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Supply chain adaptations for bundled service offers in the automotive aftermarket supply chain

Master of Science Thesis
in the Supply Chain Management Master's Program

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MASTER'S THESIS E 2015:088

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Göteborg, Sweden 2015

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Chalmers Reproservice
Göteborg, Sweden 2015

Abstract

Aftermarket services are considered very important and are no longer an afterthought within companies. In fact, the aftermarket has turned into the main source of profit for companies. For OEMs to be able to upgrade and transform their aftermarket supply chains, they must understand what type of supply chain design that is appropriate given the performance requirements of the bundled service offers they provide. The current aftermarket supply chain at the case company was not originally designed around the bundled service offers, which puts pressure on the case company to adapt their aftermarket supply chain to be able to meet the challenges that the bundled service offers put on them.

The purpose of this thesis is to study the bundled service offers in order to provide recommendations for adaptations of the aftermarket supply chain. In order to deliver the recommendations, an investigation of the key challenges with the aftermarket supply chain in regard to the bundled service offers currently offered by the case company will be conducted, as well as a benchmarking study on what other companies identify as supply chain challenges in regard to aftermarket services. The scope of this thesis only includes bundled service offers for Volvo Group Trucks in the Nordic market and the focus is on the offers that impact the aftermarket supply chain, the service contracts. There are three different types of service contracts provided by the case company; Blue, Silver and Gold. The content in the service contracts differs, which puts different demands on availability of spare parts.

This thesis has contributed to the area of aftermarket supply chains when it comes to the understanding of how to achieve operational excellence through operationalization of service strategies. The conclusion is that from a physical handling perspective, the current aftermarket supply chain at the case company is considered sufficient, but some adaptations could be made to further improve it. Furthermore, the operational and organizational principles in terms of administrative handling of the current aftermarket supply chain can be improved. The recommendations consists of five areas of improvements. The first recommendation is prioritization of availability of critical spare parts according to service contract orders. This implies that the contract prioritization should be included in the current order classes, and the orders should be prioritized according to the service contracts. The second recommendation is prioritizing suppliers according to criticality, which means that suppliers supplying critical parts should be prioritized higher than the ones supplying less critical parts. The third recommendation is implementing local hubs close to the dealers, that serve more than one dealer in the area. This means that critical parts would be stored at the local hubs providing improved availability to meet the requirements of the service contracts. The fourth recommendation is to measure the total lead-time from order placed until delivered as a KPI to improve customer satisfaction. The last recommendation is improving internal information sharing between the functions sales and materials management when designing the service contracts, but also when supplying the spare parts.

Keywords: *aftermarket services, uptime, automotive, aftermarket supply chain, bundled service offers, service contracts*

Acknowledgements

This thesis has been carried out during spring 2015, by two students from the Master Program Supply Chain Management at Chalmers University of Technology. The thesis was supported by Volvo Group Trucks Operations Logistics Services.

We want to direct gratitude towards our supervisors at both Volvo Group and Chalmers University of Technology. As a starting point, Lina Liljenberg, Dealer Inventory Manager for Europe North, served as the Volvo Group supervisor, and mid-way into the process Cathrine Sandberg, Project Manager, took over the position as supervisor. We direct our gratitude towards the supervisors who have made our work easier by providing contact details to personnel within the Volvo Group, but who have also assisted and guided us throughout the thesis process. We also want to show our gratitude towards Árni Halldórsson, Professor at Chalmers University of Technology, for assistance throughout the whole process regarding frameworks and outline of the report. These comments have greatly improved the manuscript.

A total of 26 stakeholders have given input to this thesis, mainly through interviews. We want to thank each and every one of these stakeholders for forming our thesis to what it is today. The stakeholders provided us with their time to participate in interviews and gave us essential information for the thesis as well as a great insight into the Volvo Group. This assisted the research immensely.

