieke aspect aanwezig was maar niet de hoofdtaak.	Techniek en logistiek.	Hiervoor werkzaam in de customer service.
Question 5	-	Engineer en consultant in het technisch logistieke vlak.	Customer service

	Respondent 1, Chemical Company A	Respondent 2, Chemical Company B	Respondent 3, Chemical Company C
Question 6:	Ja, wij transporteren niet zelf. Wij verkopen onze producten Free On Board aan onze klanten. Zij huren een schip en zorgen ervoor dat een schip de goederen komt ophalen, wij laden hun schepen. Akzo is dan van het hele transportvraagstuk af.	Ja	Ja
Question 7:	Inbound: Uitbesteed aan leverancier . Wij halen de stoffen zelf uit de grond dus inbound logistiek is er niet veel. Alleen wat additieven en die worden bij ons afgeleverd. Intern: Uitbesteed aan klant. Wordt hetzelfde als outbound georganiseerd. Outbound: Uitbesteed aan klant. Wordt overgelaten aan de klant, wij leveren FOB.	Inbound: uitbesteed aan leverancier. De stoffen die wij nodig hebben voor onze processen worden bij ons afgeleverd. Dus op die manier laten we het transport over aan onze leverancier. De risico's en de kosten die veroorzaakt worden doordat grondstoffen niet of laat geleverd worden zijn niet zo groot dat we daarom het inbound transport zelf willen verzorgen. Intern: idem outbound transport. Eigen fabrieken worden opgenomen in de routes die naar klanten gereden worden. Outbound: gedeeltelijk uitbesteed. Het fysieke transport is uitbesteed aan een logistieke dienstverlener, de planning van de transporten en de training van de chauffeurs doen wij zelf.	Inbound: Uitbesteed aan leverancier. Alle input voor onze processen worden door onze leveranciers bij ons afgeleverd. Wat we wel zelf moeten doen is de planning van de inkoop zodat de grondstoffen ook op tijd bij onze fabrieken afgeleverd kunnen worden. Intern: Eigenlijk niet van toepassing. Outbound: Het plannen van het transport doen we zelf en het fysieke vervoer van de stoffen is uitbesteed aan een logistieke dienstverlener.
Question 8	Uit de eerdere vragen bleek dat het fysieke transport niet door Akzo Nobel uitgevoerd wordt. In de outbound supply chain zorgen de klanten daarvoor. In de interne supply chain wordt het transport uitbesteed aan schippers. Het transport planning gedeelte is volledig in handen van Akzo Nobel. Tranport planning, order processing, load planning, invoice en loading wordt zelf gedaan. Transport, unloading en delivery is uitbesteed aan de klant. Order picken en warehousing is niet van toepassing omdat het om bulkgoederen gaat.	Orderprocessing, route planning, invoice, order picking en loading worden in-house uitgevoerd. Transport, unloading en delivery wordt uitbesteed. Een apart load planning proces is niet te onderscheiden, dat maakt deel uit van transport planning. Warehousing vindt bijna nooit plaats, dat is namelijk erg duur voor chemische en gekoelde goederen. Wij leveren dus direct aan de klant.	Order processing, load planning, invoicing en laden wordt in-house uitgevoerd. Transport, unloading en delivery laten we over aan de logistieke dienstverlener. Load planning, wij bepalen wanneer een vervoerder moet komen laden. Dus dat doen we in-house. Dat neemt niet weg dat een vervoerder ook een laadplanning maakt. De goederen worden direct bij de klant afgeleverd en passeren in 99% van de gevallen geen warehouses of andere hubs in het transportnetwerk.

