



CHALMERS
UNIVERSITY OF TECHNOLOGY

A Supply Market Analysis Framework for Test Equipment of New Technologies

A Case Study of Volvo Cars Corporation

Master's thesis in Supply Chain Management

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MASTER'S THESIS 2018:019

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Department of Technology Management and Economics
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Master's Thesis 2018:019
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Typeset in L^AT_EX
Printed by Chalmers Reproservice
Gothenburg, Sweden 2018

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Abstract

The automotive industry is currently undergoing several innovation changes, such as electrification of vehicles, autonomous drive and connected cars. These changes are affecting several operational activities, for example procurement of test equipment, which is a crucial activity for automotive OEMs. This thesis has focused on one new innovation change and its related test equipment, which has gained increased focus the recent years. The market for the test equipment is new and is expected to grow rapidly in the future which attracts new suppliers to enter the market. Today only a few companies are offering the test equipment with right features and due to that the supply market is dynamic it is hard for automotive OEMs such as Volvo Cars Corporation to get an overall understanding of the market. An understanding like this is especially important when conducting competitive sourcing strategies. Therefore, this thesis aimed to increase the understanding of the supply market of test equipment by performing a supply market analysis.

The analysis was done by using a supply market analysis framework which was designed according to both literature and strategic buyers at Volvo Cars Corporation. By following the framework new understandings about the market were gained and thus contributed to a foundation for future sourcing strategies. When performing this study, data was collected through interviews, site observations and secondary sources such as market reports and news articles.

During the supply market analysis, six trends were identified. Three of the trends were related to the market and these were; growing market in terms of revenue, increasing power of established suppliers and an increase of partnership constellations between start-ups, OEMs and established suppliers. The other three identified trends were related to the product and these were; decrease in price, change in product characteristics and development of unique solutions. In addition to this, five key suppliers were identified and compared regarding for instance their innovation and maturity level. This showed that the suppliers Beta and Delta have the highest innovation and maturity level. After performing the analysis, the authors propose two different ways of securing future supply of the test equipment. These options are to initiate a partnership with either a Tier-1 or Tier-2 supplier. The benefits are that it is possible to customize the product and secure future supply of such a critical component.

Keywords: Supply market analysis, Analysis framework, Test equipment, New technologies, Automotive industry.

Acknowledgements

We would like to express our gratitude to our supervisor at Volvo Cars Corporation for the opportunity to perform the thesis and getting important assistance along the study. Furthermore, we would like to thank the colleagues at Volvo Cars Corporation for their support and valuable input during the semester. In addition to this, we would like to thank our supervisor at Chalmers for always giving extensive feedback and supporting us during the thesis.

Oscar Brannestam & Greta Josefsson, Gothenburg, June 2018

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1

Introduction

This chapter starts with a background about the automotive industry and its development. This is followed by a description of the case company, Volvo Cars Corporation, and the purpose of supply market analyses. In addition to this, the chapter explains the aim of the thesis which has been broken down into two different research questions.

1.1 The Automotive Industry and Its Development

Ever since the first car was manufactured, the automotive industry has had a significant impact on society and the global economy (Townsend & Calantone, 2014). The industry has been developed a lot since then, and especially nowadays when it is undergoing several innovation changes. These are changes concerning the development of electrification of vehicles, autonomous drive and connected cars (Günther, Kanegiesser, & Autenrieb, 2015; Coppola & Morisio, 2016). The changes are a result of aggressive competition from new actors (Winkelhake, 2018) and environmental forces (Townsend & Calantone, 2014). The new competitors are free of inherited burdens and therefore have the possibility to build cars that are fully digitized and not strict to existing structures. These changes force the automotive industry to reinvent itself (Winkelhake, 2018).

One way the automotive OEMs realize this transformation is to introduce new technologies and innovations (Winkelhake, 2018). The introduction of new technologies are impacting several operational activities, for example procurement of test equipment. This is due to that the new technologies are affecting what should be tested and how. This thesis will look at one such example where procurement of test equipment for a new technology is studied. The development of the technology of interest plays a major role in the future development of the industry. In order to secure the high performance of the technology, it needs to be tested properly. The testing process is especially crucial for these types of technologies since it can cause harm if not working correctly.

The market for automotive testing had a revenue of \$442 million in 2016 and is expected to grow to over \$600 million by 2021 (Markets and Markets, 2016). The market for the technology of interest and related test systems have had an increased focus in the automotive industry the recent years. One of the reasons is that car manufacturers and suppliers have realized that this technology will lead to one of the most important revenue streams in the future. The market expectations for the technology and related equipment is high, attracting new companies to enter the market. However, the new suppliers have not traditionally participated in the automotive sector before, and therefore lack some commercial experience. The technology has been developed at a high pace and consist today of several different sub-technologies. In contrast to this, the development of the test equipment for this technology has been lagging behind, making testing of the technology complicated (Employee at the Indirect Purchasing department, Volvo Cars Corporation, Personal communication, 2018-01-25). A more extensive description of the test equipment and its characteristics is given in Section 5.2.

1.2 Volvo Cars Corporation

Volvo Cars Corporation (henceforth referred as Volvo) is a Swedish premium automobile company founded in Gothenburg 1927. In year 2017, Volvo had more than 30 000 employees worldwide, over 570 000 sold cars and a net revenue of 211 billion SEK (Volvo Cars Corporation, 2018). The company has three different core values - Safety, Quality and Care for the Environment that direct business operations throughout the whole company.

The Indirect Purchasing (IDP) department at Volvo drives sourcing of goods and services linked to the production and testing of cars. The department belongs to the Procurement organization and is responsible for purchasing non-production material, services and IT. The department is split into different purchasing areas, where Tooling and Test equipment is one of these. This department is working closely together with internal stakeholders, which are software and hardware technicians, in order to source right goods and services. The stakeholders have the technical knowledge while the sourcing buyers have knowledge in supplier evaluation and contracting. A collaboration between the purchasing department and the technical stakeholders is needed in order to meet Volvo's cost, quality and environmental requirements. (Employee at IDP, Personal communication, 2018-01-25)

According to employees at IDP (Personal communication, 2018-02-14), only a few companies are offering test equipment with right features and quality which makes the supply options narrow. Increased technical complexity and new suppliers on the market have lead to that purchasers at Volvo are requesting a detailed understanding of the supply market of the test equipment. A way to gain this type of market insight and possibly expand the supply options is to perform a supply market analysis (Van Weele, 2010).

1.3 Sourcing Strategies and Supply Market Analyses

Van Weele (2010) states that industries are getting more and more competitive, which results in that managers refer to purchasing and supply chain management as key business drivers. In order to secure that a purchasing department is effective and does the right things, a sourcing strategy should be formulated (Seshadri, 2005). According to Van Weele (2010), a sourcing strategy describes how many suppliers to buy from, which type of relationship to pursue and what type of contract to negotiate for. The sourcing strategy focuses on a long time horizon, functioning as an overall plan for the purchasing department. A first step to formulate a competitive sourcing strategy is to perform a supply market analysis (Lobermeyer & Kotzab, 2010). The findings from the supply market analysis lay a foundation for the sourcing strategy, making this step of great importance for the final result.

According to Van Weele (2010), a supply market analysis includes collection and analysis of relevant data that influence procurement decisions. This is data such as market trends, growth analysis, supplier information and competitive activity (Monczka & Petersen, 2012). Data in a supply market analysis is for instance useful when selecting suppliers, establish relationships or in negotiation tactics. According to employees at IDP (Personal communication, 2018-01-25), the market for the test equipment is highly dynamic and has therefore been changing a lot the recent years. As the market also is seen to be a lucrative business and consists of complex technologies, the market has caught interest by several technical start-ups. The number of actors that entered the market has had an exponential growth the recent years and the changing environment has made it hard for purchasers at Volvo to clearly identify the market. In order for Volvo to conduct a sourcing strategy where they choose right suppliers to source from, performing a supply market analysis of the test equipment market is seen to be critical.

There are several different frameworks in the literature regarding how a supply market analysis should be structured (Jones & Barner, 2015; Lobermeyer & Kotzab, 2010; The State of Queensland, 2017; Van Weele, 2010). These frameworks are designed in order to suit a broad variety of industries and markets. When comparing different frameworks, it can be seen that the structure of the frameworks differ from each other. Some frameworks tend to be more process oriented (Jones & Barner, 2015; Van Weele, 2010) while some are more oriented around what factors to analyze (Lobermeyer & Kotzab, 2010; The State of Queensland, 2017). A framework needs to be customized according to the applied context and business objectives in order to be successful (Košíček et al., 2012). In literature there is a lack of customized frameworks for a supply market analysis for test equipment of new technologies, which is needed when performing an analysis of this market.

1.4 Purpose

The supply market for test equipment of new technologies, similar to electrified vehicles, autonomous drive and connected cars, is challenging to understand. This is due to that type and number of actors that enter the market is highly dynamic comparing to other supply markets in the industry. The dynamic market environment makes it hard for Volvo to identify the market and hence find suitable suppliers to source from. Thus, and in order to make it possible for Volvo to conduct a competitive sourcing strategy, this thesis aims to increase the understanding of the supply market for the test equipment of a specific new technology.

1.5 Research Questions

To fulfill the purpose of this thesis, two different research questions have been formulated. In order to gain an understanding of the market a supply market analysis framework needs to be designed to suit the market context. Because of this, a first research question has been formulated as followed:

RQ1: *How should a supply market analysis framework be designed for the supply market of test equipment?*

Answering the first research question will result in a designed framework for the supply market analysis. This framework will then be used in order to gain an understanding of the market for test equipment market. The second research question has therefore been formulated as followed:

RQ2: *What are the characteristics of the supply market of test equipment?*

1.6 Reading Directives

The following section will explain the content in every chapter of the thesis. This is done in order to give the reader a short introduction of the parts this thesis consists of. As illustrated in Figure 1.1, this research is divided into four different phases, including one or two different chapters.

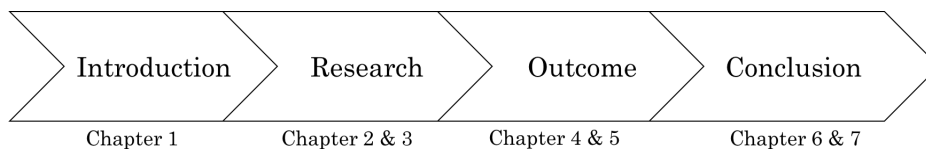


Figure 1.1: Reading directives for the thesis.

Chapter 2 - Frame of Reference

This chapter presents the theoretical background of the thesis. The chapter will start with a description of different definitions of a supply market analysis followed by a presentation of different frameworks found in the literature. These will be summarized in a new constitution in the end of the chapter.

Chapter 3 - Method

This chapter describes the method used for the research. It starts with a description of the research process which gives a general idea of how the research was carried out. This is followed by explaining the selected research approach, strategy and techniques. The chapter is concluded with a discussion about the aspects of trustworthiness and ethics in the research.

Chapter 4 - Volvo's View on Analyzing the Test Equipment Market

In this chapter the data collected from six interviews with strategic buyers at Volvo is presented. The factors that were highlighted during the interviews are divided into seven different groups, similar to the ones presented in the Frame of Reference. The chapter concludes with a presentation of the elements in the adapted framework, shown in Table 4.8.

Chapter 5 - Supply Market Analysis of Test Equipment

This chapter consist of findings from the supply market analysis of the test equipment. The chapter is following the structure as the proposed framework presents in Table 4.8 and summarizes for instance market and product trends, key suppliers and competitors sourcing choices.

Chapter 6 - Discussion

This chapter starts with a discussion of the findings from the supply market analysis and the proposed framework that was used. This is followed by presenting the design of the final framework for analyzing the market for test equipment of new technologies. The chapter is finished with an evaluation of two possible strategic sourcing options for Volvo to select.

Chapter 7 - Conclusion

This final chapter will conclude the findings from this research by answering the two research question. The chapter ends with a recommendation for Volvo, contribution and suggestions for future research.

2

Frame of Reference

This chapter presents the theoretical background of the thesis. The chapter will start with a description of different definitions of a supply market analysis followed by a presentation of different frameworks found in the literature. These will be summarized in a new constitution in the end of the chapter.

2.1 Supply Market Analysis

According to Lobermeyer and Kotzab (2010), the success of a sourcing strategy is dependent on the level of knowledge about the related supply market. This knowledge can be gained by performing a supply market analysis which aims to understand a specific market and its characteristics regarding trends, key suppliers and competition. Keith, Vitasek, Manrodt, and Kling (2015), agree that this knowledge is affecting the sourcing performance, and add that the supply market analysis should be a foundation for the overall sourcing strategy.

In literature, there are different terms related the concept supply market analysis. These are terms such as supply market research, supply market intelligence and supply market scanning (Jones & Barner, 2015; Van Weele, 2010; Zsidisin, Hartley, Bernardes, & Saunders, 2015). The definitions of each term are presented in Table 2.1. One thing common for the definitions are that they describe a process of collecting information about a market to secure future source of supply. Furthermore, a majority of the definitions include the activity of analyzing the information that has been collected. One exception is the definition written by The State of Queensland (2017). Since analysis is a part of their term, this activity could be seen as a natural part of the process. According to this, it could be concluded that a supply market analysis includes both a collection and analysis of relevant data concerning a specific supply market.

Table 2.1: Definitions of different terms of supply market analysis.

Term	Definition
Supply market analysis The State of Queensland (2017), p. 40.	<i>Supply market analysis is a technique used to identify market characteristics for specific goods or services. It provides information that is critical to develop effective procurement strategies, in the context of planning for significant procurement.</i>
Supply market research Van Weele (2010), p.131.	<i>Supply market research can be defined as the systematic gathering, classification and analysis of data considering all relevant factors that influence the procurement of goods and services for the purpose of meeting present and future company requirements.</i>
Supply market intelligence Jones and Barner (2015), Chapter 1.	<i>Supply market intelligence is created when external information is collected and analyzed to form actionable conclusions that affect a company's ability to strategically locate, secure, and manage sources of supply.</i>
Supply market scanning Zsidisin et al. (2015), p. 550.	<i>Supply market scanning includes the supply managers' efforts to learn from benchmarking, suppliers, analyzing market trends and experimenting with new technology.</i>

As earlier mentioned, when searching for explanations about how a supply market analysis should be performed, several frameworks can be found. When comparing the frameworks, it can be seen that the characteristics of the frameworks differ, where some are more process oriented (Jones & Barner, 2015; Van Weele, 2010) while other focus on what factors that should be analyzed (Lobermeyer & Kotzab, 2010; The State of Queensland, 2017). According to this, the four frameworks that will be presented have been divided into two different groups, factor- and process-oriented, which are explained below.

2.1.1 Factor-oriented Frameworks

Two frameworks that explain the different factors that should be considered during a supply market analysis are the SMA-framework (Supply Market Analysis-framework) (Lobermeyer & Kotzab, 2010) and Porter's Five Forces (The State of Queensland, 2017). The SMA-framework (presented in Figure 2.1) has divided the different factors into four different groups: 'Existing supplier markets', 'Product', 'New markets' and 'Buyer markets'. Lobermeyer and Kotzab (2010) highlight the importance of understanding the existing supplier market which includes the analysis of key suppliers, external markets and power of suppliers. This group is mainly focusing on the current supply market situation and the external factors that affect the market. In addition to this, the SMA-framework also emphasizes the importance of understanding product characteristics and trends, new geographical markets and substitute of goods, as well as buyer markets including competitors and their activities.