Margrét Guðmundsdóttir and Emmelie Gustafsson, Gothenburg June, 2015

Abbreviations

AHT	Average Handle Time
ETA	Estimated Time of Arrival
JIT	Just In Time
KPI	Key Performance Indicator
OEM	Original Equipment Manufacturer
OES	Original Equipment Supplier
PI	Performance Indicator
SKU	Stock Keeping Unit
TCO	Total Cost of Ownership
UN	United Nations
VOR	Vehicle Off Road

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1. Introduction

The aftermarket is no longer an after-thought, in fact the aftermarket has turned into the main source of profit for companies (Cohen et al., 2006). To take advantage of the aftermarket opportunity, companies have started providing service offers to their customers. In this thesis the bundled service offers are considered a soft product and are defined as service offers the case company sells to their customers that can be combined or bundled to the product. The supply chains were set up before there were bundled service offers, so the supply chains are not fully adapted to the service offerings. This puts pressure on companies to adapt their aftermarket supply chains so the supply chains are able to meet the requirements that the bundled service offers put on them, as illustrated by the authors in Figure 1.1.

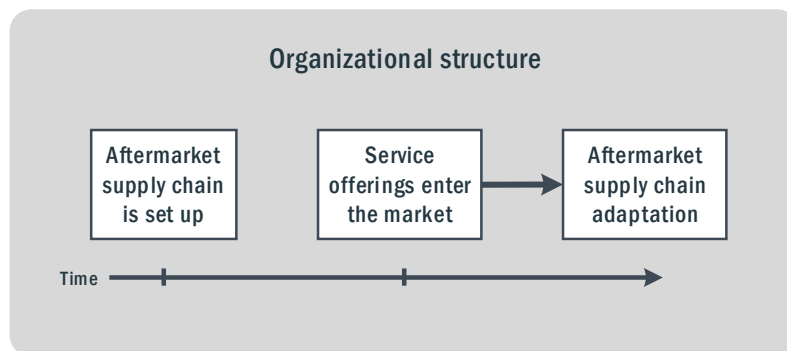


Figure 1.1: Aftermarket supply chain development over time.

1.1 Background

The background of this thesis arises from the aftermarket topic as well as the industrial context in terms of a case company. The topic and the industrial context are further described below.

1.1.1 Topic

Manufacturers of automotive parts are often divided into two categories, Original Equipment Manufacturers (OEM) and aftermarket parts suppliers (Liu et al., 2008). Aftermarket services are considered very important and are no longer an afterthought within companies. There is huge revenue potential in the aftermarket (Cohen et al., 2006). In fact, the aftermarket business has become the main source of profit, e.g. service contracts account for approximately 50 percent of profit margins and have a strong impact on customer loyalty (Accenture, 2010). Companies within the automotive and aerospace industries see opportunities in extending business models beyond 'point of sale' and instead engage with their products and customers at the 'point of use' (Thesis announcement by Volvo Group and Chalmers University of Technology, 2015).

In order to accomplish the move from 'point of sale' to 'point of use', OEMs in the automotive supply chain could offer service bundles to their customers, where uptime of

the vehicle is the key performance indicator. "A key enabler herein is IT and 'connected vehicle' technology, that allows for direct monitoring of the vehicle both its condition and usage." (Thesis announcement by Volvo Group and Chalmers University of Technology, 2015, p. 1). Offers such as remote diagnostics, 24/7 roadside assistance and full contract maintenance services require operational excellence in the aftermarket in favor for securing availability of spare parts at worldwide locations. "Bundling physical products (in this case, trucks) with aftermarket services enhances the value of the core product; this constitutes a new stream of revenue generating, enhances user experience, and supports customer retention" (Thesis announcement by Volvo Group and Chalmers University of Technology, 2015, p. 1).

Key in achieving more revenue, enhanced user experience and customer retention is the design and management of an effective aftermarket supply chain (Thesis announcement by Volvo Group and Chalmers University of Technology, 2015). Companies face numerous challenges in managing an effective aftermarket supply chain design, e.g. supply chains must handle a huge number of part numbers, spare parts demand uncertainty, and most importantly, companies must understand what kinds of supply chain designs are required in order for them to operate in and deliver to the promising and expanding but also complex area of aftermarket services (Thesis announcement by Volvo Group and Chalmers University of Technology, 2015). Furthermore, OEMs take on increased responsibility of the customer's own processes by providing aftermarket services that are thought to help customers with their own businesses. Providing service maintenance contracts enables customers to focus on their core business and not on maintenance or repairs.