	Respondent 1, Chemical Company A		Respondent 2, Chemical Company B		Respondent 3, Chemical Company C	
Question 8b Transport process	Outsource	In-house	Outsource	In-house	Outsource	In-house
Planing	Planing		Planing		Planing	
Order processing		V		V		V
Route planning	V			V		V
Load planning	V		nvt		V	
Invoice		V		V		V
Execution	Execution		Execution		Execution	
Order picking		nvt		V		
Loading		V		V		V
Transport	V		V		V	
Unloading	V		V		V	
Warehousing		nvt				nvt
Loading		nvt				nvt
Transport		nvt				nvt
Unloading	V		V		V	
Delivery	V		V		V	
Question 9	De belangrijkste reden voor ons om het fysieke transport aan de klant over te laten is de wisselende brandstofprijzen, de brandstof surcharge. Dat heeft dus met profit factoren te maken. Planning doen we zelf omdat dit een complex samenspel is tussen onze productieprocessen en de processen van de klant. Afregelen van fabrieken kan je niet overlaten aan een logistieke dienstverlener. Transport valt hier ook onder operations en niet onder sales.		De specifieke eisen die het product stelt aan het vervoer is de reden om het transport uit te besteden. De logistieke dienstverlener is goed in staat om dit te doen. Bij het transport van producten is bij ons de aard van het product erg belangrijk. Het zijn producten die gevaarlijk zijn, als ze bijvoorbeeld in contact komen met water of lucht of ongekoeld dan kunnen ze spontaan ontbranden of exploderen. Verder bespaart het ook veel kosten door transport uit te besteden, dus profit is ook een belangrijke reden om transport uit te besteden. Wij zijn een top-supplier naar onze klanten, dus service, kwaliteit en veiligheid is erg belangrijk. De polymeerfabrieken van onze klanten zijn niet zo makkelijk af te regelen en daarom hebben we een betrouwbare logistieke dienstverlener nodig. Monitoring is niet een belangrijke hoofdreden om uit te besteden of niet. Het is een onderdeel van transport, het hoort er gewoon bij		Transport is niet onze core business, wij maken en verkopen van die producten en we zijn geen transporteur. Het heeft ook hoofdzakelijk met profit te maken. Als wij zelf een organisatie in stand moeten houden om die transporten in eigen beheer uit te voeren dan legt dat een behoorlijk beslag op ons kapitaal en operationele kosten zoals personeel, vaste kosten etc. We willen het vervoer van onze producten ook overlaten aan specialisten, dat raakt ook weer aan legal issues. Het is een hele inspanning om aan alle regels omtrent het transport moeten voldoen, een inspanning die we niet willen leveren. Maar dit moet je wel zien vanuit een kosten perspectief, en niet omdat we niet aan de wet en regelgeving willen voldoen. Volgorde van factoren: profit, 3PL capabilities, business performance, service quality, legal issues en monitoring.	

	Respondent 1, Chemical Company A	Respondent 2, Chemical Company B	Respondent 3, Chemical Company C
Question 10	Wij hebben geen informatie nodig, we weten wanneer een schip geladen, met welk product en hoeveelheid. Daarna is het transport iets voor de rederij en de klant.	We vragen van onze logistieke dienstverlener een proof of delivery, elektronisch. Hebben ze op tijd geleverd. Op basis daarvan vindt ook de performance evaluatie plaats.	Ja, we willen graag informatie over het transportproces. We willen eigenlijk meer informatie dan we nu krijgen.
Question 11	Wij hebben geen informatie nodig.	Als de goederen afgeleverd, beschadigd of vertraagd zijn dan willen we dat horen. We laden zelf dus die informatie hebben we al. We leveren direct aan de klant dus er zitten geen hubs in het netwerk.	Als de goederen afgeleverd, beschadigd of vertraagd zijn dan willen we dat horen. We laden zelf dus die informatie hebben we al. We leveren direct aan de klant dus er zitten geen hubs in het netwerk. Vooral als de goederen afgeleverd worden. Vanuit een klanttevredenheid oogpunt zou je de eigen delivery performance als leverend bedrijf willen monitoren.
Question 12:	n.v.t.	We willen weten wanneer de goederen zijn aangekomen en hoe laat. On time delivery. En of het goed is aangekomen.	Eigenlijk zouden we wat meer actief informatie van de logistieke dienstverlener ontvangen. Nu horen we van klanten als een transport vertraagd is of als er iets anders mee aan de hand is. Deze informatie wil je liever eerdere al van de logistieke dienstverlener horen zodat je zelf actie kan ondernemen naar de klant toe.