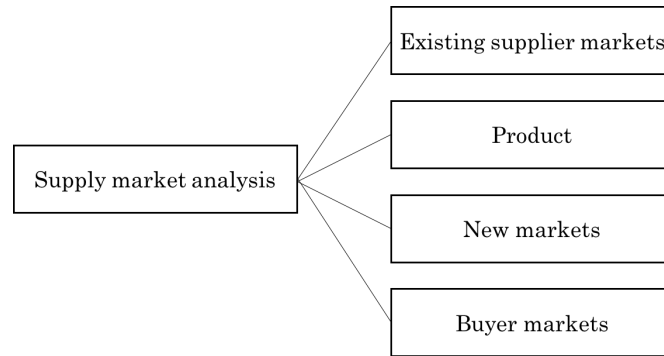


Figure 2.1: The SMA framework designed by Lobermeyer and Kotzab (2010).

The other factor-oriented framework is illustrated in Figure 2.2. This framework has been inspired by Porter’s Five Forces but adapted by The State of Queensland (2017) to suit the upstream instead of downstream market. The framework highlights five different groups of factors where the first one is ‘Market structure’. Factors that should be investigated in the first group is market size, market shares, market concentration, key suppliers, ownership structure and suppliers profitability. The second group is ‘Competition’, which includes both supplier competition and buyer competition.

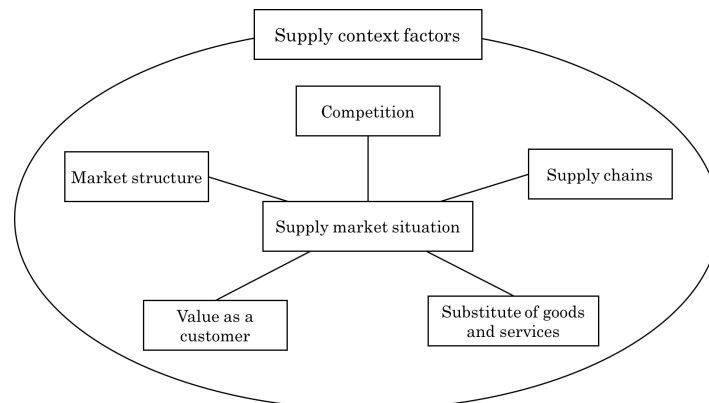


Figure 2.2: Porter’s five forces adapted to the supply market developed by The State of Queensland (2017).

In contrast to the SMA-framework, this framework is emphasizing the importance of analyzing the ‘Supply chains’ (The State of Queensland, 2017). This includes investigating the value-adding activities and actor dependencies. The fourth group is ‘Substitute of goods and services’ where purchasers are encouraged to have a broader perspective of the market to find a wider range of solutions and suppliers. The last group to consider is ‘Value as a customer’ where an analysis of the buying company’s position on the market should be performed. This is done in order to understand how important the company is to an existing or potential supplier. In addition to these five groups the ‘Supply context factors’ should be included in the supply market analysis. These factors can be identified by using the PESTEL framework, which will be described more in detail in Section 2.2.6.

2.1.2 Process-oriented Frameworks

The other group of frameworks found in literature is mainly focusing on what activities that should be performed when realizing a supply market analysis. Two frameworks that can be found in literature that highlights different steps in the process is designed by Van Weele (2010) and Jones and Barner (2015). Both frameworks explain what research activities that should be done instead of focusing on the specific factors that should be analyzed. Van Weele’s framework consists of several different steps that should be performed in order to execute a supply market analysis (Van Weele, 2010). As illustrated in Figure 2.3, the first three steps are performed to decide if a supply market analysis should be performed. When the decision is made, the planning phase starts, which is followed by execution and data collection. Lastly, the information should be documented and also evaluated.



Figure 2.3: Eight steps to follow when performing a market research (Van Weele, 2010).

The other process-oriented framework designed by Jones and Barner (2015), does in contrast to Van Weele’s framework only consist of four steps. As seen in Figure 2.4, the first step is to identify and define the aim of the research. Next step is to start the information gathering, which should be analyzed in the third step. The last step is the same as in Van Weele’s framework, where the collected data should be documented. Another activity included in Jones and Barner’s framework (2010) is the internal review. This activity, which should be performed after the analysis, consist of a review of the gathered data by other purchasers.

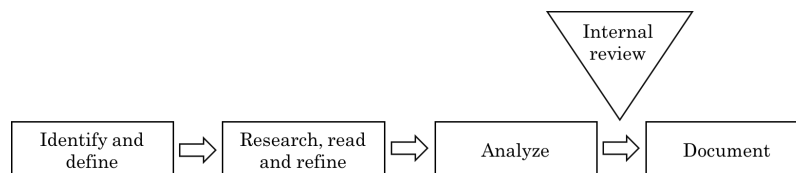


Figure 2.4: Supply market intelligence creation process (Jones & Barner, 2015).

2.2 Factors for Analyzing a Supply Market

As presented in Section 2.1.1 some literature is highlighting different factors that should be considered when performing a supply market analysis. These factors are described in detail in this section and also grouped into six different groups. These groups are based on findings from the literature (Lobermeyer & Kotzab, 2010; The State of Queensland, 2017) and illustrated in Figure 2.5.

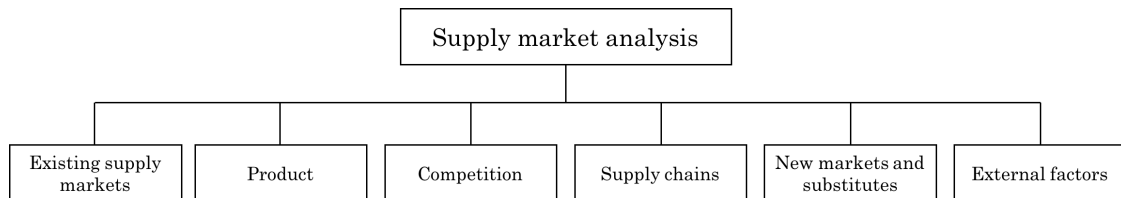


Figure 2.5: Groups of factors to consider when performing a supply market analysis according to previous research.

The factors included in these six groups are presented in Table 2.2. Each factor is given a short description, where the key elements are defined. Since different researchers are highlighting different factors, all researchers that mentioned the factor is listed next to the factors.

Table 2.2: Factors to consider in a supply market analysis according to literature.

Group	Factor	Elements	Reference*
Existing supplier market	Key suppliers	Key suppliers' role on the market and company information	R1, R2, R3, R6
	Market size and market shares	Sales volumes (divided in private and public sector)	R2, R5
	Industry trends	Changes in the business environment, trends affecting the balance of supply and demand	R2, R3, R5, R6
Product characteristics	Cost-price analysis	Cost-drivers, indirect versus direct costs, price estimation	R1, R3, R4, R5
	Product innovation	Comparing technological, material and service development, document best-in-class products	R1, R3, R6
	Product trends	Trends in product development and price trends in production materials	R1, R5, R6
	Product life cycle consideration	Determine product stage; <i>Introduction, Growth, Maturity</i> or <i>Decline</i>	R2
Competition	Supplier competition	Number of suppliers, threat of new entrants, barriers to entry and exit	R1, R2, R3
	Buyer competition	Competitors characteristics, competitors purchasing volumes, supplier capacity	R1
Supply chains	Value-adding activities	Determine level of value added in each supply chain step	R2
	Dependencies	Buyer-supplier power relationship	R2, R5
New markets & substitutes	Alternative sourcing markets	Investigate new international suppliers	R1
	Alternative products and substitute	Substitute and supplements of materials and products	R1, R2, R5
External factors	PESTEL	Analyzing <i>Political, Economical, Social, Technological, Environmental</i> and <i>Legal</i> context factors	R1, R2, R3, R4

***R1:** Lobermeyer and Kotzab (2010); **R2:** The State of Queensland (2017); **R3:** Keith et al. (2015); **R4:** Jones and Barner (2015); **R5:** Monczka and Petersen (2012); **R6:** Zsidisin et al. (2015).

2.2.1 Existing Supply Markets

The first group of factors to consider when analyzing a supply market is ‘Existing supply market’ which implies a general investigation of the market (Lobermeyer & Kotzab, 2010; The State of Queensland, 2017). Lobermeyer and Kotzab (2010) argue that the existing supply market is analyzed by determining key suppliers. In addition to this it is also important to understand market size, market shares and industry trends when analyzing the existing supply market (Monczka & Petersen, 2012).

The evaluation of key suppliers in a supply market aims to understand the main market players and their role in the market (Lobermeyer & Kotzab, 2010). When these suppliers are investigated, key company information and strengths and weaknesses of the companies should be studied. The focus when evaluating strengths and weaknesses should be on supplier performance, financial situation and technological capabilities (Lobermeyer & Kotzab, 2010). Keith et al. (2015) emphasize the importance of understanding the financial situation of a supplier because when investing in a relationship with one supplier, the impact and effort of changing supplier will increase. In addition to this, The State of Queensland (2017) argues that the ownership structure and market shares of the key suppliers should be studied. The market share is interesting to know in order to get a better understanding of what role different suppliers and other buyers have on the market (The State of Queensland, 2017).

As shown in Table 2.2, several researchers emphasizes the importance of studying the industry trends when performing a supply market analysis (Zsidisin et al., 2015). Monczka and Petersen (2012) state the importance of finding patterns in the market in order to estimate how the market might evolve. By identifying these trends, critical decisions related to purchasing operations can be made more easily (Zsidisin et al., 2015). These are decisions such as what volumes to purchase and from who.

2.2.2 Product Characteristics

A second dimension of analyzing a supply market often includes studying the characteristics of the product to be sourced (Lobermeyer & Kotzab, 2010). As shown in Table 2.2, this group consist of four different factors. These factors are cost-price analysis, product innovation, product trends and product life cycle consideration.

According to both Lobermeyer and Kotzab (2010) and Jones and Barner (2015), a cost-price analysis is recommended to perform when doing a product analysis. According to Johnson (1998), the cost-price analysis should include an investigation of material costs, direct labor costs, overhead costs and profit. The first step aims to understand what material the supplier use, where it is sourced from and to what price. If the supplier does not provide this information, market insights about price and future fluctuations can be used instead. The second step is to analyze the direct labor costs, which can be calculated from time expended and salary level. These two first factors are the direct costs. Next step is to estimate the overhead

costs, and to what extent the customer is contributing to the overhead recovery. The overhead costs can be broken down into R&D, sales and marketing and administration etc. The last step is to analyze what profit-margin that is reasonable for the product. When understanding all these different cost drivers, it is possible to estimate the reasonable price for the product. According to Lobermeyer and Kotzab (2010), this type of knowledge is very valuable in the process of choosing the right sourcing strategy or argumentation tactic. In addition, Johnson (1998) states that a customer never will know if they get a good price without understanding the cost drivers.

Keith et al. (2015) and Lobermeyer and Kotzab (2010) argue that product innovation needs to be considered when analyzing a product. Granstrand (2010) refers to product innovation as a technological innovation which can be protected through patents. A company can access this either by developing it in-house or by acquiring another company (Brem & Tidd, 2014). The purpose with product innovations is to supplement or complement existing product portfolios. Lobermeyer and Kotzab (2010) state that product innovations should be investigated during a supply market analysis with the objective of forecasting future developments. According to Keith et al. (2015), understanding innovations on the market are also crucial when determining market leaders.

Product trends should also be examined in this step of the analysis (Lobermeyer & Kotzab, 2010). The purpose with this is to understand how trends influence the product and the future product development. The development of material and quality related to the product's components should be investigated since this will influence the future development of the product (Lobermeyer & Kotzab, 2010). According to The State of Queensland (2017), the products' current stage in the life cycle should be included when studying the product. The product life cycle is divided into four different phases (Introduction, Growth, Maturity and Decline) which all products undergo (Yang & Zhao, 2010). Klepper (1996) states that each phase of the product cycle implies different marketing strategies for the supplier. By defining the products' current stage, a buyer can understand which strategy the supplier will use and how they will compete (The State of Queensland, 2017).

2.2.3 Competition

The third group to consider when analyzing a supply market is 'Competition', where both the supplier competition and buyer competition should be analyzed (Lobermeyer & Kotzab, 2010; The State of Queensland, 2017). According to The State of Queensland (2017), the competitive landscape among suppliers is defined by the number of suppliers and the level and type of barriers to enter and exit the market. If a market is capital intensive only a few companies will be able to enter the market, which in turn will make the suppliers compete with technical features and brand image rather than price (Mathooko & Ogutu, 2015). If the entry barriers instead are low, this will increase the threat of new entrants as it will be easier to compete with a similar business (The State of Queensland, 2017).

The competitive landscape among suppliers should be complemented by understanding how the buyers compete (The State of Queensland, 2017). To better understand the buying competition, characteristics of competitors and their purchasing volumes should be investigated. Purchasing volumes are interesting in order to understand who is the most prominent supplier on the market, but also to see how much each customer wants to buy of the total demand. In addition to this, it is of importance to understand supplier capacity since it affects the buyer competition. If one supplier runs out of stock or has a stop in the production, the competition among buyers will increase, which in turn affect the price-level. Furthermore, Lobermeyer and Kotzab (2010) emphasize that switching costs are a good indication of the competitive landscape. Switching costs are the cost that arises when a customer shift from one supplier to another that sell the same product with same functionality (Dong, Bárcena-Ruiz, & Díaz-Benito, 2017). If the switching costs are low, buyers can easily change to the cheapest supplier or the one with the best offer whenever it is beneficial (Zhang, Tang, & Hu, 2015).

2.2.4 Supply Chains

The next group to consider in a supply market analysis refers to the ‘Supply chains’ (The State of Queensland, 2017). During this analysis, a better understanding of value-adding activities and supply chain dependencies will be gained (Lobermeyer & Kotzab, 2010; The State of Queensland, 2017)

Defining value-adding activities are important in the process of understanding a supply chain (The State of Queensland, 2017). A supply chain consists of actors such as resource suppliers, manufacturers and distributors, who all want their share of the revenue stream (Krakovsky, 2015). If the value of the adding activities does not outpace the extra costs it implies, the buying company should develop the product in-house or purchase from an actor further upstream in the supply chain. The purchaser should also investigate if the risk of performing an activity in-house is lower than the adding costs that a supplier or middleman add for managing this activity (The State of Queensland, 2017).

Dependencies in a buyer-supplier relationship arise when one actor is more dependent on the other one (Kähkönen, 2015). Kähkönen (2015) argues that dependencies do not need to imply conflicts between two parties, but can create risks and challenges for the party that are more dependent on the other. Another type of dependency arise when the market is dependent upon one major supplier. In these cases, all customers will likely face challenges if this supplier’s capacity is reduced (Van Hoek, 2006). Understanding these different dependencies in a supply market facilitates for estimating different risks that may rise when sourcing from a specific supplier (The State of Queensland, 2017).