The design of the aftermarket supply chain determines the flow of spare parts from the suppliers to different customers, such as; service stations, dealers, truck owners/users, and OEMs' internal customers. For OEMs to be able to upgrade and transform their aftermarket supply chains, they must understand what type of supply chain design that is appropriate given the performance requirements of the bundled service offers they provide. OEMs must also understand what role dealers, third-party service stations and logistics providers will play, what types of supply chain designs that can be considered on short-term and long-term, and how spare parts supply should be planned and controlled in the networks (Thesis announcement by Volvo Group and Chalmers University of Technology, 2015). However, there is a lack of understanding on how to achieve operational excellence when it comes to operationalization of service strategies (Johnstone et al., 2009), and there is a lack of systematic approaches linking strategic objectives with aftermarket strategies and KPIs (Cavalieri et al., 2007).

1.1.2 Industrial context

The aerospace, manufacturing and defense industries share similarities with the automotive industry. They are high-tech, unique and complex industries. These industries have complex supply chains and aftermarket business strategies, e.g. service offerings are present in these industries as well. In order to study the service offerings phenomenon in

the aftermarket supply chain, this thesis studies an automotive case company in Sweden, namely Volvo Group.

Volvo Group is a global company with their headquarters located in Gothenburg, Sweden, and their activities include production as well as distribution and sales of trucks, construction equipment, buses, and marine and industrial combustion engines (Volvo Group, 2015a). Noteworthy, Volvo Cars is a separate company and has no linkage to the Volvo Group besides the logotype and the Volvo Museum. Within Volvo Group, there is Volvo Group Trucks Operations Logistics Services, which encompasses all logistics services of the Volvo Group's engines and transmissions as well as logistics services of Volvo Trucks, Volvo Penta, Volvo Buses, Volvo Construction Equipment, Renault, Mack, UD trucks, Eicher, SDLG, Prevost and Nova Bus (Thesis announcement by Volvo Group and Chalmers University of Technology, 2015). Group Trucks Operations also includes spare parts supplies to the Volvo Group's customers as well as logistics.

Logistics Services is part of Group Trucks Operations and is situated on more than 60 locations worldwide with approximately 5,000 employees (Volvo Group, 2015b). Their mission is to design, handle and optimize the supply chain for all Volvo Group brands and for selected customers within the automotive industry (Volvo Group, 2015c, 2015b). This thesis is conducted at Logistics Services within the department Materials Management in Arendal, Gothenburg, further on referred to as the case company. Logistics Services is responsible for transportation of material to the production facilities, that packaging is available, that vehicles are distributed to the dealers, and that management of material, warehouses and distribution ensures availability of parts everywhere in the world. Logistics Services makes sure that all logistics services are delivered with world-class operational excellence (Volvo Group, 2015c, 2015b).

1.2 Problem description

The automotive sector has gone through some major changes during the last decades. The industry has globalized and the historically sold vehicles are now starting to break down. Cavalieri et al. (2007) explains that it is important for all the actors of the supply chain, from the manufacturers to retailers to ensure long-term relationships with their customers through all of the product's life cycle. Their role does not end when the product has been sold and customers should be offered a customized and valuable portfolio of after-sales services e.g. technical advice for use, maintenance and repairs, spare parts delivery, etc. (Cavalieri et al., 2007; Saccani et al., 2006). There is huge revenue potential in the aftermarket. In fact, manufacturers have come to realize that aftermarket business is the main source of profit and that the aftermarket business can generate more than three times the turnover of the original purchase during the product's life cycle (Cohen et al., 2006; Oliva & Kallenberg, 2003; Cavalieri et al., 2007; Saccani et al., 2006, 2007).