	Respondent 1, Chemical Company A	Respondent 2, Chemical Company B	Respondent 3, Chemical Company C
Question 13:	Knowhow is nodig om processen weer in-house uit te voeren. Je ziet vaak dat kennis samen met de uitbesteedde processen verdwijnt, dat maakt het moeilijk deze processen weer te insourcen.	Profit redenen, als het economisch een goede case is dan kunnen we zelf vrachtauto's kopen en het transport verzorgen. Dit doen we overigens in landen in Zuid Amerika waar we geen logistieke dienstverleners kunnen vinden die aan onze kwaliteit- en veiligheidseisen kunnen voldoen.	Als we het zelf echt heel veel goedkoper kunnen dan is dat een reden om het transport weer zelf te doen. Dus als het ons geld oplevert of wanneer de logistieke dienstverlener zo duur is dat we het idee hebben dat het voordeliger kan. Dit is overigens niet aan de orde. Volgorde van factoren: Profit, Service quality, Increase business performance, 3PL capabilities, Gekwalificeerd personeel, Legal issues, Monitoring.
Question 14	Geen transportprocessen meer insourcen.	Alleen het fysieke transport kan nog in-house genomen worden, maar dat is niet aan de orde.	Alleen het fysieke transport kan nog in-house genomen worden, maar dat is niet aan de orde.
Question 15	-	-	We hebben het nog niet gehad over de vele transportmodaliteiten. Dit varieert van vrachtauto ladingen, verpakt, bulk, wagonladingen, containers die we over de hele wereld sturen, zeetransport en dedicated transport etc. Juist deze verschillende modaliteiten en verschillende activiteiten maakt het complex te managen. Dit is ook een reden om het uit te besteden. Tweede punt is dat we wel laadeenheden zoals ISO containers en wagons leasen. Tanks met onze producten kunnen niet of moeilijk gereinigd worden. Het reinigen is dan duurder dan het lege transport terug naar onze fabriek.

Appendix 12 Results of the pair-wise comparisons for the chemicals case study

In this appendix the results of the pair-wise comparisons of the categorized factors and alternatives with respect to the factors is shown. These results are realized by means of the analytical hierarchy process.

These bar charts are a graphical representation of the results that were presented in table 17 in sub-section 8.3.1.

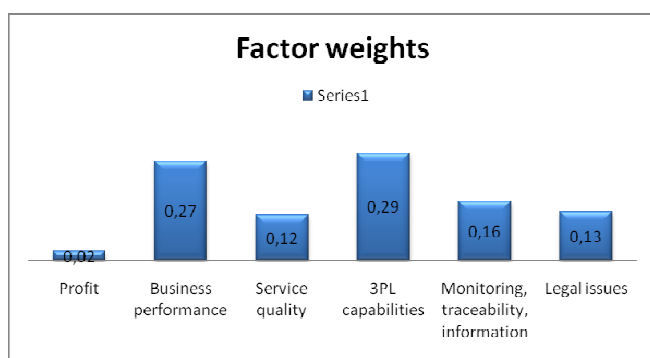


Figure 56 Weight of the factors in the transport outsourcing decision at chemical company A

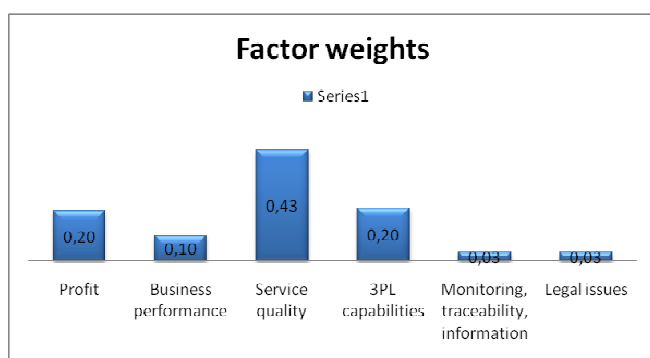


Figure 57 Weight of the factors in the transport outsourcing decision at chemical company B

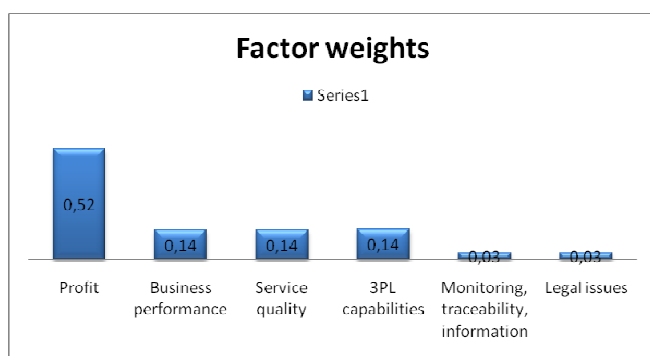


Figure 58 Weight of the factors in the transport outsourcing decision at chemical company C

Appendix 13 Summary of the high-tech interviews

In this appendix a summary of the interviews in the high-tech market sector is shown. The summarized answers are tabulated, for easy comparison of the answers of the different respondents. The rows represent the questions, the columns represent the respondents.

For confidentiality reasons the names of the companies and the results are decoupled. The results cannot be traced back to one specific company or respondent.