2.2.5 New Markets and Substitutes of Goods

When performing a supply market analysis, literature emphasizes to not only consider the current product portfolio but also search for new geographical markets and possible product supplements or substitutes (Lobermeyer & Kotzab, 2010; The State of Queensland, 2017). Due to that sourcing of services and products have become more international, seeking for alternative international markets have come into focus (Senft, 2014).

By investigating substitutes and supplements of goods, new products, materials or technologies can be found from more competitive and less risky supply markets (The State of Queensland, 2017). Sourcing substitute products increase the number of firms that meet the standards and reduces the possibility of being in a vulnerable position when dealing with a monopoly supplier.

2.2.6 External Factors

In addition to the earlier mentioned groups, several authors emphasize the importance of understanding the overall external market (Keith et al., 2015; Lobermeyer & Kotzab, 2010; The State of Queensland, 2017). External factors are especially important to analyze in order to understand the risks on the market (Lobermeyer & Kotzab, 2010). A common way to perform this type of external analysis is by following the PESTEL framework (Srdjevic, Bajcetic, & Srdjevic, 2012), which will be described further below.

PESTEL is an abbreviation of six different factors (Srdjevic et al., 2012). These factors are *Political*, *Economical*, *Social*, *Technological*, *Environmental* and *Legal*. The first aspect to analyze is factors that arise because of new policy initiative or change of government (Cadle, Paul, & Turner, 2010). This is followed by analyzing the market from an economical and social point of view, meaning how the market is affected by both the economy and social welfare. The market is then studied according to external technology development and how this can affect an organization for instance regarding distribution, manufacturing and communication (Navarro-García, Arenas-Gaitán, & Rondán-Cataluña, 2014). The environmental factor arises from the concern of the natural environment, which can lead to new regulations of standards (Cadle et al., 2010). This could for example be regarding pollution or material usage. The last factor to take into account in the PESTEL analysis concerns the legal part of the market. This includes investigating factors that arise from changes in regulations and laws (Cadle et al., 2010).

3

Method

This chapter describes the method used for the research. It starts with a description of the research process which gives a general idea of how the research was carried out. This is followed by explaining the selected research approach, strategy and techniques. The chapter is concluded with a discussion about the aspects of trustworthiness and ethics in the research.

3.1 Research Structure

According to Saunders, Lewis, and Thornhill (2008), methodology is the theory of how a research study should be carried out. Saunders et al. (2008) highlight different elements that should be taken into consideration when designing a research methodology, which is presented in a framework called the ‘Research onion’. The different layers in the research onion consist of, for instance, research approach, research strategy and research techniques. Saunders et al. (2008) state that it is important to first consider the outer layer and then continuously design the research layer by layer. In Figure 3.1, Saunderson et al.’s framework has been adjusted for this research and the different methodology choices is presented. The reasoning behind each choice are explained in more detail in this chapter.

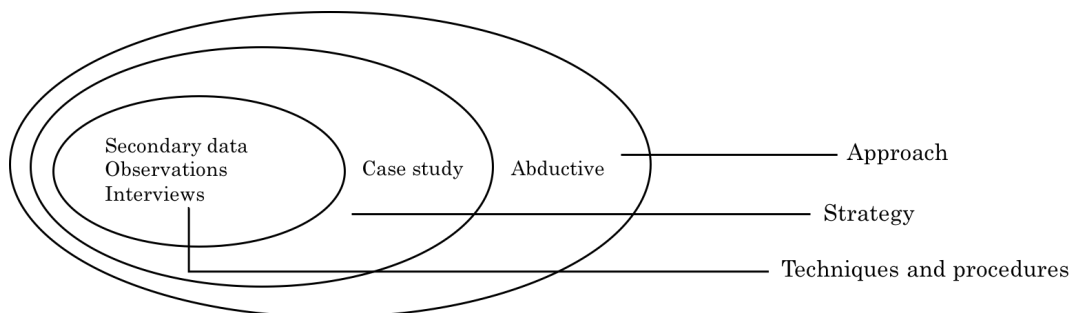


Figure 3.1: Adapted research onion for this study (Saunders et al., 2008).

3.2 Research Process

The research process of this thesis is illustrated in Figure 3.2. The initial phase of the research included a literature review in parallel with a case study at the IDP department, Volvo. During the case study, strategic buyers were interviewed in order to adapt theory into practice. This step was performed in an iterative manner, meaning that the data collection of literature and interviews overlapped each other, which Spens and Kovács (2006) refer to as a learning loop. The literature review of supply market analysis frameworks was performed to take advantages from previous research. The literature was found through different search engines of science and academical publications, such as Summon and Google Scholar. The keywords used for finding different frameworks during the online search were: 'framework' and 'supply market' followed by either 'analysis', 'research', 'intelligence' or 'scanning'. To get an understanding of sourcing strategies, words such as 'sourcing strategy' and 'purchasing strategy' were also used.

The iterative process of reviewing the literature and performing the case study created a foundation for the framework creation. Building-blocks from the literature review and the case study were put together in a new constitution to answer the first research question: *'How should a supply market framework be designed for the supply market of test equipment?'*. In the second phase, the framework was tested by performing a supply market analysis of test equipment and thus answering the second research question: *'What are the characteristics for the supply market of test equipment?'*. The testing of the framework was then followed by a conclusive evaluation of the designed framework and the findings from the analysis.

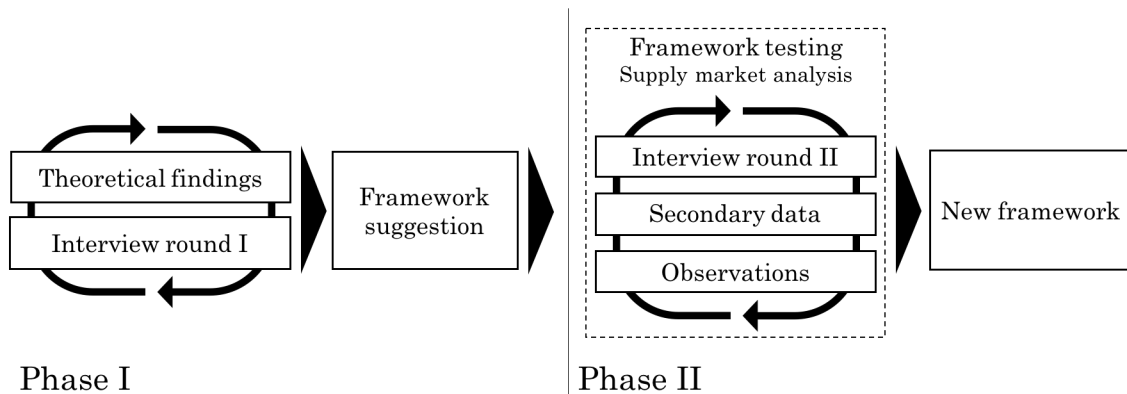


Figure 3.2: Illustration of the research process.

3.3 Abductive Approach

There are two generally known approaches for a research study, namely an inductive or deductive approach (Bryman & Bell, 2015). According to Spens and Kovács (2006), there is a third less known research approach namely the abductive approach. When following the abductive approach for a research process, empirical data and theory overlaps and results in a learning loop. The starting point in an abductive research process is always a real-life phenomenon or observation. The process of an abductive research approach follows the process *rule - case - result*. Spens and Kovács (2006) have developed a research process framework which clarifies the differences between the three research approaches inductive, deductive and abductive.

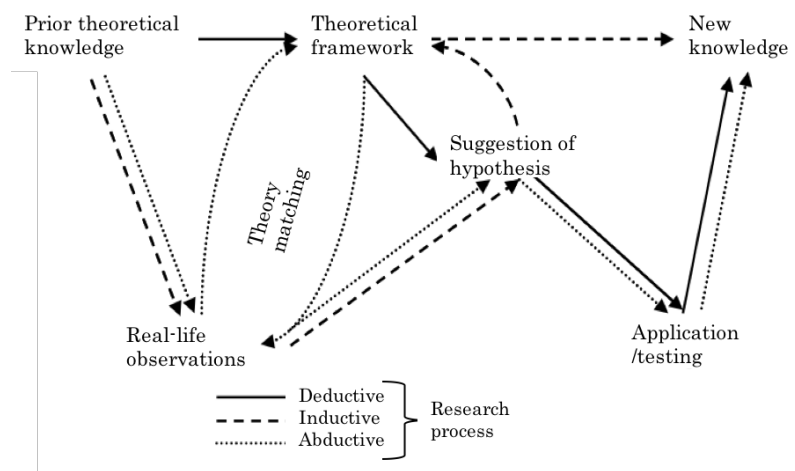


Figure 3.3: Illustration of the differences between the three research approaches (Spens & Kovács, 2006).

As illustrated by Spens and Kovács (2006) in Figure 3.3, all three research approaches start with prior theoretical knowledge. Next step in the abductive research process, is real-life observations which are followed by theory scanning. This initiates the iterative process where the researcher tries to find a suitable framework or to extend theory that has been used for the situation before. This iterative process is called ‘theory matching’ or ‘systematic combining’ and characterizes the abductive approach. Spens and Kovács (2006) also state that the aim of the abductive approach is to suggest new theories. This could for instance be hypotheses or propositions which have been tested before generalizing the theory as new knowledge.

For this study, an abductive research approach has been chosen. This is due to that the framework has been designed by using an iterative process. Secondly, the framework has been tested in order to find potential improvements of the framework design, and lead to new knowledge which is aligned with the principles of an abductive approach.

3.4 Qualitative Research

According to Bryman and Bell (2015), qualitative research emphasize words rather than numeric data compared to quantitative research. The focus of qualitative research is instead to generate and develop explanations of a specific phenomenon (Hammersley, 2013). Qualitative data is suitable when generating and developing explanations while quantitative data is better when testing pre-define hypothesis. Qualitative data can be collected through interviews, observations or written reports (Hammersley, 2013).

This thesis is focusing on qualitative data since the aim is to understand what the strategic buyers at Volvo consider as important in a supply market analysis of test equipment. Using a qualitative approach is therefore useful to make it possible to get open and explaining answers. Moreover, when applying the framework, opinions and experiences from industry experts, suppliers, researchers and Volvo employees, were taken into account making a qualitative approach suitable for this purpose as well. How the data was collected is explained in detail in Section 3.6.

3.5 Case Study

According to Bryman and Bell (2015) and Yin (1994), the case study strategy is widely used in business research. Bryman and Bell (2015) state that a case study entails a detailed analysis of a specific case. This could for example be a study of a single organization, location, person or event (Bryman & Bell, 2015; Robson, 2002). Saunders et al. (2008) state that this research design aims to answer research questions including ‘why?’, ‘what?’ and ‘how?’. This is due to that these questions often require broad and describing answers.

According to Yin (1994), there are several analytical techniques to use when performing a case study. One of the most common is pattern matching. Here the observed empirical data is related and compared to some theoretical proposition (Yin, 1994). Performing a case study benefits often from using qualitative methods such as unstructured interviewing (Bryman & Bell, 2015). This is due to that these methods is particularly helpful when aiming to get a detailed view of a certain case.

In order to design the framework in a proper way, a detailed understanding about what factors that are important to study was needed. How the factors are related to each other was also vital to understand in order to constitute the framework. As the strategic buyers at Volvo have experience in analyzing supply markets of industries similar to the market of test equipment, a case study at this department has been performed. Unstructured interviews with strategic buyers were conducted to get exploratory and detailed answers about how to perform the analysis. In addition to this internal documents at Volvo were also examined to facilitate for the understanding how to design the framework. Designing the framework to suit Volvo’s context enabled the authors to perform the market analysis from a Volvo perspective.

The case study at Volvo followed pattern matching as an analytic technique, where literature about supply market analyses were compared with data gained from the interviews. Here, similarities and differences between the two data sources were highlighted and discussed. By doing this, this research conducted a detailed supply market analysis framework for test equipment according to both the case study at Volvo and the theoretical proposition.

3.6 Data Collection and Analysis

Bryman and Bell (2015) refers to two different types of data, primary and secondary. Primary data is collected for the sole purpose of a research. Secondary data is referred to data collected by other researchers for other purposes (Bryman & Bell, 2015). For this study both primary and secondary data have been collected. How the data has been collected is explained in detail in this section. In the end of the section, a description of how the collected data has been analyzed is presented.

3.6.1 Primary Data

Primary data was collected in this study during two different interview rounds, which are shown in Figure 3.2. During the first phase of the study primary data was collected in order to build a foundation for the framework design. Primary data was also collected during Phase II with the purpose to analyze the supply market. The primary data during Phase I was only collected through interviews, while the second phase consisted of both interviews and observations.

According to Bryman and Bell (2015), interviews can follow three different structures: structured, semi-structured or unstructured. The semi-structured interviews are referred to “qualitative research interviews”. During a semi-structured interview the interviewer has a list of questions that should be covered during the interview, but these questions can vary from interview to interview (Saunders et al., 2008). The interviewer might also add additional questions in order to understand the answer more in-depth. During unstructured interviews the respondent has the opportunity to freely talk about one specific topic since the interviewer does not follow any question template. The interview should be guided by the interviewee’s perception in order to gain deep knowledge in one area.

The interviews performed during the first interview round were with senior strategic buyers at Volvo. In total, six strategic buyers that have several years of experience in this field were interviewed which were selected since they are working with indirect procurement. In addition to this, another criteria was that they should be used to perform supply market analyses. A majority of the respondents are working with the procurement of new technologies and those who work with other types of products were well informed about the context and what product the framework aimed to be adapted for. The structure of the interviews was unstructured where all interviews were initiated with one open question about what factors that are most important

3. Method

to take into account when analyzing this market. The interviews were face-to-face meetings and lasted for 30 minutes. The strategic buyers that participated and gave permission were audio-recorded. This was done during all interviews performed in this study.

The interviews performed during the second interview round had the purpose to both verify the secondary data from market reports, news articles and to get in-depth knowledge. In Table 3.1 the different groups and number of interviewees are presented.

Table 3.1: Number and type of interviews performed during the study.

Interview round	Interview group	# of interviews
Round I	Senior strategic buyers at Volvo	6
Round II	Suppliers of the test equipment	8
	R&D engineers at Volvo	3
	Legal expert at Volvo	1
	External product engineers	2
	Researchers in the test equipment at Chalmers	3

All interviews performed during the second interview round have been following a semi-structured approach. The interview templates that were followed can be found in Appendix A-D. The first group presented in the table is suppliers which consisted of eight different companies that supply the test equipment. A majority of the suppliers are located abroad, and therefore only one out of eight suppliers were interviewed face-to-face. Five out of eight suppliers were interviewed through online video calls while two suppliers answered the questions by email. The interviews lasted for approximately 30-45 minutes. Suppliers were selected and asked for participation in the study if they are developing or selling the equipment with right product features.

The R&D engineers at Volvo were interviewed face-to-face and the interview lasted for 45-60 minutes. The R&D engineers that were interviewed are working with the test equipment and are familiar with several of the suppliers. These engineers were selected because they are technical responsible for the orders of test equipment that the IDP department is sourcing. In addition to this, one legal expert at Volvo was also interviewed to get detailed information and verify secondary sources regarding external factors that affect the market. This person was frequently mentioned in news articles regarding the legal aspect of the test equipment and therefore contacted to participate in the research. This person was interviewed face-to-face and the interview lasted for 60 minutes.