The accumulated sold vehicles together with service demanding customers have put pressure on the aftermarket for automotive companies (Oliva & Kallenberg, 2003). Cohen et

al. (2006) and Saccani et al. (2006) stress that the accumulated vehicles sold over the years have made the aftermarket four to five times larger than the OEM businesses themselves. Cohen et al. (2006) stress that the aftermarket supply chain needs to manage 20 times the number of SKUs compared to the manufacturing unit. Providing services also implies that people, equipment, and parts need to be dispatched to the service locations, so the aftermarket supply chain expands in all directions when delivering services to customers. A large aftermarket supply chain is difficult to manage and requires a certain structure in order to deliver the service levels promises that companies make (Cohen et al., 2006). In this case, this means that the aftermarket supply chain must be designed to fit the bundled service offers at the case company. This is an important issue to investigate further since the current aftermarket supply chain at the case company was not originally designed around the bundled service offers (respondent 24).

Furthermore, customers increasingly get less loyal towards brands and are more prone to switch brands if better deals can be obtained elsewhere (Accenture, 2014). In pursuance of providing customers with the best deals, service offerings (or in the case company terms bundled service offers) are a significant differentiator in the aftermarket (Cohen et al., 2006; Saccani et al., 2006; Lightfoot et al., 2013). Cavalieri et al. (2007) state that after-sales services can increase customer loyalty and promote the company's brand. Baines, Lightfoot, and Evans (2007) explain that emphasis has shifted from "sale of product" to "sale of use." There is competitive value in the area of after-sales services and service management is an important differentiator for companies in highly competitive markets (Amini et al., 2005). The shift towards "sale of use" implies that the customer pays for the use of the product instead of owning the product (Johnstone et al., 2009). A term used for this phenomenon is "power by the hour" and it is mostly referred to the aerospace industry, where the customer pays for the running hours of jet engines, and in return the manufacturer provides availability of the engine. In order to realize this service strategy, the manufacturer must be able to monitor the engine in real time (Johnstone et al., 2009). This is identical to the automotive industry, since the technology, or so-called remote diagnostics connectivity, allows for monitoring of vehicles. By doing so, the uptime of the vehicle can be improved, even to that extent that companies can expand their businesses into offering trucks with an uptime promise. Consequently, a tighter relationship is required between the manufacturer and the customer (Johnstone et al., 2009; Brax & Jonsson, 2009; Cavalieri et al., 2007).

The challenges the OEMs face within the automotive aftermarket are numerous. Delivering aftermarket products globally or regionally can impact the complexity of the aftermarket supply chain and can even be more complex than the manufacturing of the product itself (Cohen et al., 2006). In order to provide the case company with recommendations on how they could adapt their aftermarket supply chain, it is first significant to understand what challenges there are within the automotive aftermarket, which leads to the first research question.

1. What are the key challenges with the aftermarket supply chain in regard to the bundled service offers?

In order to gain a broader understanding of how to address the challenges in the after-market sector, it is important to perform a benchmarking study by analyzing how other leading companies within the automotive industry are expressing views on these challenges but also to identify what challenges they have. This leads to the second research question.

2. What other supply chain challenges do other companies identify as regards to after-market services?

The aftermarket is ultimately driven by customer satisfaction and therefore services need to be performed rapidly, allowing for minimum waiting time for customers (Bacchetti & Saccani, 2011). To address this, it is of importance that the right spare parts are at the right location at the right time (Bacchetti & Saccani, 2011; Gadde et al., 2010). A heavy-duty vehicle consists of hundreds of thousands of part numbers (Cohen et al., 2000); it is impossible to store all the parts at each and every repair shop since that would imply too much tied up capital. According to Saccani et al. (2007), configuration of aftermarket supply chains is treated sparsely in literature. An important aspect covered in literature is that companies implement solutions into their offers, but they fail to deliver efficient and effective repair service solutions, which in turn impact their competitive advantage negatively (Amini et al., 2005). In order to effectively accomplish aftermarket services, e.g. repair services, companies must comprehend the competitive role that the design of the aftermarket supply chain plays, which leads to the third research question.

3. How should the aftermarket supply chain be adapted in regard to the bundled service offers, based on the challenges identified?

The research questions are interlinked as shown by the authors in Figure 1.2. The bundled service offers put requirements on the aftermarket supply chain and the aftermarket supply chain needs to respond to those offers. In order to do so, the aftermarket supply chain needs to be adapted to better fit the bundled service offers.