	Respondent 4, High-Tech Company A	Respondent 5, High-Tech Company B	Respondent 6, High-Tech Company C	Respondent 7, High-Tech Company D
Question 1:	Senior Director, Global Warehousing.	European Transport Director voor de EMEA (Europe Middle East Africa) region. Dit bedrijf heeft de sales organisatie in drie wereldwijde stukken opgedeeld: America's, EMEA inclusief Rusland en Azië/Japan. Nu zit je bij wat we noemen Europe maar dat is eigenlijk dus EMEA regio.	De interview vragen zijn door twee personen beantwoord, respondent 6.1 (R6.1) en respondent 6.2 (R6.2). Deze personen hebben de volgende rol: Logistics Operations Manager (R6.1) en European Transport Manager (R6.2).	Logistics Director Europe.
Question 2:	Verantwoordelijk voor de strategische sourcing van de fysieke distributie services wereldwijd. Dat is een combinatie functie tussen inkoop en supply chain management. Hierin was is dus de taak om vanuit de demand side alle requirements die er zijn ten opzichte van transport en logistiek op te stellen. Van daaruit wordt de vertaalslag gemaakt naar een inkoop strategie. Hiermee ga je naar de supply side, de markt van de aanbieder.	Het is mijn rol om voor dit gebied de transporten in de gaten te houden en te managen. Het gaat dan om de transporten van onze magazijnen in Europa naar de klant toe. De transporten van onze fabrieken in Azië naar Europa toe worden vanuit Azië gemanaged.	De interview vragen zijn door twee personen beantwoord, respondent 6.1 (R6.1) en respondent 6.2 (R6.2). Deze personen hebben de volgende rol: Logistics Operations Manager (R6.1) en European Transport Manager (R6.2).	Verantwoordelijk voor warehousing voor het West Europese distributiecentrum, downstream distributie van het DC naar de customers. Verder customer care en claims en tot slot customs& trade. Daar werken wij met een team van 22 man aan.
Question 3	Zeker langer dan 6 jaar.	Binnen dit bedrijf bijna 4 jaar bezig in deze rol.	Beide langer dan 6 jaar.	Langer dan 6 jaar.
Question 4	Voor deze functie ook altijd werkzaam geweest in de supply chain en logistiek. Totaal houd ik me daar zo'n 24 jaar mee bezig.	Daarvoor altijd gewerkt als consultant of aan de 3PL kant ofwel supply chain providers kant.	Beide logistieke dienstverleners als achtergrond.	Altijd werkzaam geweest binnen de logistiek.
Question 5	Niet altijd bij strategische inkoop gezeten, maar ook bij aftersales service. En meer logistiek management en supply chain management rollen. Sinds 1994 ook actief betrokken geweest bij de discussies over het outsourcen van transport. Altijd in de logistiek bezig geweest dus.	Is niet expliciet gevraagd.	In vergelijkbare rollen en verantwoordelijkheden als bij vraag 1 en 2.	Verschillende rollen en functies gehad.