External product engineers are engineers from another organization that are working with the test equipment. The engineers were interviewed to get technical information about the test equipment, suppliers and market trends. These interviews lasted for 45-60 minutes and were performed face-to-face or through online calls. These people were found when asking other interviewees about contact information to people that are experts in the field. The last group of interviewees is the researchers in the test equipment at Chalmers. The researchers were interviewed to get an understanding of the future development of the equipment. The interviews lasted for approximately 30 minutes and were performed face-to-face or through online calls. The researchers are working at Chalmers University of Technology and were selected since they are all doing research within technology linked to the test equipment.

In addition to interviews, observations were performed during Phase II in terms of site visits at test centers. During these site visits the test equipment was displayed and a person explained the equipment's functions. During the observations, additional questions were asked by the authors following an unstructured approach. The focus during the site visits was to understand the technical aspects of the equipment, but also to get insights into the supply market by asking questions regarding different suppliers.

3.6.2 Secondary Data

As earlier mentioned, secondary data is referred to data collected by other researchers for other purposes (Bryman & Bell, 2015) and often used in combination with primary data (Saunders et al., 2008). Saunders et al. (2008) also state that secondary data can be available in both written and non-written form. Secondary data in written form can be organizational documents, reports, emails and newspapers. Examples of non-written secondary data are audio- and video-recordings.

Secondary data was collected during the second phase with the aim to understand the supply market of test equipment. The different sources that have been used are market reports, news articles, company websites and video-recordings. Market reports written by consultancy firms and industry experts have been investigated to see what already is stated about this market. Since this market is rapidly changing, news articles have been helpful to find information about suppliers, such as new investments, acquisition or launches of products. When analyzing suppliers in detail, company websites and video-recordings of interviews with CEOs of the companies have been studied. To verify the collected information from the secondary sources, questions related to the findings were asked during the interviews performed during the second interview round. Secondary data was also used in Phase I where internal documents regarding how a supply market analysis should be structured according to Volvo were studied.

3.6.3 Data Analysis

Bryman and Bell (2015) state that when performing a qualitative research a huge amount of data is generated in the form of transcripts, documents and field notes. One common way to analyze this data is to use coding. This means that when the gathered data is reviewed, components that seem to be of significance are given codes or names. By giving different quotations codes, data could easier be compared and categorized. This technique was used during the study when analyzing the data from the interviews with strategic buyers at Volvo. When reviewing the transcriptions, different quotations were coded with the factor it was related to. This made it possible to understand what factors that were most important and why, but also what factors that were least important or not mentioned.

The data during the second round was collected and analyzed iteratively to apply early learnings later in the process. Throughout the study, weekly discussions and presentations with the responsible senior strategic buyers have been held, this in order to verify the hypothesis and findings. Since a lot of data was collected regarding the supply market, tables and charts have been created for the data that were suitable. This was done in order to organize and analyze the data. Examples of such information are the number of employees and patented inventions.

3.6.4 Quality Assurance

Bryman and Bell (2015) argue for two main principles when evaluating the validity and reliability of a study. In qualitatively studies these principles are known as authenticity and trustworthiness. The later can be divided into four different categories, which are; (1) confirmability, (2) credibility, (3) transferability and (4) dependability. In order to ensure confirmability and credibility in this study, triangulation by using several sources of data have been used. Transferability has been achieved by having a high level of documentation of data. This is data such as recording files and transcribing documents of interviews. Data about suppliers have been stored in document files, which continuously have been updated. The research dependability has been ensured by documenting all phases of the study and reporting process steps on a regular basis to supervisors both at Chalmers and Volvo.

3.6.5 Ethics

In research studies, it is of great importance to consider ethical aspects. To uphold an ethical standard in a research, Bryman and Bell (2015) argue for four different aspects that should be regarded; (1) harm to participant, (2) lack of informed consent, (3) invasion of privacy and (4) deception. In order to avoid harming the participant, the interviewees have been informed that no data or information that they consider sensitive will be included in the report. Since the master thesis is conducted in cooperation with Volvo, some information will be handled under confidentiality agreements. The report has therefore excluded confidential data from Volvo or any other company or institute being a part of this study.

Lack of informed consent has been avoided by informing interviewees about the purpose of this study and how their contribution will be used. By doing this thoroughly, the possibility of participants feeling deceived have been decreased. In order to avoid invasion of privacy, the participants in the study have been informed that they have the right to refuse to answer questions or being included in the study. When introducing an interview, all participants were asked for permission before audio-recording. The audio-recordings were transcribed directly after the interviews. In cases where the respondents refused to be recorded detailed notes were taken and directly transcribed after the interviews.

4

Volvo's View on Analyzing the Test Equipment Market

In this chapter the data collected from six interviews with strategic buyers at Volvo is presented. The factors that were highlighted during the interviews are divided into seven different groups, similar to the ones presented in the Frame of Reference. The chapter concludes with a presentation of the elements in the adapted framework, shown in Table 4.8.

4.1 Important Factors According to Volvo

This section is presenting the empirical findings from the first round of data collection. The groups presented are 'Market structure', 'Product characteristics', 'Competition', 'Supply chains', 'New markets and substitutes', 'Key supplier characteristics' and 'External factors'.

4.1.1 Market Structure

The interviews showed that two factors in the group 'Existing supply market' are more important to consider than others. The first factor is industry trends that was mentioned by three out of six respondents. The respondents argued that trends play a key role when understanding a supply market. Example of trends could be new characteristics in the market, company acquisitions or changes in manufacturing strategies. As stated in one of the citations shown in Table 4.1, the underlying factors that affect trends might be even more important to consider. Example of these underlying factors could be future regulations impacting the market from a legal or environmental perspective.

A second factor that was highlighted in the interviews was key suppliers. This factor was mentioned by two people where one stated that a key supplier investigation is one of the most important factors to consider in this type of market context. As the market consist of few players, it was argued to study these players as extensively as possible. When studying the key suppliers on the market, the employees emphasized the importance of understanding what industry the suppliers been in before. Analyzing this was argued to be of a dual purpose since both an understanding of the supplier could be achieved as well as new potential actors on the market could be predicted. More information to find when analyzing key suppliers have been grouped into a new group called ‘Key supplier characteristics’ which is presented in Section 4.6.

Table 4.1: Most important factors in the group ‘Market structure’ according to Volvo.

Factor	Citations
Industry trends	<i>“Trends is essential. We need to understand the trends but especially the underlying factors that affect the trends.”</i>
Key suppliers	<i>“For me the most important aspects to consider are trends, key suppliers and technical performance.”</i> <i>“We need to understand the suppliers and what industry they have been operating in before.”</i>

4.1.2 Product Characteristics

When analyzing answers from the interviews regarding the product characteristics, two factors could be identified to have high priority. The first factor considers product trends that were mentioned by two respondents. As the market is fast moving, not only trends on a market level but also on a product level should be examined. Moreover, it was stated that it is important not to be limited to understand the technology as it is today but also estimate its future potential. As seen in Table 4.2 one of the employees stated that understanding product trends is a mean of being up to date regarding the technology.

A second factor mentioned by five out of six strategic buyers at Volvo was the technical requirements. As emphasized in one of the citations, the test equipment consists of several complicated subsystems. According to this, knowledge about the technical requirements plays a key role when purchasing the test equipment. Therefore, this type of knowledge will also be essential when performing a supply market analysis in this context. The technical requirements defined by the technicians set the scope of potential suppliers to search for. Knowing what technical requirements to fulfill will therefore, in this case, be a critical activity when performing the supply market analysis. In addition to this, strategic buyers at Volvo stated that if technical requirements are not met by one supplier, the commercial requirements are not needed to be investigated.

Table 4.2: Most important factors in the group 'Product characteristics' according to Volvo.

Factor	Citations
Product trends	<i>"When trying to understand new technologies, product trends need to be evaluated. It is important to be up to date."</i>
Technical requirements	<i>"The most important factor is that the supplier is offering a product that meets the requirements."</i> <i>"We are working closely with the stakeholders to first understand the technical requirements."</i> <i>"This is a complex product. Understanding its different components and what materials it consists of is very important."</i>

4.1.3 Competition

Findings from the interviews show that studying other OEM’s activities is important when analyzing the test equipment market. A total number of five out of six respondents emphasized that competition is critical to understand. As stated in Table 4.3, it is of crucial importance to understand how other OEMs are working with testing these technologies, since this contributes to an understanding of industry standards. Moreover, one strategic buyer stated that this technology could not be developed by one single actor, but the industry as a whole. Therefore, a company needs to be aware of what activities other competitors perform.

When knowing which suppliers the competitors use it will be possible to understand how many OEMs that compete on the same supplier capacity. Volvo is a large actor but not the largest on the market, and therefore the suppliers capacity is important to consider since some suppliers tend to prioritize their largest customers. The interviews showed that supplier capacity could be investigated in this step when analyzing the competition, otherwise it can also be studied when understanding key supplier characteristics as presented in Section 4.1.6.

Table 4.3: Most important factors in the group ‘Competition’ according to Volvo.

Factor	Citations
Buyer competition	<p data-bbox="730 1093 1378 1279"><i>“Competition is important, we need to understand how the industry is working. Testing this technology is a critical activity. In the end, it’s the entire industry that will develop this, it cannot be done by one single actor.”</i></p> <p data-bbox="730 1305 1378 1375"><i>“It is of importance to know how many companies that want to buy from one specific agent.”</i></p> <p data-bbox="730 1402 1378 1471"><i>“When evaluating a supplier we ask what capacity they have available for us.”</i></p>

4.1.4 Supply Chains

The group 'Supply chains' was mentioned by two employees who argued that Volvo wants to buy products from the source and not use middlemen if possible, which is stated in Table 4.4. The strategic buyers at Volvo argued that suppliers who develop the products are most interesting. However, if they only sell through a middleman, Volvo does not have any other option than to buy from this source. One employee explained that the benefits of buying from the source instead of using a middleman are reduced costs and that communication can be handled more easily. Therefore, Volvo's supply chains are most of the time as short as possible in order to exclude non value-adding activities. According to this, the strategic buyers did not see an analysis of value-adding activities as a critical part of the supply market analysis.

Table 4.4: Mentioned factors in the group 'Supply chains' by Volvo.

Factor	Citations
Middleman	<p><i>"Volvo wants to buy from the source and if possible not use retailers"</i></p> <p><i>"We are trying to buy the test equipment directly from the supplier instead of sourcing from a middleman."</i></p>

4.1.5 New Markets and Substitutes

During the interviews, two respondents stated that it could be hard to find a substitute for this type of test equipment. The main arguments are that the technology is new both for Volvo and its suppliers. As stated in one of the citations in Table 4.5, the technology is in the early development stage and therefore it is seen to be too early to find substitutes.

Table 4.5: Mentioned factors in the group 'New markets and substitutes' by Volvo.

Factor	Citations
Substitute of goods	<p><i>"It can be hard to find substitutes of goods when it is a new critical product both for us and the suppliers."</i></p> <p><i>"Since this is a new technology it will be a bit too early right now to analyze substitute of it."</i></p>

4.1.6 Key Supplier Characteristics

Results from the interviews show that key supplier characteristics are important to consider. Since there are few existing suppliers on the market it is possible to analyze each supplier specifically. The factors that are of importance to study regarding the suppliers is company information, innovation level and company maturity. Four out of six respondents stated that company information was of importance. Company information includes an analysis of the supplier's ownership structure. The owner is an important stakeholder in a company, and therefore they will affect most of the strategic decisions. In addition to this, as illustrated in Table 4.6, some strategic buyers also stated that how the companies are working with CSR is important to consider. This is due to that Volvo do not want to collaborate with suppliers lacking this mindset. The global capacity of the supplier should also be investigated to understand if they can deliver to all sites.

As mentioned, the market of test equipment of new technologies is partly characterized by new suppliers that lack some commercial experience. According to this, it is very important to understand how mature a supplier is. As shown in Table 4.6, Volvo needs to know that they source from a company that will be in business in the future. According to this, it is of great importance to perform an extensive supplier evaluation and search for a supplier that meet, or has the potential of meeting, Volvo's requirements regarding delivery reliability, capacity and financial situation. One of the respondent also state that the company maturity can be analyzed by looking at ownership, number of employees and economical situation.

According to the citations in Table 4.6, it is essential to study the innovation level of the companies. A successful and innovative supplier know how to realize and transform smart ideas into business. Even though some suppliers are at the forefront of the technology solution they need to ensure they could commercialize their technical solution into a business.

Table 4.6: Most important factors in the group 'Key supplier characteristics' according to Volvo.

Factor	Citations
Company information	<p data-bbox="730 421 1380 566"><i>“When I choose which companies to start a dialog with I would look at the company structure. How does the organization look like, how do the companies work with CSR etc.”</i></p> <p data-bbox="730 595 1380 667"><i>“We focus on the global capacity of the supplier to understand if they can deliver to all our sites.”</i></p> <p data-bbox="730 696 1380 768"><i>“Moreover the owner structure of the companies is also important to consider.”</i></p> <p data-bbox="730 797 1380 869"><i>“Something that is important for us is the ownership of the company.”</i></p>
Company maturity	<p data-bbox="730 887 1380 1077"><i>“It is important to get a picture of how stable the companies are. We need to ensure that we source from a company we know will be in business in the future. In this case, it is more important than ever to perform an extensive supplier evaluation.”</i></p> <p data-bbox="730 1106 1380 1211"><i>“We are looking for a company that meet our requirements regarding for instance delivery reliability, capacity and financial situation.”</i></p> <p data-bbox="730 1240 1380 1386"><i>“Most of the times we want to ensure that the suppliers can supply in the long run, and see if it is possible to have a long-term collaboration with them and develop together.”</i></p> <p data-bbox="730 1415 1380 1518"><i>“To understand if a company is stable I’m looking at ownership, number of employees and economical situation.”</i></p>
Innovation level	<p data-bbox="730 1541 1380 1655"><i>“When sourcing from these companies, we need to ensure that they know how to realize and transform their smart ideas into business.”</i></p>

4.1.7 External Factors

Three external factors were highlighted during the interviews with the strategic buyers. These factors were political, legal and environmental, where each of them was mentioned by three employees respectively. Findings from the interviews show that these factors are important to consider in order to prepare for future changes in the external market. As stated in a citation in Table 4.7, Volvo has seen examples of that new political decisions have a direct impact on the testing of this technology. A recently taken decision by the government in Sweden, made it easier for an OEM as Volvo to perform the testing activity. This time the decision was beneficial for the testing activities but next time it might be the opposite. According to this, it is important to investigate and be up-to-date of current political discussions.

The respondents also stated that considering legal factors is especially important since this is a new technology. Right now the society and infrastructure are not developed to fully support this technology, it is therefore assumed to be new regulations to come. In addition to this, the environmental factor is very important for Volvo since this is one of their core values. Therefore, the employees stated that they want to ensure that their suppliers are working for a sustainable environment and thus following set regulations.

Table 4.7: Most important factors in the group ‘External factors’ according to Volvo.