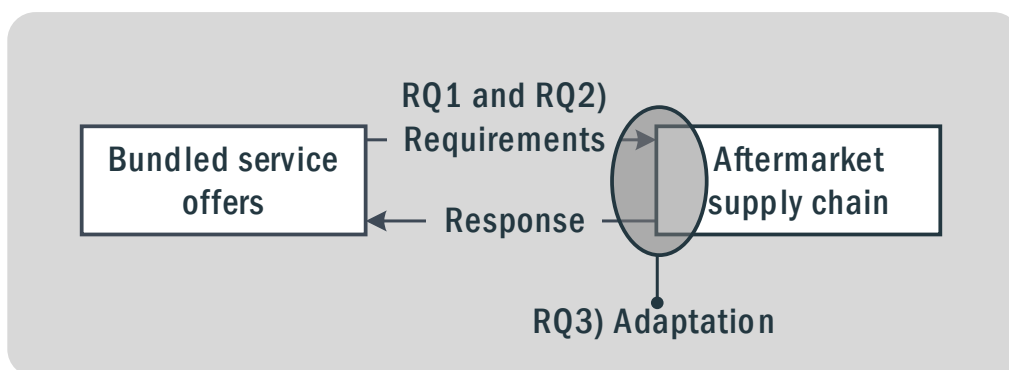


Figure 1.2: How the research questions are interlinked.

1.3 Purpose and research questions

The purpose of this thesis is to study the bundled service offers in order to provide recommendations for adaptations of the aftermarket supply chain. In order to deliver the recommendations, an investigation of the key challenges with the aftermarket supply chain in regard to the bundled service offers currently offered by the case company will be conducted, as well as a benchmarking study on what other companies identify as supply chain challenges in regard to aftermarket services.

To approach the purpose, three research questions are presented in Table 1.1 below with supporting evidence and expected contribution for each question. In order to show the emphasis on each research question, it was decided to weigh them. The primary weight is on research question three, but research question one is important to set the base and is complimented with research question two.

Table 1.1: Research questions.

Research questions	Supporting evidence – literature	Supporting evidence – empirical data	Expected contribution
1. What are the key challenges with the aftermarket supply chain in regard to the bundled service offers?	Academic articles about challenges in the aftermarket supply chain.	Interviews within the case company regarding challenges in the aftermarket supply chain and internal material.	List of challenges that contributes to the building blocks for analysis and what requirements the supply chain must be designed for in regard to the bundled service offers.
2. What other supply chain challenges do other companies identify as regards to aftermarket services?		Benchmarking with other companies within automotive industry from consultancy reports and industry press.	List of challenges that contributes to the building blocks for analysis and what requirements the supply chain must be designed for in regard to the bundled service offers.
3. How should the aftermarket supply chain be adapted in regard to the bundled service offers, based on the challenges identified?	Academic articles.	Consultancy reports and interviews within the case company.	Recommendations on how the aftermarket supply chain could be adapted to better meet the requirements of the bundled service offers.

1.4 Scope and delimitations

The thesis focuses on aftermarket services within the case company. Aftermarket services contain all activities related to maintaining a vehicle after its point of sale, which includes replacement parts, lubricants, appearance products, accessories, service repairs (both planned maintenance and sudden breakdowns), as well as any other service that yields uptime. The two terms aftermarket and after-sales are used interchangeably throughout the thesis. Both terms encompass all services after the purchase of a product and aim at supporting the customers' further usage. The problem owner of this thesis is the case company, but since the aftermarket supply chain is cross-functional other functions in the company could benefit from the thesis as well.

The thesis focuses on the process level of the aftermarket supply chain, and is therefore not focusing on different aftermarket supply chains for different brands. The study contains an overview of all the service offerings for Volvo Group Trucks, Volvo Penta, Volvo Construction Equipment and Volvo Buses provided in Appendix B. However, the study was further narrowed down and contains only the Volvo Group Trucks bundled service offers. Thereafter, the focus is on the service offers that impact the aftermarket supply chain. Consequently, only a few offers (out of approximately 50 offers) will be further analyzed and recommendations for improvements will be presented.