	Respondent 4, High-Tech Company A	Respondent 5, High-Tech Company B	Respondent 6, High-Tech Company C	Respondent 7, High-Tech Company D
Question 6:	Ja, absoluut.	Ja, alle transport executie is uitbesteed. De transportplanning is een ander verhaal. Als je het hebt over de magazijnen dan is het een mix, een deel is uitbesteedt en een deel is van ons zelf.	Eerst de definitie van transportprocessen en logistieke processen helder stellen. Transport is alleen het vervoer van A naar B. Logistieke processen omvat veel meer, planning, warehousing. Ja. We hebben dus op alle gebieden uitbesteed, maar niet alles aan dezelfde dienstverlener.	Ja, transportprocessen zijn uitbesteed.
Question 7:	Inbound: uitbesteed aan leverancier. De inbound logistiek ligt bij onze suppliers, zij leveren goederen af bij onze fabrieken of DC's. In sommige gevallen is de supplier niet capabel genoeg om dit te regelen en dan laten we het transport uitvoeren onder onze eigen contracten. Intern: idem inbound. Het interne transport tussen verschillende Philips entiteiten in Europa wordt op dezelfde manier afgehandeld als het inbound transport. Outbound supply chain is eigenlijk volledig bij onze logistieke dienstverleners onder gebracht. Zowel transport planning als executie is volledig uitbesteed, alleen het order processen doen we nog zelf.	Inbound: uitbesteed aan de vestiging in Japan. Voor de inbound logistiek worden dienstverleners ingeschakeld, Canon heeft geen eigen vrachtauto's, schepen of vliegtuigen. Maar hier hoeven wij niets voor te managen, dat wordt vanuit Azië geregeld. Outbound supply chain zijn de transportprocessen ook uitbesteed aan een logistieke dienstverlener. Hier heb ik het dan ook weer over de transport executie. En niet over de planning.	Inbound: Uitbesteed aan een interne afdeling die het transport vanuit China naar Europa organiseert. Daar hoeven wij niets aan te doen. Intern: Niet van toepassing. Outbound: Zoveel mogelijk uitbesteed aan een logistieke dienstverlener.	In alle supply chains is transport uitbesteed. Er zijn geen Samsung medewerkers die met vrachtauto's rijden, alle transport is uitbesteed. De planningsprocessen op een andere manier georganiseerd. Het is een combinatie van outsourcen en zelf doen. Wij werken met een concept waarin we heel nauw samenwerken met een logistieke dienstverlener al tijdens de planning van het transportproces. Er zijn dus mensen van Samsung en mensen van de logistieke dienstverlener bezig met transport planning, load planning, route planning et cetera. Deze mensen maken gebruik van ons eigen ICT TMS systeem. Dat is van ons en dus niet uitbesteed.
Question 8	Eigenlijk zijn alle transportprocessen uitbesteed aan een logistieke dienstverlener. Order processen doen we zelf, net als de invoicing. Nu onderhouden wij zelf de financiële relatie met de transport bedrijven, de volgende stap is dat de logistieke dienstverlener dit afhandelt. Ook de warehousing is uitbesteed aan een logistieke dienstverlener. Zij controleren de inkomende goederen. En ze handelen de shipments naar klanten af. Daarbij kiezen zij ook een transporteur.	We besteden het liefst zoveel mogelijk uit. Order processing, een gedeelte van de route planning en invoicing wordt in-house uitgevoerd. Load planning, order picking, loading, transport, unloading and delivery wordt uitbesteed. Warehousing soms zelf, soms uitbesteed. Route planning, load planning, order picking en loading vindt plaats in het warehouse. Soms zijn die van ons, soms van een logistieke dienstverlener. Dus soms uitbesteed en soms in-house.	We besteden het liefst zoveel mogelijk uit. Order processing, route planning en invoicing wordt in-house uitgevoerd. Load planning, order picking, loading, transport, unloading and delivery wordt uitbesteed. De warehouses zijn van ons maar de warehouse processen worden door een andere partij uitgevoerd Load planning, order picking en loading vindt plaats in het warehouse. Het warehouse heeft op een day-to-day basis contact met de vervoerders maar wij hebben zelf de regiefunctie naar de vervoerders toe.	De fysieke uitvoering van het transportproces is uitbesteed. De planningsprocessen op een andere manier georganiseerd, zie vorige vraag. Reden dat wij dit weer gedeeltelijk zelf doen is gebrek aan kwaliteit, gebrek aan visibility en het idee dat er bij ons wat creatievere mensen zitten dan bij die logistieke dienstverlener. De vervoerders / carriers (die het fysieke vervoer verzorgen) worden aangestuurd vanuit ons ICT systeem en zij voeren informatie in dat systeem.