Factor	Citations
Political	<i>“Political aspects are important in order to make infrastructure supportive for this technology. I know for instance that the Swedish government changed the regulation which made it easier to test cars.”</i>
Legal	<i>“Regulations are important to consider. We need to know and understand the responsibilities in the industry and how these are distributed.”</i> <i>“Legal is a critical part in the case of testing this technology.”</i>
Environmental	<i>“Sustainability is a very hot topic right now.”</i> <i>“Legal and environmental aspects are very interesting.”</i>

4.2 Proposed Supply Market Analysis Framework

In this section the empirical data presented in Section 4.1 will be analyzed and compared with the literature. By analyzing the findings from these two different data sources, a proposed framework for analyzing the supply market of test equipment for new technologies has been developed. The factors and elements included in the framework are presented in Table 4.8.

Table 4.8: Suggestion of an adapted supply market analysis framework for test equipment of new technologies

Group	Factor	Elements
Market structure	Industry trends	Changes in business environment and underlying factors that affect industry trends
	Key suppliers	Identifying the key suppliers
Product characteristics	Product trends	Future development of the product, changes in product features, design or material
	Technical requirements	Understanding the technology's functionality and how it should be tested
Competition	Buyer competition	Understand how other OEMs test the technology and number of buyers that want to buy from one supplier
	Supplier competition	Enter barriers and supplier capacity
Key supplier characteristics	Company information	Founded, Headquarter location, Number of employees, Ownership structure, Financial situation, Partnership, Customers, Market share and Product differentiation.
	Innovation level	Number of patented inventions
	Company maturity	Financial situation, Founded, Years until launching product and Number of employees
External factors	Political	Understanding what impact the governments have on the market
	Environmental	Environmental regulations and standards both in the industry and related to the technology
	Legal	Understanding current and future regulations

4.2.1 Differences to Literature

As earlier mentioned, the framework in Table 4.8 has its foundation in the literature and inspired by the frameworks focusing on factors presented in Section 2.2 (Lobermeyer & Kotzab, 2010; The State of Queensland, 2017). The main changes compared to the theoretical findings are that the groups 'Supply chains' and 'New markets and substitute of goods' have been excluded and a new group called 'Key supplier characteristics' has been added.

The group 'Supply chains' is excluded in the adapted framework, since the aim of the supply market analysis is to investigate suppliers that develop the technology and not retailers or distributors. During the interviews it were also stated that Volvo wants to buy directly from the source. The literature states that when understanding supply chains, value-adding activities should be identified in order to eliminate middlemen (The State of Queensland, 2017). If only technological companies which develops the product in-house will be analyzed, the need for identifying value-adding activities will not be necessary. The literature also states that the factor dependencies should be included in the group 'Supply chains' (The State of Queensland, 2017). This factor is instead included when finding company information about the key suppliers.

The group 'New markets and substitute of goods' was emphasized in the literature (Lobermeyer & Kotzab, 2010; The State of Queensland, 2017). During the interviews it was stated that it could be hard to find substitutes of goods for a new technology like this. The authors of this thesis agree and have therefore excluded this factor from the adapted framework. The scope of the supply market analysis is to analyze the global market and therefore all geographical markets will be included. Thus, the authors have chosen to exclude this factor and the whole group from the adapted framework.

From the interviews, it was understood that when analyzing the supply market for the test equipment of new technology, it is important to analyze the existing suppliers in detail. The reasoning behind this was that only a few suppliers are established on the market and also have a great impact on the overall market. Therefore, the authors of this report have chosen to add a new group of factors, 'Key suppliers characteristics', this in order to give these factors the right amount of attention during the analysis. As a result from a combination of interviews and literature research (Keith et al., 2015; Lobermeyer & Kotzab, 2010; The State of Queensland, 2017), this group will include the factors company information, innovation level and company maturity. The factor company information will consist of the key components of each supplier specifically. These are components concerning for instance the number of employees, headquarter location and financial situation. When studying what customers each supplier have, relationships and dependencies will also be analyzed since this is one thing that can affect potential future business for Volvo.

The maturity level was considered to be of great importance to understand according to the interviewees, since some of the suppliers available on the market are known to lack some commercial experience. The maturity level of the companies will be studied by analyzing the number of years each supplier been in business and how many or how far the supplier is to have products available on the market. The maturity level will also include an analysis of the companies' financial situation and number of employees. In addition to understanding the maturity level and key company information, the innovation level of the companies should also be studied. As stated by one of the employees, companies innovativeness can also be studied by investigating the number of patented inventions a company has.

4.2.2 Similarities to Literature

The remaining groups ('Market structure', 'Product characteristics', 'Competition' and 'External factors'), as depicted in Table 4.8, are similar to those found in the literature (Lobermeyer & Kotzab, 2010; The State of Queensland, 2017). However, the authors identified some discrepancies in the interviews on how to measure them in this context. The group 'Market structure' was highlighted both in literature (Keith et al., 2015; Monczka & Petersen, 2012) and during the interviews, where the factors market trends and key suppliers are included. Industry trends include changes in the business environment and things that affect the balance of supply and demand. In addition to this the supply market analysis will include an analysis of the underlying factors that affect industry trends. One factor stated in the literature which is not included in the new framework is the market size and market shares (The State of Queensland, 2017). The authors of this master thesis have chosen to include market share in the factor company information, which is included in the group 'Key supplier characteristics'. An estimation of the total market size will be done by accumulating each suppliers' market share.

The next group presented in the adapted framework is called 'Product characteristics'. As mentioned both in the literature (Lobermeyer & Kotzab, 2010) and in the interviews, product trends are important to consider and will therefore be a part of the this group. Product trends will in this case include how the key suppliers and the market in general want to develop the product. These are trends for instance in product features, design or material. Comparing to what was stated in the interviews, literature also emphasizes that product innovation should be studied (Keith et al., 2015; Lobermeyer & Kotzab, 2010). However, innovation as a factor was mentioned by the respondent but from a company perspective rather than a product perspective. According to this, the innovation level is included in the group 'Key supplier characteristics'.

Another factor, not mentioned in the literature but during the interviews is the factor of technical requirements. This factor was mentioned by more than 80% of the respondents. As the technology is complex it is more important than ever to understand how the technology works in order to see what test equipment that is needed. In the adapted framework, the technical requirements will be of a huge focus to get in-depth knowledge about the technology. The technical requirements include what technologies that are needed to be tested, how these technologies work and what test equipment standards that are needed to be considered. According to the literature, a supply market analysis should include a product life cycle consideration and a cost-price analysis (Jones & Barner, 2015; The State of Queensland, 2017). These factors have been excluded from the framework. This is due to that these parameters are already known by Volvo when the supply market analysis will be performed.

As stated in the literature, 'Competition' includes both supplier and buyer competition (Keith et al., 2015; Lobermeyer & Kotzab, 2010; The State of Queensland, 2017), while only the buyer competition was emphasized during the interviews with strategic buyers at Volvo. The authors of this master thesis have chosen to include both supplier competition and buyer competition in order to understand both supply and demand on the market of test equipment. For a market with few suppliers and higher demand than supply, it is of importance to understand the supply competition. One of the reasons why the supply competition was not mentioned during the interviews at Volvo could be that competition is generally related to competition from a horizontal rather than a longitudinal perspective. When analyzing the buyer competition, the aim is to understand how many that want to buy from the same supplier but also to see if other actors use a different method to test this technology. The purpose of investigating the supply competition is to find enter barriers, which gives an understanding of the possibility of new suppliers on the market. This affects the supply capacity which also should be included when investigating buyer competition.

According to the literature the group 'External factors' can be analyzed by using the PESTEL framework which includes six different factors (Keith et al., 2015; Lobermeyer & Kotzab, 2010; The State of Queensland, 2017). During the interviews with Volvo, three of these were mentioned as important to understand to get a total picture of the supply market. The authors have therefore chosen to include the three factors that were highlighted during the interviews, which are *Political*, *Legal* and *Environmental* context factors. These factors include understanding current and future regulations, as well as the government policies and its future change. The environmental regulations or standards in the industry and its future development should be investigated in order to have the possibility to adapt to these. The other factors, *Technological*, *Economic* and *Social* factors have been excluded from the adapted framework, since they were not emphasized during the interviews.

5

Supply Market Analysis of Test Equipment

This chapter consist of findings from the supply market analysis of the test equipment. The chapter is following the structure as the proposed framework presents in Table 4.8 and summarizes for instance market and product trends, key suppliers and competitors sourcing choices.

5.1 Market Structure

The first group that has been analyzed is 'Market structure', which includes the factors market trends and key suppliers. Identifying industry trends are according to Monczka and Petersen (2012) to find patterns in the market, which contributes to an understanding how the market will develop. During the supply market analysis, three different market trends were identified. These were found through interviews, news articles and consultancy reports.

Trend I: Growing Market

The market for this technology and its related test equipment is expected to grow rapidly the upcoming years. This is a trend verified by a raft of involved actors, including both industry experts, suppliers and engineers at Volvo. Several market experts have projected a rapid revenue growth on this market and the expectations are high among the actors involved. The development of the technology is in its beginning and only the first versions of the product have reached the market. Several of the suppliers are now working on prototypes that will reach the market in a very near future. In Figure 5.1 the predicted revenue growth for the technology which the test equipment are used for is illustrated. As it can be seen in the graph, the market expectations for the technology are high and the average growth rate annually between 2018-2024 is estimated to be approximately 150%. The market growth can also be illustrated by showing the number of patents related to the test equipment. As illustrated in Figure 5.2, the number of patented inventions have also had a clear trend the recent years where the number increased by 570% between 2006-2017.

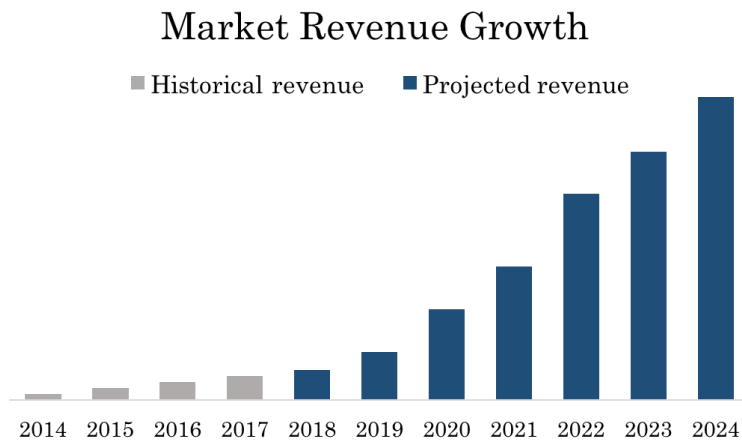


Figure 5.1: Historical and projected market revenue for the technology which the test equipment is used for.

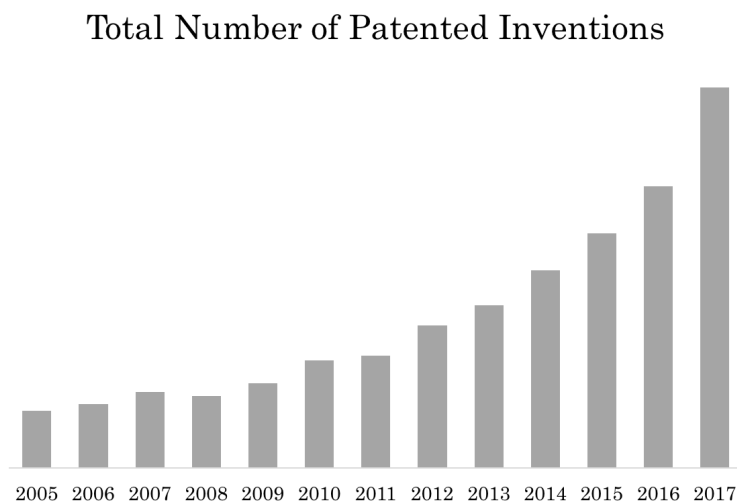


Figure 5.2: Total number of patented inventions for the test equipment.

The reason why several new companies enter this market is the attractiveness of the market, characterized by high demand and low supply. Furthermore, the price competition has historically been very low since only a few suppliers have been able to produce the test equipment with the right quality. According to this, the suppliers on the market have had the opportunity to charge a high price, attracting more actors to enter the market. The new actors that are entering the market are mainly concentrated to start-ups, where some founders have previous experiences from operating in the automotive industry, while others have been active in other markets. Through the interviews with industry experts and suppliers, it has been shown that the actors that earlier have not been active in the automotive industry are lacking important experience, which is related to the next industry trend.

Trend II: Increasing Power of Tier-1 Suppliers

Another identified trend is that the role of Tier-1 suppliers is getting more important in the supply chain. This trend was mentioned during the interviews where partnerships and strategic investments between Tier-1 and Tier-2 suppliers were declared. The Tier-1 suppliers refer to suppliers that supply directly to the automotive OEM. Tier-2 suppliers are instead selling their products to the OEM through Tier-1 supplier. Most of the Tier-2 suppliers are start-ups and therefore lack experiences from selling to the automotive industry and also commercial practices. According to this, several Tier-2 suppliers have started to collaborate with Tier-1 suppliers that have direct contact with automotive OEMs. These Tier-1 suppliers have been selling to automotive companies before which enables them to contribute with their commercial and industry knowledge, while the start-ups are responsible for the technical development. Furthermore, Tier-1 suppliers have also realized the opportunity to enter the market and develop the product by themselves. According to this, several Tier-1 suppliers have not only started to establish partnerships but also to acquiring Tier-2 suppliers.

Trend III: Partnerships Constellations

As previously stated, it is common that the Tier-1 suppliers both acquire and partner with Tier-2 suppliers. However, this is the case also for the automotive OEMs. By doing this, the OEMs can affect how the equipment is designed to suit their context and also choose to produce the test equipment in-house. Producing the equipment in-house makes it possible for the automotive manufacturers to both ensure product quality and secure future supply of the equipment. According to that manufacturers and Tier-1 suppliers are contributing to various partnership constellations on the market, several suppliers and market experts believe that the market environment will change the coming years. As more start-ups are acquired and partnered with, the market will go from a high number of small actors to be concentrated to fewer larger players instead. According to this, it is very essential to understand which supplier that collaborates with who in order to project the future market.

Key Supplier Identification

According to Zsidisin et al. (2015), key suppliers and their role in the market should be identified when performing a supply market analysis. In order to find the key suppliers for the test equipment market, the authors have been analyzing information from news articles, interviews and market reports. The different factors that have been taken into consideration are the maturity of the company, their technical performance and innovation level. In addition to this, the input from suppliers when answering who they consider as their main competitors have also been contributing to identifying five key suppliers.

Table 5.1: Description of the five identified key suppliers.

Supplier	Description	Supplier type	Supply chain role
<i>Alpha</i>	A start-up that entered the market the same year as Gamma. Will launch their first product this year.	Technical start-up	Tier-2 supplier
<i>Beta</i>	The first supplier that entered the market. Have been a industry standard for the market and active on another market before entering this market.	Established supplier	Tier-2 supplier
<i>Gamma</i>	A start-up that entered the market the same year as Alpha. Producing prototypes.	Technical start-up	Tier-2 supplier
<i>Delta</i>	Have been selling other products to the automotive industry and entered the market by partnering with a Tier-2 supplier.	Middleman	Tier-1 supplier
<i>Omega</i>	The newest supplier on the market. The founders of this start-up had experience from working with this equipment in another industry. Producing prototypes.	Technical start-up	Tier-2 supplier

As illustrated in Table 5.1, the key suppliers have been chosen to be named Alpha, Beta, Gamma, Delta and Omega. Historically supplier Beta has been the market leader for many years and was entering the market years before their competitors. According to this, Beta’s first product launch has been used as an industry standard for the market. The OEMs have been forced to purchase the product developed by Beta since this was the only option. Because of these circumstances, Beta was first identified as a key supplier by the authors. The four other companies were identified since they were mentioned most frequently in market reports and news articles. Furthermore, these suppliers were also stated to be the key suppliers during the interviews.