Volvo Group Trucks acts in seven regions worldwide. Due to time limits, the scope of the thesis includes one region, Europe North. Within that region, there are four different markets, but this study only focuses on the Nordic market that includes Sweden, Norway, Finland, Denmark, and Iceland. Within the Nordic market, there are five warehouses that serve the market, the central warehouse in Ghent (Belgium) and the central warehouse in Eskilstuna (Sweden) that for now serves Volvo Construction Equipment, but will soon be taken into reconstruction and become a support warehouse for the Nordic market. The central warehouse for Renault in Lyon (France) also serves the Nordic market with a small number of Volvo parts stored for emergency purposes. The support warehouse in Gothenburg (Sweden) serves Sweden, Norway, Denmark and Iceland, but after the reconstruction it will be terminated as a warehouse. The last warehouse is the support warehouse in Helsinki (Finland), which serves Finland. After the reconstruction there will be four warehouses in total that serve the Nordic market, as shown by the authors in Figure 1.3.



Figure 1.3: Warehouse locations, Nordic market.

1.5 Outline of the thesis

This thesis is divided into nine chapters. The first chapter gives an introduction to the thesis, why it is conducted and what it aims to fulfill. The second chapter provides a literature review about aftermarket challenges and aftermarket supply chain configurations. The literature chapter founds the base for answering research question one, (RQ1: What are the key challenges with the aftermarket supply chain in regard to the bundled service offers?) and research question three (RQ3: How should the aftermarket supply chain be adapted in regard to the bundled service offers, based on the challenges identified?).

Chapter three explains the method used and how the research questions were answered. In the fourth chapter, the current situation at the case company is presented in terms of the bundled service offers and the aftermarket supply chain. In chapter five, challenges from both literature and employees from the case company are put in relation to the bundled service offers. This chapter aims at answering research question one (RQ1: What are the key challenges with the aftermarket supply chain in regard to the bundled service offers?). In chapter six, challenges found from the benchmarking study are accounted for and put in relation to the bundled service offers. This chapter aims at answering research question two (RQ2: What other supply chain challenges do other companies identify as regards to aftermarket services?). However, chapter five and six together are meant to

discover challenges that the third research question (RQ3: How should the aftermarket supply chain be adapted in regard to the bundled service offers, based on the challenges identified?) aims to solve.

Chapter seven constitutes of recommendations to the case company on how to adapt their aftermarket supply chain in terms of operational and organizational principles to meet the requirements of the bundled service offers. Chapter seven aims to answer research question three, (RQ3: How should the aftermarket supply chain be adapted in regard to the bundled service offers, based on the challenges identified?). In chapter eight, discussion about findings in relation to literature is further elaborated on. The thesis is then concluded in chapter nine, the conclusion chapter where the main findings are presented as well as future research opportunities.

2. Literature and frame of references

This chapter includes the academic articles that are relevant for the topic of this thesis. These articles were used as a base mainly to answer research question one (RQ1: What are the key challenges with the aftermarket supply chain in regard to the bundled service offers?) and also research question three (RQ3: How should the aftermarket supply chain be adapted in regard to the bundled service offers, based on the challenges identified?). This chapter is divided into two sections where the first section focuses on research question one where the characteristics and challenges of the aftermarket supply chain are explained. At the end of section one, the challenges in the aftermarket are summarized. The second section focuses on research question three where the configurations of the aftermarket supply chain design are outlined.

2.1 Characteristics of the aftermarket supply chain

In comparison to a manufacturing supply chain, an aftermarket supply chain is much more difficult to handle due to its unpredictableness. Cohen et al. (2006) display the main differences between a manufacturing supply chain and an aftermarket supply chain, these are shown in Table 2.1.

Table 2.1: Comparison of a manufacturing supply chain and an aftermarket supply chain. Adapted from Cohen et al. (2006).