	Respondent 4, High-Tech Company A		Respondent 5, High-Tech Company B		Respondent 6, High-Tech Company C		Respondent 7, High-Tech Company D	
Question 8b Transport process	Outsource	In-house	Outsource	In-house	Outsource	In-house	Outsource	In-house
Planing	Planing		Planing		Planing		Planing	
Order processing		V		V		V		Partly
Route planning	V			V		V		Partly
Load planning	V		V	V	V			Partly
Invoice		V	V			V		Partly
Execution	Execution		Execution		Execution		Execution	
Order picking	V		V		V		V	
Loading	V			nvt		nvt	V	
Transport	V			nvt		nvt	V	
Unloading	V			nvt		nvt	V	
Warehousing	V		Partly		Partly	Partly	V	
Loading	V		V	Partly	V		V	
Transport	V		V		V		V	
Unloading	V		V		V		V	
Delivery	V		V		V		V	
Question 9	In het verleden is al duidelijk geworden dat de uitvoering van transport efficiënter kan. Bij de uitbesteding van transport planning processen spelen anderen redenen een rol. Er zijn maar twee redenen die van doorslaggevend belang waren. Dat is de increase van de business performance, heeft te maken met de integratie van rollen en verantwoordelijkheden bij de magazijnen en transport. Ten tweede is de visibility, monitoring, traceability van transport.		De kernreden om transport uit te besteden is omdat het voor ons geen core proces is. Dat valt een beetje onder de business performance categorie. Increase in profit is ook een goede reden om uit te besteden. Wij kunnen niet dezelfde ladingdichtheid halen als een logistieke dienstverlener. Service quality is niet zo'n issue in de beslissing OM het transport uit te besteden. Bij de supplier selectie houd je wel rekening met wat voor service quality een 3PL aan onze klanten kan leveren. De 3PL capabilities spelen ook een rol, zij hebben meer capabilities om het transport uit te besteden. Ook dit vind ik, net als die service quality, meer basisvoorwaarden om uit te besteden. Dit moeten ze gewoon kunnen en anders heb je een verkeerde dienstverlener		De cost efficiency is eigenlijk de belangrijkste reden, ik kan geen distributienetwerk in bijvoorbeeld Frankrijk vullen met mijn eigen volume. Dat moet ik wel overlaten aan een andere partij (R6.1). Door de juiste keuze voor een vervoerder kun je de juiste business performance creëren, maar ook de service quality, cost efficiency (R6.2). De 3PL capabilities zijn dus belangrijke factoren voor de carrier selectie. De logistieke dienstverlener zou visibility en traceability moeten kunnen bieden (R6.2). Dus ook dit is meer een punt voor supplier (warehouse of carrier) selectie dan een reden om logistieke processen uit te besteden of niet. Service quality is geen reden om uit te besteden. Je zet een service target en je zoekt daarbij partijen die dat kunnen leveren (R6.1).		Alle redenen zijn belangrijk. Maar het komt er uiteindelijk op neer dat transport niet onze core business is. Maar profit factoren hebben er ook mee te maken. Ik wil geen kapitaal investeren in vrachtauto's en personeel dat ermee moet gaan rijden. Wij maken gebruik van part loads en netwerken en dan kunnen wij natuurlijk niet zelf efficiënt vullen. Cost efficiency is het allerbelangrijkste. Die logistieke dienstverlener kan een distributienetwerk veel efficiënter vullen met goederen van verschillende klanten.	

	Respondent 4, High-Tech Company A	Respondent 5, High-Tech Company B	Respondent 6, High-Tech Company C	Respondent 7, High-Tech Company D
Question 10	Ja, uiteraard.	Ja	Ja.	Ja
Question 11	Als de goederen geladen zijn en als de goederen afgeleverd, vertraagd of beschadigd zijn. Wanneer de goederen langs een hub gaan is niet zozeer belangrijk, het gaat erom dat de goederen op tijd vertrokken en aan gekomen zijn.	Als de goederen geladen zijn dan weten we dat uit ons WMS systeem. Als de goederen een hub passeren is niet noodzakelijk om te weten, is wel een pluspunt voor de vervoerder. Als de goederen vertraagd, beschadigd en afgeleverd zijn dan willen we ook informatie.	Als de goederen geladen zijn, hubs passeren en als ze afgeleverd, vertraagd of beschadigd zijn dan willen we dat weten. We hebben deze informatie in onze systemen die gekoppeld zijn aan de systemen van de dienstverleners. We willen een continue informatieoverdracht en die hebben we dus ook (R1). Maar als er iets misgaat willen we dat wel direct horen zodat we onze klanten kunnen inlichten (R1).	Wij willen alle informatie hebben. Hier staan de standaard events of netwerk events in de supply chain genoemd. Maar we willen ook de tussenliggende gebeurtenissen weten, bijvoorbeeld als een vrachtauto vertraagd is tussen het DC en een hub in het netwerk. Pro-active track and tracing.
Question 12:	We ontvangen de complete terugkoppeling over de order afhandeling. Dit wordt via onze ERP omgeving behandeld. Dan heb je nog de wekelijkse, maandelijkse, jaarlijkse performance reports van de logistic service provider. En de derde stroom is de exception reports (uitzonderingen zoals vertraagd en beschadigd) en die zouden direct per mail of telefoon moeten worden doorgegeven.	Elektronisch, meestal overnight. Soms kan het binnen een paar uur na levering al bekend zijn, bij DHL bijvoorbeeld.	Zie vraag 11	Wij willen die informatie elektronisch hebben in ons eigen ICT / TMS systeem