Three of the suppliers, Alpha, Gamma and Omega, are start-ups and have less experience from the automotive industry compared to Delta and Beta. Supplier Alpha will launch their first product during this year while Gamma and Omega still only produce prototypes. The recent years Alpha, Gamma, Omega and Beta have gained attention in media regarding investments and established partnerships. Supplier Delta is a company that has been active in the automotive market before and supplying other types of technologies. When this market started to grow, Delta decided to enter the market by initiating a partnership with a start-up that had the technical knowledge Delta needed. All five key suppliers will be described further in Chapter ‘Key supplier characteristics’.

5.2 Product Characteristics

According to Lobermeyer and Kotzab (2010), the characteristics of the product are important to understand and investigate. When analyzing the technical requirements of the test equipment, site visits at Volvo and interviews with Volvo employees were performed. The technical features of the test equipment have a long history of usages in other industries before they were used in the automotive. The version of the equipment used in the automotive industry is more complex than the versions used in other industries. Because of the complexity, Volvo had to spend years to set the technical requirements for the test equipment. The test equipment for the technology is in general terms equal to the technology itself. The difference between the technology and its test equipment lays in the overall product complexity and performance. In order to test the technology successfully, the test equipment has more strict requirements in terms of accuracy and capacity. Despite requirements concerning the performance of the equipment, the test equipment needs to have a convenient design concerning size and form. This is necessary to make it possible to use the test equipment in different conditions and environments.

When analyzing the product characteristics, three different trends were identified. According to Lobermeyer and Kotzab (2010), product trends is important to examine in order to understand how these influence the product and its future development. When determining the product trends, information was gathered through interviews, site observations and market reports. The three identified trends are decrease in price, change in product characteristics and development of unique solutions.

Trend I: Decrease in Price

An emerging trend is the decreasing price. As the number of suppliers to enter the market is expected to grow, competition among suppliers will increase and the price for the equipment is therefore estimated to decrease. The automotive industry is characterized by large volumes, making it a favorable industry to supply and room for achieving large economics of scale. Moreover, the automotive OEMs have strict requirements regarding the price of the equipment. Therefore, the price is also estimated to decrease as a result of requirements from the automotive OEMs.

Trend II: Change in Product Characteristics

Another trend characterizing the product development concerns how the test equipment works. A clear trend in the supply market is to develop test equipment with new characteristics. These characteristics differ from the current product but are similar to the very first product generation. The difference is that the new test equipment consists of additional incremental innovations, enabling the equipment for instance to be smaller in its size, but with the same accuracy. By developing the test equipment similar to before it is also proven that both the price can be reduced and higher product performance reached. According to this, the trend in decreasing price is also related to the change in product development.

Trend III: Development of Unique Solutions

As earlier stated and illustrated in Figure 5.1, the market for the test equipment is continuously increasing. Since new suppliers that enter the market want to differentiate themselves from established actors, a more diverse option of test equipment will be found in the future. The elementary technology that the test equipment consists of is in general simple. However, the automotive industry is requiring high product performance since insufficient quality of the test equipment can cause harm to the society. These requirements result in that the test equipment is highly complex, even though the product builds upon a simple technology. In addition to this, the automotive OEMs also requires a low price which leads to that suppliers are looking for unique product improvements. Therefore, an identified trend is that actors on the market have their own solution, making the market consist of several types of variations of the test equipment that often also is protected by patents.

5.3 Competition

As earlier emphasized by Lobermeyer and Kotzab (2010), competition is important to consider when performing a supply market analysis. Lobermeyer and Kotzab (2010) also state that when analyzing the competition on the market, both supplier and buyer competition should be included. The findings from the supply market analysis regarding competition will be presented below.

Supplier Competition

Stated by The State of Queensland (2017), the competitive landscape among suppliers is defined by the number of suppliers and the characteristics of the barriers to enter and exit the market. When identifying the number of suppliers on the market, data was gathered through market reports and interviews with suppliers. Today, more than 60 suppliers are measured to be present on the market were 50 of these suppliers were founded during the recent years. A large portion of the suppliers that recently entered the market aim to either supply a Tier-1 supplier or become one itself.

The technology used in the test equipment has been used in several types of industries before. Because of the product complexity, the entry barriers for this market is mainly related to technical research and development. Since the automotive industry is complicated to supply, the suppliers of test equipment have to understand principles and requirements for the automotive industry. To reach these specific requirements is challenging, making the role of Tier-1 suppliers critical and the barriers for a Tier-2 supplier to become a Tier-1 high.

Buyer Competition

As stated in the interviews with strategic buyers at Volvo, competition from other OEMs is important to consider when understanding the supply market. When studying how other OEMs source this product, news articles and market reports were studied. As most of the suppliers are immature in its business development, many suppliers offer prototypes rather than test equipment directly off the shelf.

In order to get the test equipment, OEMs are encouraged to join a partnership, promise to buy a certain order batch or invest in the suppliers to make it possible for them to develop and manufacture the products. According to this, there is not only a trend that Tier-1 suppliers invest in Tier-2 suppliers, but this is also done by several OEMs. By doing this, the OEMs could ensure right quality and design of the equipment and at the same time contribute to the development of the suppliers. Another activity explained during the interviews is that several automotive manufacturers not only invest but acquire Tier-2 suppliers. By doing this, the OEMs have the goal to develop own test equipment in-house and thereby ensuring the future supply of the equipment and minimize cost.

Summarized in Table 5.2 is the key suppliers and nine automotive manufacturers. The table illustrates which of the key suppliers the OEM's are using to source the test equipment. Some of the OEMs are also having partnerships with other suppliers which are not included in the table. The nine OEMs are all selling high-end vehicles and hence competing with Volvo. The table shows that all OEMs use Beta except from OEM 1. The reason for this is Beta's early product launch. Except supplier Beta, the choice of supplier tends to be quite dispersed among the manufacturers. As seen in the table, OEM 6 and 9 only collaborates with one of the key suppliers. Both OEM 5 and 6 have chosen to acquire one supplier each. By doing this, both of these suppliers aim to produce the test equipment in-house and are therefore not in need to collaborate with any other supplier except Beta. The reason why OEM 9 do not collaborate with any other supplier except Beta, is due to that this manufacturer does not believe in this type of test equipment when testing the technology.

Table 5.2: OEMs choice of the key suppliers.

	OEM 1	OEM 2	OEM 3	OEM 4	OEM 5	OEM 6	OEM 7	OEM 8	OEM 9
Alpha									
Beta									
Gamma									
Delta									
Omega									

As illustrated in Table 5.2, key supplier Alpha and Omega only collaborates with one OEM each. Alpha is supplying their products to several of low-end instead of high-end automotive manufacturers. As the table only illustrates the direct competitors, all Alpha's customers are not shown. In addition to this, Alpha is active in other markets and thus supplying their products to other industries except from the automotive. The reason why Omega only has one OEM as a customer is due to that this supplier has not started their full-scale production yet. However, Omega is still collaborating with several Tier-1 suppliers to develop their products.

5.4 Key Supplier Characteristics

As earlier mentioned in this chapter, five key suppliers have been identified during the supply market analysis. The information about the key suppliers were collected through interviews, news articles and market reports. These suppliers will be described further in this section and also compared to each other. This will be done in order to understand how the market is structured today and how it is predicted to develop in the future. The three factors from the supply market analysis framework that are included in the group ‘Key supplier characteristics’ are company information, company maturity and innovation level. Company information will first be presented and from this, the company maturity and innovation level will be derived. A short description of the key suppliers can be found in Section 5.1.

Founded

As earlier mentioned, several suppliers have entered this market the most recent years. This can also be seen when investigating the key suppliers. Alpha and Gamma were founded the same year, only a few years from now, while supplier Omega has been founded most recently. The Tier-1 supplier Delta has been in business for many years but entered this market approximately at the same time as the other three suppliers by initiating a partnership with a Tier-2 supplier. Beta was founded years before the other four suppliers started to develop their products, and is the company that has been active in the market for the longest time.

Geographical Location

The geographical location of the headquarters of the key suppliers have been studied. A majority of the suppliers are located on the west coast of North America while the others are located in Europe. One reason why many suppliers are located in North America is the product characteristics. This is due to that a high technology product benefit from being in a location where a lot of technological innovations take place. The geographical location of the other suppliers are dependent upon the company’s history.

Number of Employees

In order to get an understanding of the size of the different suppliers, their number of employees are illustrated in Table 5.3. Delta is not included in the table since they are offering a lot of different products and services resulting in a high number of employees. According to this, it would be misleading to compare the number of employees at a Tier-1 company with a Tier-2 company. What could be seen in Table 5.3 is that Beta has the highest number of employees and one reason could be that they have been on the market for a long time. Beta has also been active in another market before they entered this market, which also can affect the number of employees. Alpha and Gamma have been on the market for approximately the same time, and this could be the reason why they have a similar number of employees. Omega on the other hand, has least employees which could be related to their late entrance on the market.

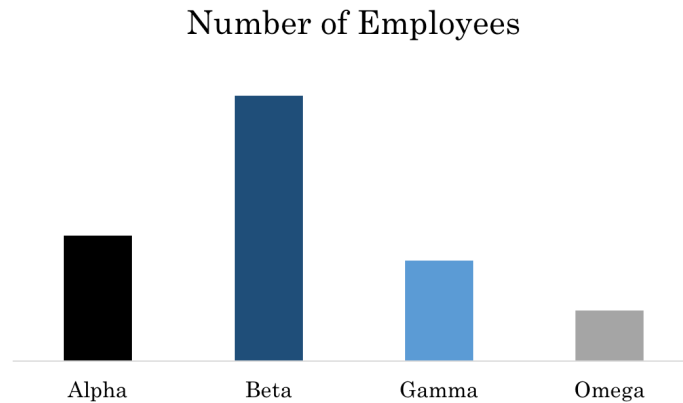


Figure 5.3: Number of employees among the key suppliers.

Ownership

The ownership structure of the suppliers differ and are dependent on the characteristics of the company. The start-ups are privately owned while Delta is listed on the stock exchange. Gamma and Omega are owned by the founders as well as Beta. Beta has recently sold some of the shares to external actors since financial investments were needed. However, in some news articles there are speculations regarding that Beta is expected to be listed in a near future.

According to industry experts and suppliers that were interviewed during the market analysis, the ownership structure for the actors on this market will probably change the upcoming years. The market consist of many start-ups that are privately owned. As mentioned, industry experts and suppliers expect that these types of actors most likely will be acquired by automotive OEMs or a Tier-1 supplier. The authors of this study have seen that these types of activities have already started to happen and the market will probably therefore be concentrated to fewer larger actors instead, listed or owned by large corporations.

Financial Situation

One of the most important factors for a start-up to get successful is to ensure financial support. Investments are also an indicator that people believe in the company and the business idea. Therefore, the recent funding for the key suppliers are illustrated in Figure 5.4. Delta is not included in the diagram because they receive outside investments differently since they are listed and can not be compared to investment rounds performed by start-ups. As can be seen in Figure 5.5, supplier Beta have reached the highest total funding, while supplier Gamma has the lowest amount. As earlier mentioned supplier Beta was active on another market before entering this market. This could be the reason why they have not searched for external fundings before period 4. However, since the market is growing fast and the competition increases, Beta has been in need for additional investments.

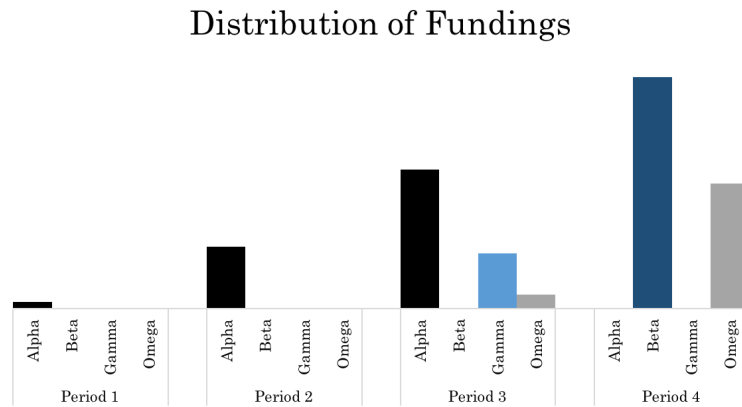


Figure 5.4: Fundings between Period 1-4.

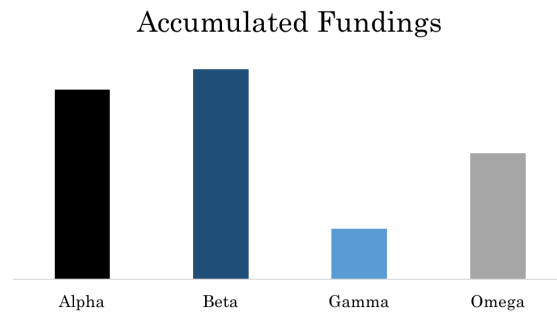


Figure 5.5: Accumulated funding between Period 1-4.

Illustrated in Figure 5.4, Alpha started their search for external fundings already in time period 1, before the other suppliers. This has resulted in the second highest accumulated fundings. Gamma, on the other hand, has only had one funding round, which have resulted in the lowest accumulated investment. Supporting a start-up can also be done in different ways than financial support for example by promising to buy a specific order batch when the product is launched or initiating a partnership to develop the product together.

Partnership

As earlier mentioned, there are a lot of partnerships established on the market. Earlier explained are the partnerships between Tier-2 suppliers and automotive OEMs or Tier-1 suppliers. In Table 5.3, two other types of partnerships are illustrated. These partnerships concern the development of components or manufacturing of the test equipment. Several suppliers on the market partner with manufacturers that perform the electronics and mechanical assembly of the test equipment. Moreover, some suppliers also partners with companies that offer complementary solutions, similar to vendors who offer components to the test equipment. As seen in the table, both Alpha and Omega have initiated a partnership with the purpose to make it possible to manufacture their components. In contrast to this, Delta manufacturers their products in-house but with support from a partner who develops some components of the equipment. As can be seen in the table, a majority of the suppliers

aim to develop their equipment in-house. Two of these, Beta and Delta are also the only ones that launched their products on the market. The reason why Alpha and Omega established manufacturing partnerships is to reduce their time to market.

Table 5.3: A summary of different partnerships on the market.

Partnership	Automotive OEM	Tier-1 supplier	Components	Manufacturing
Alpha				
Beta				
Gamma				
Delta				
Omega				

Customers

Customers of the key suppliers are present in several industries. Three out of the five key suppliers are only selling to the automotive market and two suppliers are selling to three other industries as well. However, what is common for the suppliers operating in several industries is that the automotive industry stands for the largest share of the customer base. The reason for this is that the need for test equipment in the automotive market is continuously increasing and that the test equipment in this industry has a more central role than what their products have in the other industries they are supplying.