Parameter	Manufacturing supply chain	Aftermarket supply chain
Nature of demand	Predictable, can be forecast	Always unpredictable, sporadic
Required response	Standard, can be scheduled	ASAP (same day or next)
Number of SKUs	Limited	15 to 20 times more
Product portfolio	Largely homogeneous	Always heterogeneous
Delivery network	Depends on nature of product; multiple networks necessary	Single network, capable of delivering different service products
Inventory management aim	Maximize velocity of resources	Pre-position resources
Reverse logistics	Does not handle	Handles return, repair, and disposal of failed components
Performance metric	Fill rate	Product availability (uptime)
Inventory turns (the more the better)	6-50 a year	1-4 a year

According to Cohen et al. (2006), the *nature of demand* is predictable and can be forecasted for manufacturing supply chains, but in the aftermarket supply chain the demand is unpredictable. This makes the aftermarket supply chain more complex when it comes to spare parts management and maintenance. Wang and Syntetos (2011) state that there are two types of maintenance: planned (scheduled, preventive) maintenance, and unplanned (repair, corrective) maintenance. These two differ when it comes to the urgency of the maintenance, preventive maintenance is planned in advance and corrective maintenance occurs suddenly. Regardless the type of maintenance, Wang and Syntetos (2011) and Romeijnders, Teunter, and van Jaarsveld (2012) state that maintenance demand is intermittent in nature, which implies that there is frequent demand during certain periods of time and infrequent during others.

From a forecasting and stock control perspective, intermittent demand patterns are difficult to handle due to two reasons (Wang & Syntetos, 2011). Firstly, the demand arrival is unevenly distributed. Secondly, the size of demand is uneven too, because demand does not necessarily occur for a single unit, instead demand could be what Wang and Syntetos (2011) and Romeijnders et al. (2012) term 'lumpy', which combines slow demand with clumped demand. Romeijnders et al. (2012) exemplify what changes in demand can result in. A drop in demand for spare parts originates from either 1) the vehicles are taken out of use, or 2) finding new ways of repairing instead of replacing malfunctioning parts. The first case implies that demand for certain spare parts will drop, and the second case impacts the number of components needed per repair (Romeijnders et al., 2012).

In aftermarkets, forecasts for spare parts supply consist of probability distributions as opposed to just in time delivery via backward planning when planning for production (Cohen et al., 2006; Wang & Syntetos, 2011). The aftermarket supply chain is very unpredictable due to the sporadic breakdowns of vehicles. When these events occur, the supply chain must *respond* fast in order to get the vehicle up and running again allowing for maximum uptime (Cohen et al., 2006). Predicting the occurrence of unplanned maintenance is a difficult task. Vehicles do break down unexpectedly, and in order to repair the vehicle as fast as possible, the right spare parts must be at the right workshop at the right time (Cohen et al., 2006). This requires that possible breakdowns and their indicators are known beforehand, which in turn requires both knowledge and experience of the original production equipment (Brax & Jonsson, 2009).

Furthermore, the *product portfolio* for an aftermarket supply chain is heterogeneous, which means that there are many product models that are to be served by the supply chain (Cohen et al., 2006). E.g. there are many truck models included in the automotive product portfolio, all of which are served by the same aftermarket supply chain. The condition of the trucks in use also differs between the trucks. Due to the dispersed product portfolio, the inventory is bigger for the aftermarket supply chain compared to the manufacturing supply chain. The *inventory* must be managed through pre-positioning of resources, which means that the demand for resources (parts, staff, equipment) must be forecasted, although this is very difficult due to above mentioned reason that the aftermarket supply chain is highly unpredictable (Cohen et al., 2006).

Managing spare parts is complex. Inventories must exist at the appropriate points in the supply chain, or the desired service levels fail (Bacchetti & Saccani, 2011). The big number of spare parts (Cohen et al., 2006), the intermittent demand (Wang & Syntetos, 2011; Romeijnders et al., 2012; Bacchetti & Saccani, 2011), and the responsiveness needed also add to the complexity of managing spare part inventories (Bacchetti & Saccani, 2011). In order to manage the flow of spare parts, a well-designed or adapted *delivery network* is required. In the aftermarket supply chain, the delivery network must be able to deliver different service products (Cohen et al., 2006).