	Respondent 4, High-Tech Company A	Respondent 5, High-Tech Company B	Respondent 6, High-Tech Company C	Respondent 7, High-Tech Company D
Question 13:	Als het de business performance zou verbeteren, op het moment dat de business onder de kwaliteit van de transportuitvoering gaat lijden dan moeten we het zelf maar doen. Dan moet ook die visibility weer in huis gehaald worden.	Als het de logistieke dienstverlener aan de planningscapabiliteiten ontbreekt dan is dat een reden om het zelf weer op te pakken.	Als uitbesteden geen meerwaarde meer biedt dan moeten we het zelf weer doen. Dus uitbesteden zou veel duurder of veel slechter moeten zijn. Dit geldt voor alle processen die we uitbesteed hebben zowel planning als executie dus (R6.1). Dat zijn is dus increase in profit en increase in business performance.	Transport executie gaan we nooit zelf doen, dat is uitgesloten. Wat we nog zouden kunnen doen is de planning volledig zelf kunnen gaan verzorgen. Als ze niet capabel genoeg zijn dan zou dat een reden zijn om te insourcen. Of als ik de volledige controle wil hebben. Bv. personeelsaannamesbeleid van de 3PL.
Question 14	Alleen de planning en de informatie over de transport processen. Maar dat is niet aan de orde op dit moment.	Zoals ik aangaf hebben we in sommige gevallen we een gedeelte van de planning weer moeten insourcen, door een lack of capability bij de 3PL.	Zowel planning als executie, maar dat is niet aan de orde. Distributie blijft daarbij lastig omdat we niet zelf een cost efficiënt distributienetwerk kunnen opzetten (R6.1).	Zie vraag 13
Question 15	Freight Invoice Control, wij krijgen een heleboel facturen en vaak hebben wij in-house niet de informatie beschikbaar om te verifiëren of het transport gegaan is zoals de transporteur op de factuur beweert. Dit kun je uitbesteden naar een partij die de informatie wel heeft. Tweede element wat ik niet ben tegengekomen is het continuus improvement traject. De verantwoordelijkheden moeten zo scherp gesteld worden dat de provider verbeterlagen kunnen doorvoeren, dit heeft bij ons dan impact op de kosten bij ons maar ook bij de provider zelf. Ten derde is er nog de ketenintegratie tussen ons, de logistieke dienstverlener en de klanten. En dan kun je denken aan VMI-achtige constructies met verschillende partijen die onder één dienstverlener (transport manager) staan. Op die manier kun je natuurlijk ook veel besparen door de schaalvoordelen die optreden.	Je ziet wel eens dat warehousing en transport aan één partij wordt uitbesteed onder één contract. Dat doen wij zo min mogelijk. Wij proberen zelf de transportcontracten te beheren. Dit geeft veel meer grip op de vervoerders, dan kunnen we beter monitoren en ook zorgen dat het goed blijft lopen. Als we in zee gaan met een grote partij dan moet je ook altijd naar de organisatie kijken. Soms lijkt het één bedrijf maar ontbreekt de coördinatie, dat willen we niet.	-	Het doel van een TMS is om een efficiency slag te maken. Minder rijden met vrachtauto's en meer goederen in die vrachtauto. Wie die TMS heeft is van belang. Als verladers die zelf hebben dan geeft dat veel meer vrijheid en flexibiliteit. Je ben niet van de TMS van je logistieke dienstverlener afhankelijk. En je kunt veel makkelijker suppliers wisselen. Je ziet ook de trend hierin, vroeger werd zoveel mogelijk van de IT uitbesteed en volgens mij wordt dit steeds meer in-house genomen. En de achterliggende reden voor die trend is het ontbreken van de 3PL capabilities op dit terrein. Verladers willen, gedreven door de informatiebehoeften van hun klanten, informatie hebben over de logistieke processen. En die volledige informatie kunnen 3PLs nu niet goed aanbieden. Eigenlijk bieden ze alleen volledige visibility voor express luchtvracht, maar daar betaal je ook een prijs voor.

Appendix 14 Results of the pair-wise comparisons for the high-tech case study

In this appendix the results of the pair-wise comparisons of the categorized factors and alternatives with respect to the factors is shown. These results are realized by means of the analytical hierarchy process.

These bar charts are a graphical representation of the results that were presented in table 21 in sub-section 9.3.1.

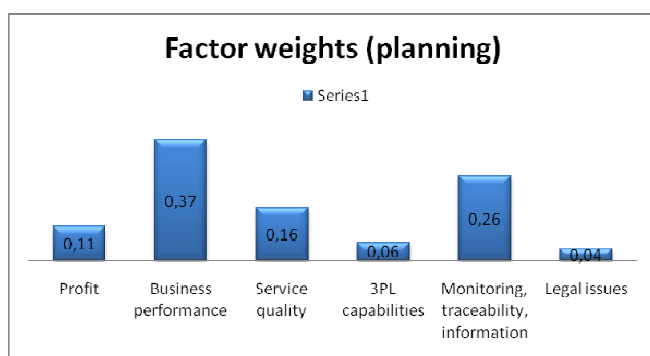


Figure 59 Weight of the factors in the outsourcing decision for transport planning at high-tech company A