Market Share

Market share of each supplier are hard to estimate since this market is under development and some of the suppliers have not launched their products to the market yet. What has been seen during the supply market analysis is that a majority of the interviewees argue that supplier Beta has been market leaders since they entered the market. However, when supplier Delta entered the market with a completely new version of the product they have, according to news articles and experts, been the market leaders since then. However, in the industry there are diverging opinions regarding if Delta's version of the test equipment is the future generation or not.

Product Differentiation

As earlier mentioned, the way to manufacture and develop the product differs between the actors on the market and in turn also the key suppliers. As illustrated in Table 5.3, some of the key suppliers' partners with other actors to make it possible to manufacture their products. Another approach used by some of the key suppliers is to develop the test equipment from scratch. By using a bottom-up approach, it is possible for the suppliers to ensure both in-house knowledge and production control. This can be seen to be especially important in a market with intense competition. Today, there are only two of the key suppliers that are able to not only manufacture prototypes but produce the equipment in large volumes. However, due to the fact

that the market is dynamic and fast developing, the other three key suppliers are estimated to produce test equipment for several automotive OEMs in the near future.

The suppliers of test equipment can be divided into two different groups depending on the performance of the equipment. One group is focusing on develop high-quality equipment with high accuracy, while the other focus on lowering the price. As earlier mentioned, one of the market trends is the decrease in price, but for the high quality equipment this has not been the case, rather the opposite. However, industry experts are expecting that the reduction in price for the standard equipment will in the future also affect the equipment with high quality. As the sales volumes increase and the technology develops, it will be possible for the suppliers to produce the high-quality products at a lower cost as well.

Innovation Level

As shown in the proposed framework in Table 4.8, the strategic buyers at Volvo recommended that the innovation level should be determined by studying the number of patented inventions. Therefore, the number of patented inventions are illustrated in Figure 5.6 to compare the innovation level of the key suppliers. As seen in the figure, the number of patents varies between the different actors, where Delta has a much higher number than the other suppliers. The reason for this is that this supplier is not limited to work with this technology, and therefore have patented inventions for several other products as well. When collecting this data, only the department responsible for this technology have been included instead of the whole company. Despite this Delta have a higher number of patented inventions than the rest.

Beta has the second highest number of patented inventions and could therefore be seen as the most innovative supplier together with supplier Delta. However, during the supply market analysis a correlation between the number of patented inventions and years since founded was identified. Suppliers with more years of experience tend to have more patents. The reason for this might be that the application period for a patent to be approved requires time, thus explain why suppliers that been active longest time on the market also have the highest number of patents. As illustrated in Figure 5.6, Supplier Omega has least number of patented inventions and this is also the supplier that most recently entered the market.

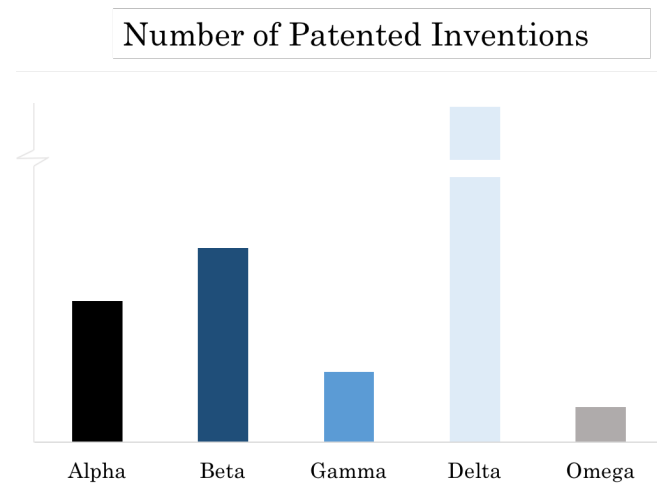


Figure 5.6: Distribution of Patents.

When analyzing the number of patented inventions each supplier has, the geographical spread was also recognized. In Figure 5.7 the geographical spread is illustrated of the patented inventions for the five key suppliers. As can be seen, the patents are concentrated to be active in similar areas of the world. As illustrated in the picture, all suppliers have active patents in the US. In addition to this, Beta and Delta also have patents active in China and Delta also in some other countries in Europe.

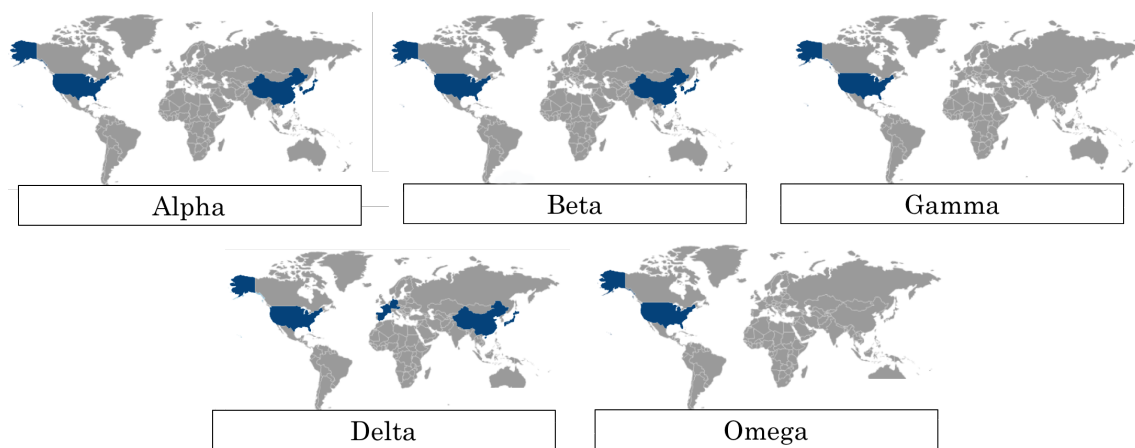


Figure 5.7: Geographical distribution of patents.

Company Maturity

To sum up the Section 'Key supplier Characteristics', an analysis of the key suppliers maturity level will be performed. As shown in the proposed framework in Table 4.8, the maturity level is determined by studying several elements such as when a company is founded, their financial situation, years until product launch and the number of employees. This information have been presented above and here follows a combined analysis of the information. What earlier has been stated is that Beta and Delta were the first to be founded and thus also first to launch their products on the market. In addition to this, they have a stable economic situation, where Beta has gained the highest amount of funding as illustrated in Figure 5.5 and Delta gets

external financial support by being listed on the stock exchange. Delta and Beta have also shown to have the highest number of employees which indicate a high mature level. When combining all this information, it can be said that Beta and Delta have the highest maturity level among the key suppliers.

Supplier Alpha and Gamma can be seen to be at the same level of maturity. These two suppliers were founded the same year and they are also projecting to start their full-scale production in the same time period. The supplier that can be seen to be less mature among the key suppliers is Omega. This supplier has the lowest number of employees and was founded most recently. In addition to this and contrast to the other suppliers, Omega is expecting to start to produce their products in a more extended time perspective from now.

5.5 External Factors

The last group that has been analyzed is 'External factors'. This group includes the factors political, legal and environmental. According to Lobermeyer and Kotzab (2010), external factors have a considerable impact on a market, and are therefore of great importance in a supply market analysis. The findings from this analysis will be described in the following section. This data was collected through interviews with suppliers, news articles and a comprehensive interview with an expert in the field.

Political

The first factor that was analyzed concerns how governments are affecting the test equipment market. Today there are different regulations regarding how the testing activities can be performed, and they differ a lot between different countries around the world. One country where most of the testing activities are permitted is the US. This is due to that everything that not is stated as explicitly illegal is legal in the US. China, on the other hand, is a country where it is challenging for OEMs to perform any testing. Right now only one company have received permission to perform these kinds of activities in China. In Sweden, the test activities are permitted but everyone needs to get permission from the Swedish Transport Agency before initiating any testing of the technology. According to several experts, there is a need for establishing regulations on an international level in order to catch the fast technological development. Automotive manufacturers are not letting the technology development be affected by the outdated regulation systems, but see the regulations as a hindrance for innovations to reach the market.

The regulations for the countries in EU is set by UNECE Sustainable Transport Division, which has representatives from different countries around EU. One challenge mentioned during the interviews is that some of the representatives in this group do not have the technical knowledge. In addition to this, some countries represented in the group do not have automotive manufacturers in their country. Therefore, some automotive OEMs are disgruntled that the authorities are lacking insight about the technology and thereby mainly influenced by what is reported in the news.

Legal

The next factor that has been analyzed is the legal aspect. This factor is strongly correlated to the political aspect since governments have a huge impact on the legal systems around the world. Most of the regulations in the field of the transport sector were set before the automotive market started to undergo the current innovation changes which are mentioned in the introduction of the thesis. Therefore, several of the regulations are not adapted to the cars that are under development today. One of the reasons why regulations systems are lagging behind is because it is hard to set rules for a technology that have not been launched yet.

When operating in the automotive industry, there are many regulations and standards to follow. All OEMs have chosen to follow several different ISO-standards which today are seen as a norm in the automotive industry. In addition to this, the OEMs only source products from ISO-certified suppliers. There are some general ISO-standards that apply to the vehicle in general, while others are more specific for the equipment used when testing this technology. A particular regulation affecting the testing process was mentioned during the interviews. This regulation was established in order to control that the testing will not cause any harm to the surroundings. This regulation is new to follow for the automotive industry, since it is specific for this type of test equipment.

Environmental

The third external factor to consider is the environmental factor. According to literature this factor arose because of concerns for the natural environment, which sometimes is called the 'green issues' (Cadle et al., 2010). There are many environmental regulations that the OEMs need to follow, and customers are also requesting greener products. When asking the interviewees about what environmental factors that affect this test equipment, it was stated that the OEMs should follow the general factors since there is no specific factors for this equipment. The concern for the environment can also affect the access of some resources. During the interviews, the suppliers mentioned that because of increase in demand for the equipment, the availability of some components are low. Some natural resources are limited and when the demand for the equipment increases, some rare material that are included can become a scarce resource.

6

Discussion

This chapter starts with a discussion of the findings from the supply market analysis and the proposed framework that was used. This is followed by presenting the design of the final framework for analyzing the market for test equipment of new technologies. The chapter is finished with an evaluation of two possible strategic sourcing options for Volvo to select.

6.1 Characteristics of the Supply Market of Test Equipment

As mentioned earlier, the purpose of a supply market analysis is to identify market characteristics for specific goods or services (The State of Queensland, 2017). After performing the analysis of the supply market for test equipment, characteristics of the market have been identified and some of these will be discussed below.

During the supply market analysis, it was found that the market for test equipment is dynamic regarding growth in the number of suppliers and fast technology development. Suppliers try to find new innovations in order to differentiate their offering among each other. The increase in patented inventions during the last years is one of the indicators for this trend. According to Ferreira and Serra (2010), markets that consist of companies that race to launch innovations and want to differentiate themselves from competitors are related to emerging industries. An emerging industry consists of products that are in the early stages of the product life cycle (Ferreira & Serra, 2010). In the introduction and growth stage of a product, sales and profit are very low but increasing. Since the market of test equipment is characterized by innovations and technology development, this market is in the early stages of the product life cycle, which can be related to what literature refers to an emerging industry.

Another trend that was identified during the analysis is that the market is predicted to grow rapidly. The main reason behind this is that the equipment can be used both as test equipment and in production cars. Today the equipment is mainly used as test equipment, but industry experts believe that it will be a part of every new car produced in the future. As a result of this, the potential purchased volumes will most likely increase over the upcoming years. A growing market with high growth expectations attracts new suppliers, which was another identified trend during the supply market analysis. A strong majority of these suppliers are start-ups. The reason behind this could be that the product innovation have been derived from and managed by these companies.

According to Braunerhjelm, Eklund, and Henrekson (2013), established companies that develop new product innovations tend to compete with their current product portfolio. This can result in that their will of creating new innovations sometimes is diminished. According to Feinleib (2012), one of the key success factors for start-ups is to be risk-taking instead of being comfortable in their way of doing business. This might explain why start-ups is seen to be more willing to take risks, by investing in technological development before knowing about a future market. As the market has been growing and starting to get more mature, several Tier-1 suppliers have also entered the market. Their entrance have been made by either partnering with or acquiring a start-up. By doing this, the Tier-1 suppliers could reduce time to market and eliminate some risks regarding the technology development.

As more Tier-1 suppliers enter the market, the characteristics of the market are predicted to change. The Tier-1 suppliers are, in this case, larger market players than the start-ups. As already seen and estimated to continue, the start-ups will probably merge with, or be acquired by a larger player. As a result of this, there is a chance that the market soon will consist of fewer start-ups and more Tier-1 suppliers. According to Gorden, Calantone, and Di Benedetto (1991), a mature market is characterized by stability regarding for example a stop in the number of competitors entering or leaving the market. When Tier-1 suppliers get more powerful in the market, the possibility for new actors to gain market share will be reduced. This is because it is hard for a start-up to compete against more established actors. The new merges on the market could be an indication that the market is in its early movement towards what Gorden et al. (1991) refer to a mature stage.

When a market reaches the maturity stage, it is according to Ferreira and Serra (2010) characterized by cost-based strategies by the suppliers, this is because it is harder to differentiate the product. This also affirms the trend identified during the supply market analysis that the price of the test equipment will be reduced in the future. Furthermore, Gorden et al. (1991), state that another characteristic of a mature market is that there is a stagnation of the technology development of the products. Therefore, suppliers will produce standardized products which will make it harder for buyers to get them customized. Gorden et al. (1991) also state that mature markets are having less customer-supplier interactions which are a result of the stagnated technology development. Lack of interactions between buyers and

suppliers will make it harder for buyers to preserve a close collaboration with the suppliers. One of the identified trends during the supply market analysis concerns the partnership constellations on the market. As the market for test equipment is starting to move towards a more mature stage, challenges for buyers and suppliers in preserving these partnerships will arise.

6.2 A Suggested Framework for Supply Market Analysis of Emerging Industries

In this thesis, a framework for analyzing the supply market of test equipment has been designed and validated. The result after performing the first interview round with the strategic buyers at Volvo was that the groups 'New markets & substitutes' and 'Supply chains' were chosen to be excluded from the proposed framework. These factors were emphasized by Lobermeyer and Kotzab (2010) and The State of Queensland (2017) to be included in a supply market analysis. As the supply chains of the test equipment market consist of few vertical actors, it was argued by the strategic buyers that resources should not be allocated to study the group 'Supply chains', as this was not as important as the other groups in the framework. However, during the analysis, it was shown that studying the group 'Supply chains' is vital in this context. The reason behind this is that the Tier-1 suppliers are becoming more powerful in the supply chain and also that several OEMs are investing and partnering with Tier-2 suppliers. According to this, an aspect to consider would be if supply chains are getting more and more important to understand as the market matures. As earlier discussed, the market environment will most likely change as a result of acquisitions and partnership constellations. Therefore, it is vital for purchasers to be aware of the activities in the supply chain. This, as the market in this case, was shown to sooner be more mature than first thought.

When performing the analysis of the 'Key supplier characteristics', it was seen to be challenging how to measure the innovation level. The level was decided to be measured by comparing the number of patented inventions each supplier had. However, these numbers have been seen to correlate with how long the suppliers have been active on the market and the method could therefore be questioned. Other suggestions how to determine the innovation level are according to Davila, Epstein, and Shelton (2012) to measure investments in R&D, the number of strategic alliances, investments in training and time dedicated to innovation. However, some data required for these suggestions can only be found if studying an organization in detail, and therefore challenging for this research to access.

In the suggested framework in Table 4.8, the factors cost-price analysis and product life cycle consideration in the group 'Product characteristics', mentioned by Lobermeyer and Kotzab (2010) and The State of Queensland (2017), are excluded. The reasoning behind this was that these parameters were already known by Volvo when this study was introduced. At Volvo, there is a specific department that supports the purchasing department by performing cost-price estimations. However,

if the purchasing department was responsible for the cost-price analysis, this factor would be included in the supply market analysis. In contrast to The State of Queensland (2017), the senior strategic buyers argued that the product life cycle consideration should not be included in the framework. The reason behind this was that this is already known by Volvo since this is a new technology in its early development. This statement was confirmed during the analysis since characteristics were found that indicates that this market is still in the early stages of the product life cycle, even if some characteristics show that the movement towards a more mature market has started. However, since this framework is adapted for new technologies, the authors have chosen not to include this factor in the final framework.

The proposed framework presented in Table 4.8 has been adjusted according to findings from the market analysis. Therefore, an updated version of the framework is presented in Figure 6.1. The different groups distinguished from each other and thus contributed to getting a holistic view of the market context. The new group 'Key supplier characteristics' was seen to be valuable since it gave an understanding of different key suppliers and their role in the market. Moreover, studying the key suppliers' characteristics also contributed at the same time to learning of other factors, such as supplier competition and dependencies in the supply chain. After designing and validating the supply market analysis structure, the following final framework illustrated in Figure 6.1 has been designed.

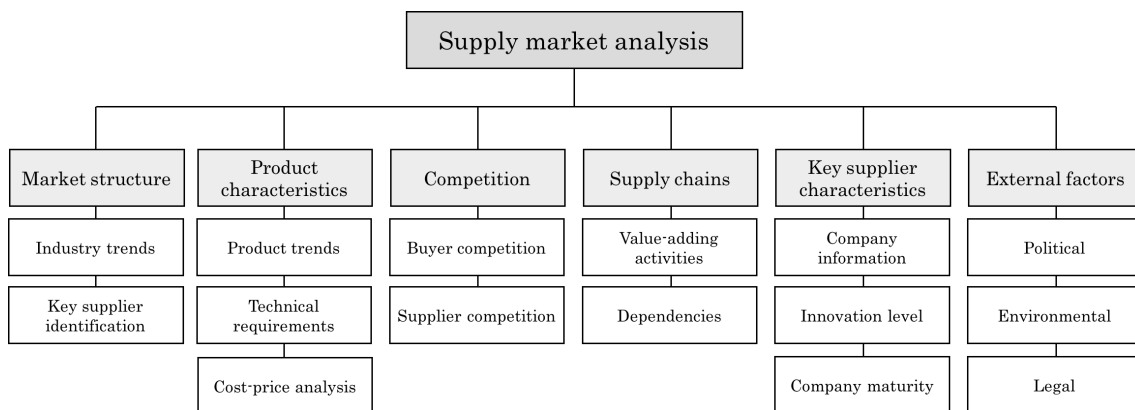


Figure 6.1: The final framework for analyzing the supply market of test equipment of new technologies.

As seen in the figure, the framework consists of six different groups. When studying the framework on a group level, it can be seen that five out of six groups are similar to the general frameworks of supply market analyses. The difference between the new framework and what is emphasized in literature is that the group 'New markets and substitutes' is eliminated and a new group 'Key supplier characteristics' is introduced. In addition to this, the new framework also differ from what is suggested in the literature concerning what factors that should be included in each group.

6.3 Proposed Sourcing Strategies

It can be seen that there are several ways for an automotive OEM as Volvo to secure the supply of the test equipment. Some suggestions seen in the market are to produce the test equipment in-house, outsource or collaborate with suppliers. According to Van Weele (2010), which of these sourcing strategies to pursue depends upon two factors, the product's level of competitiveness and the strategic importance of the competence to the firm.

The authors of the thesis propose that Volvo should initiate a partnership with a supplier. The reasoning behind this suggestion is that the test equipment is complex and a critical component for Volvo, and should therefore not be outsourced. On the other hand, the development of the test equipment is not Volvo's core competence, which is an incentive to not allocate resources to produce the test equipment in-house.

According to Hottenrott and Lopes-Bento (2016), establishing partnerships like this facilitates the pooling of complementary skills. In addition to this, partnership collaborations also ease for learning as well as the sharing of risks and costs. There are several ways of establishing partnerships, where the authors of the thesis are suggesting two options. The first proposal for Volvo is to initiate a partnership with a Tier-2 supplier. By establishing a partnership like this, it will be easier for Volvo to adapt the test equipment to suit their testing activities, and at the same time control the product quality. However, partnering with a Tier-2 supplier requires substantial investments. To reduce the risk of establishing a partnership with a supplier that runs out of business, it is critical to consider which Tier-2 supplier to partner with carefully.

The second proposal for Volvo is to establish a partnership with a Tier-1 supplier that distribute the product. Comparing to a partnership with a Tier-2 supplier, partnering with a Tier-1 supplier can be seen to be less risky. This is due to that Tier-1 suppliers are more focused towards developing the test systems than Volvo which is beneficial when choosing what upstream suppliers to collaborate with. Moreover, partnering with a Tier-1 supplier will most likely require less financial instruments compared to a partnership with a Tier-2 supplier. However, partnering with a Tier-1 supplier implies that Volvo will be longer from the source and thus risk paying a higher price than if they were sourcing the products from the suppliers that manufacture them.

Another risk that can arise when sourcing from a Tier-1 supplier is that Volvo will be more dependent upon the supplier than the opposite. Most of the Tier-1 suppliers have a larger customer base than Tier-2 suppliers and this can lead to that Volvo gets a low prioritization. The process of handling these dependencies and power balances is discussed by Simatupang and Sridharan (2002), who argue that this is a critical task in new partnership collaborations. On the other hand, when partnering with a Tier-2, supplier both actors invest in the relationship which leads to the same

level of dependencies. However, investing in a Tier-2 supplier also means that the switching cost of changing partner will increase.

When initiating a partnership within a supply chain, Simatupang and Sridharan (2002) states that establishing performance measurements for the collaboration rather than the performance of the individual members is important. Despite this, to facilitate the success of the partnership, information sharing between Volvo and the potential partner should also be considered. According to Simatupang and Sridharan (2002), parties in a partnership tend to have different states of private information. Problems therefore arise when participating firms generally lack the knowledge required for the partnership to work.

During the market analysis, it was also seen that the internal communication between the technical stakeholders and the procurement department could potentially be improved. To facilitate the sourcing of the test equipment, the technical stakeholders and the procurement department could benefit from working more cross-functional. By doing this, the procurement department would be earlier involved in the sourcing process and thus more easily contribute with their knowledge in the sourcing decision.

7

Conclusion

This final chapter will conclude the findings from this research by answering the two research question. The chapter ends with a recommendation for Volvo, contribution and suggestions for future research.

The dynamic market environment on the supply market of test equipment has made it difficult for Volvo to identify the market and hence find suitable suppliers to source from. Therefore, this thesis has aimed to develop an understanding of this market and its key characteristics. In order to do this thoroughly, a supply market analysis framework for analyzing the market have been developed. The development of the framework was done by combining a literature review about supply market analyses and unstructured interviews with experienced strategic buyers at Volvo. In the thesis, two different research questions have been guiding the research. The answer to these research questions will be given below.

RQ1:*How should a supply market analysis framework be designed for the supply market of test equipment?*

This research question was answered by combining findings from literature research and a case study at Volvo in an iterative process. What can be concluded from this is that six different groups are important to consider when analyzing this specific market. The framework is illustrated in Figure 6.1 and the groups are named 'Market structure', 'Product characteristics', 'Competition', 'Supply chains', 'Key supplier characteristics' and 'External factors'. The group 'Key supplier characteristics' is the only group which is not emphasized in literature and thus solely a result of the case study at Volvo. This group was found to be one of the most important since it gave a detailed understanding of the suppliers and their activities on the market. Moreover, one group that was emphasized in literature has been excluded from the final framework. This group is discussed by Monczka and Petersen (2012) and The State of Queensland (2017) and is called 'New markets and substitutes'. The reason behind excluding the group was that the framework is adapted for new technologies, which it is too early to find substitutes for. The research is an example of how a supply market analysis framework should be adapted to the test equipment of new technologies in the automotive industry. Thereby, the designed supply market analysis framework is also relevant to deploy when studying other supply markets with similar characteristics.

The other part of the research aimed to answer the second research question. This question was formulated as followed:

RQ2: *What are the characteristics of the supply market of test equipment?*

By analyzing the market according to the designed framework, it contributed to a great market understanding and an answer to the second research question. During the supply market analysis, six trends were identified. The market-related trends were growing market, increasing power of Tier-1 suppliers and partnership constellations. The other trends concerned the product and these were decrease in price, change in product characteristics and development of unique solutions. During the analysis, five different key suppliers have been identified to play a major role in the market. Company information about the key suppliers has been collected in order to compare them and also understand the market.

Historically, this market has been characterized by consisting of a lot of start-ups offering high technology products but lack some commercial knowledge. However, what this research has seen is that this might change the coming years. The reason behind this is that several of Tier-1 suppliers have started to merge with and acquire Tier-2 suppliers. This is leading to a shift in the market structure as the market will consist of a more significant portion of Tier-1 suppliers and fewer start-ups instead. Furthermore, several automotive OEMs have also chosen to acquire Tier-2 suppliers, which also results in a decrease in the number of market players. This shift in market structure is an indication that the market of test equipment is starting to move towards a more mature stage.

By performing the supply market analysis and hence gaining understanding of the market, it has been discussed that Volvo has two suitable strategic options to choose from. This is to either establish a partnership with a Tier-1 or Tier-2 supplier and thereby secure future supply of the test equipment. The reasoning behind this suggestion is that the component is complex and critical and should therefore be developed in collaboration with a supplier. Partnerships like this ease for new product development as well as sharing of risks and costs.

7.1 Contribution

In literature, there is a lot written about general frameworks to follow when performing a supply market analysis (Jones & Barner, 2015; Lobermeyer & Kotzab, 2010; The State of Queensland, 2017; Van Weele, 2010). However, when the study was initiated, it was seen that literature lacks a customized framework suitable for analyzing supply markets in emerging industries. By taking both experienced purchasers and literature into account, this thesis conducted a supply market analysis framework suitable when analyzing industries with these characteristics. By developing the framework, this thesis thus contributed to literature by proposing a new framework to follow when analyzing suppliers and trends in emerging industries.

The new framework is illustrated in Figure 6.1. By following this to understand the market for the specific test equipment, a clear explanation of the market and its characteristics were found. Furthermore, after gaining this knowledge, this thesis contributed with two different strategic proposals for Volvo how to source the equipment. In addition to this, the purpose of the analysis framework is to work as a base for further analyses of other markets with similar characteristics.

7.2 Limitations & Future Research

One of the limiting factors in this study was time. During a longer period, more suppliers and industry experts could have been interviewed. Thus it would have been possible to get even more details about the market. Moreover, by interviewing the suppliers several times but in different time periods would make it possible to analyze how the market changes over time, and not only predict the changes.

Among the interviewed strategic buyers at Volvo, only a few of them are working with the sourcing of this specific test equipment. This was one of the limitations of the thesis and by interviewing more strategic buyers at other automotive companies working with the supply of this equipment would give more exact information about what factors that is suitable to include in the framework. In addition to this, a majority of the interviewed suppliers were located abroad which led to that the interviews were performed through online-calls. This was a limiting factor since it is easier to connect with a respondent in a face-to-face meeting and thus contributing to a deeper discussion.

As the study investigated the supplier market of test equipment from a Volvo perspective, it would be suggested to analyze how other OEMs are analyzing the supplier market. Moreover, the focus of this research has been from the buyer perspective, and for future research it would be interesting to analyze this market from a supplier perspective as well. This could lead to an understanding of what strategies the suppliers should have in order to succeed on the market. This thesis has performed a supply market analysis which is a foundation of a sourcing strategy. According to this, a call for future research would also be to investigate further what sourcing strategy that is most suitable to pursue in this market context.

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A

Suppliers

General information about the respondent

- Name:
- Company:
- Position:
- Career and earlier work experiences:

Company specific

- When was your company founded?
- When did you produce your first product?
- How many employees are currently employed at your company?
- How many units of the equipment do you produce each year?
- Which are the shareholders of your company?
- In what industries are your customers?
- In what industry did you start to sell your products?
- What companies are your main customers?
- What differentiate your products from competitors products?
- How many patents does your company have?

Testing of the technology

- How do you test the technology?
- Do you know how car manufacturers are testing systems including the equipment?

Questions about the test equipment and related market

- What are the trends on the market, including both product trends and commercial trends?
- What would you say is the main challenge for this market?
- How would you describe the balance between supply and demand on the market?
- What other companies are producing similar products as you?
- Have you seen many new companies entering the market the recent years?
- What are the main enter barriers in order for a new actor to enter the market?

External factors

- Do you know any regulations or environmental factors that can affect the development of the test equipment?

B

R&D Engineers & External Product Experts

General information about the respondent

- Name:
- Profession:
- Work experience:

General questions about the technology

- How would you shortly described the technology?
- How has the technology developed over the years?
- What are the main application areas for the technology?
- Where does this technology derive from?

Testing of the technology

- How do you test the technology?
- What methods and equipment do you use for testing?
- How do you think the technology will be tested in the future?
- What are the differences between the technology itself and the equipment used for testing?

Questions about the test equipment and related market

- What trends do you see on the market? Including both commercial and product?
- What is the hot topics right now in this field?
- What are the challenges on the market?
- Can you mention any supplier of the test equipment?
- What suppliers are the market leaders?
- Do you have any examples of different partnerships on the market?

External factors

- Do you know any regulations or environmental factors that can affect the development of the product?

C

Legal Expert

General information about the respondent

- Name:
- Profession:
- Work experience:

Political and legal factors

- What regulations are today affecting the development of the technology?
- What regulations have an impact on the testing of the technology?
- How are the regulations related to this testing activities different in different countries?
- What changes in the regulations must come in order for this technology to reach the commercial market?
- What general regulations do Volvo's suppliers need to follow?
- Are there any regulations that specifically affect the sourcing of the test equipment?

Environmental factors

- What environmental ISO-standards do Volvo follow?
- What general environmental regulations apply to all the products you source?
- Are there any environmental regulations that are specific for the test equipment?

D

Chalmers Researchers

General information about the respondent

- Name:
- Research field:

General questions about the equipment

- How would you shortly described the product?
- What have you seen happened on the market the recent years?
- How has the product developed?
- What are the main application areas of this product?
- Where does this technology derive from?
- Do you know how this technology is tested in the industry?
- What trends do you see on the market?
- What are the differences between the technology itself and the equipment used for testing?
- How do you think the technology will be tested in the future?

Market specific questions

- What is the hot topics right now in this field?
- Can you mention any supplier of the test equipment?
- What suppliers are the market leaders?

External factors

- Do you know any regulations or environmental factors that can affect the development of the product?