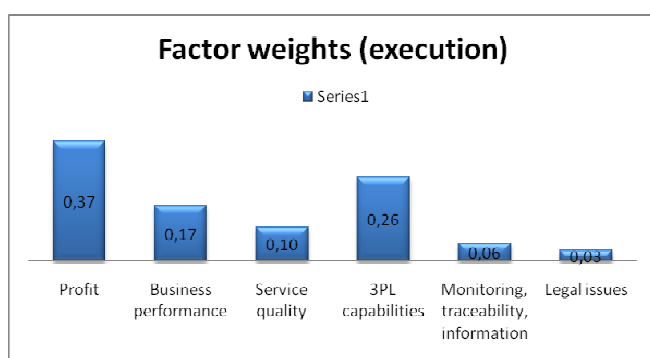


Figure 60 Weight of the factors in the outsourcing decision for transport execution at high-tech company A

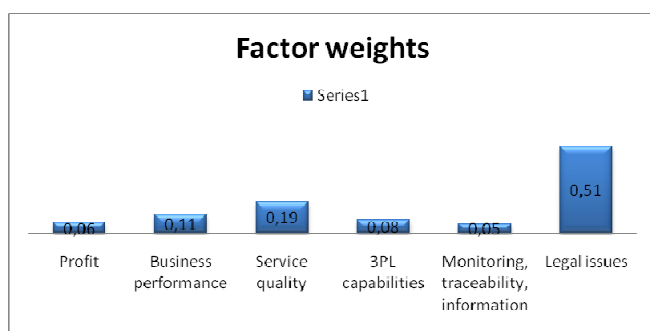


Figure 61 Weight of the factors in the transport outsourcing decision at high-tech company B

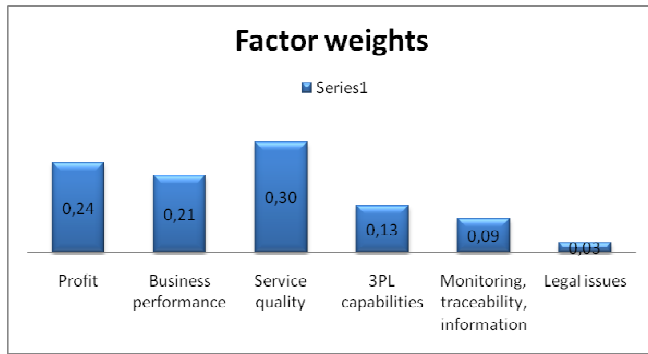


Figure 62 Weight of the factors in the transport outsourcing decision at high-tech company C

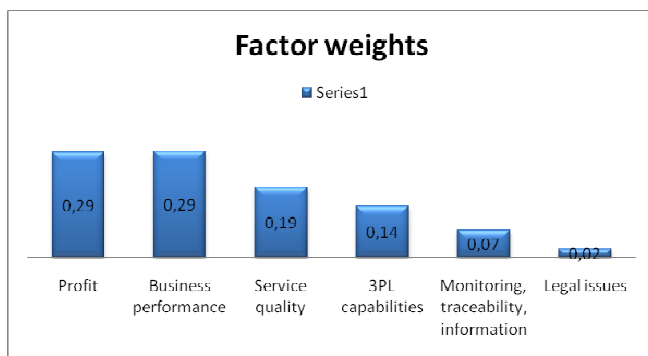


Figure 63 Weight of the factors in the transport outsourcing decision at high-tech company D

Appendix 15 List of abbreviations

In this appendix the abbreviations that are used throughout the report are listed. References are made to the sections in which the term is explained.

3PL	Third Party Logistic Service Provider	See 5.2
AHP	Analytical Hierarchy Process	See 6.3
BP	Business Performance factors	See 5.2
Chem1	Chemical company 1	See 4.2.3 and 8.1
CI	Consistency Index	See 7.3.2
CR	Consistency Ratio	See 7.3.2
DM	Decision Maker	See 2.5
HT1	High-tech company 1	See 4.2.2 and 9.1
L	Legal issue factors	See 5.2
MCDA	Multi Criteria Decision Analysis	See 6.4 and appendix 5
MIT	Monitoring, Information, Traceability factors	See 5.2
P	Profit factors	See 5.2
RI	Random Index	See 7.3.2
SC	Supply Chain	See 2.2
SCM	Supply Chain Management	See 2.2
SQ	Service Quality factors	See 5.2