Reverse logistics (the handling of failed components, refurbishing, etc.) is handled by the aftermarket supply chain, but not by the manufacturing supply chain (Cohen et al., 2006). A well-handled reverse logistics flow is considered a competitive advantage for companies since it is not easily duplicated by others (Amini et al., 2005). Furthermore, reverse logistics is not necessarily limited to containing product returns, repairs, and refurbishments, it can also include activities aiming to reduce the environmental impact of the supply chain, making the reverse flow very complex (Amini et al., 2005). In the automotive industry, returns constitute the base for a reverse material flow, and the returns can be divided into two categories: expected and unexpected. Engine starters, e.g., fall into the category of expected returns. Used starters are returned for remanufacturing and resale. The unexpected returns are parts associated with incorrect shipments, damaged shipments, and poor sales (Daugherty et al., 2003).

Additionally, not all companies think of reverse logistics as something strategically important (Amini et al., 2005). However, with the level of strategic importance, there are also some challenges that companies face. Amini et al. (2005) account for challenges with repair specific services in a reverse logistics flow. The first challenge is the nature of the demand for spare parts, that it is uncertain and inconsistent. Meaning, the demand can result in low *inventory turns*, which can be seen in Table 2.1. Secondly, the *number of SKUs* implies that inventories are very extensive. In comparison to the manufacturing supply chain, the aftermarket supply chain must also handle parts belonging to vehicles that are not produced anymore. Thirdly, customers may require specific repair processing which originates from their own operations. Long-hauling trucks have different needs than e.g. construction trucks. Fourthly, customers are keen on having their vehicles repaired as quickly as possible, which implies that the repair cycle time must be kept to a minimum. Fifthly, there is a need for coordinating actors involved in the repair services, e.g. dealers, customers, and warehousing providers. Lastly, there must be flexible capacity for storage, processing, and transportation related services (Amini et al., 2005).

Another challenging area within the aftermarket is to maintain customer satisfaction. Cohen et al. (2006) argue that customers do not expect all products to be flawless but they want the manufacturer to act quickly in case of a breakdown of their product. Speed is a crucial factor since customers want the delay time to be minimized as much as possible (De Leeuw & Beekman, 2008). Consequently, customers think there is a lack of quality provided by the manufacturer when it comes to the aftermarket support (Cohen et al., 2006).

Availability of reliable maintenance services can often affect the customer's decision whether or not to purchase a product. Uptime of an equipment or vehicle is a crucial factor for the customer but also any improvements of it (Brax & Jonsson, 2009). Promising a customer a certain amount of uptime of equipment or vehicle contains many factors, such as; spare parts availability, location of warehouses, and quality of the product. Cohen et al. (2006) continue stressing that OEMs must get a deeper understanding of customers' needs and through that knowledge create products and/or solutions that satisfy the different customer segments.

Customer satisfaction is important to consider when setting up sufficient KPIs in order to measure performance of the supply chain (Cohen et al., 2006). The focus must be on the customer, and the KPIs must therefore also focus on the customer (Cohen et al., 2006). Traditional KPIs in aftermarkets are typically; part-fill rate (Cohen et al., 2006), internal lead times (warehousing loading and unloading time, transport time, invoice delivery time), costs (spare parts costs, cost of picking errors) (Saccani et al., 2006), etc. However, these KPIs do not focus on the customer and what is important are the promises they make, because customers do not gain anything if the warehouse can meet the demand for spare parts if their vehicles still have not been repaired (Cohen et al., 2006). Instead, Cohen et al. (2006) and Cohen et al. (2000) argue that *performance metrics* should be customer-based, such as; uptime and overall response time for completion of repair.

Lead-time is also important to measure. According to Gadde et al. (2010, p. 41), "lead-time concerns the time elapsed from the identification of a certain need to the point in time when this need is satisfied." In supplying terms, lead-time is the time from the instant that an order has been placed until the time that the order has been delivered and made available (Gadde et al., 2010). The lead-time measurement can be applied to all processes within a supply chain, e.g. in production and customer order processes and it is important for order placements (Gadde et al., 2010).

Performance measurements also differ between centralized and decentralized service supply chains (Cohen et al., 2000). Centralized service supply chains use metrics for cost reduction and efficiency, whereas decentralized service supply chains use metrics for availability and repair response time. According to Abrahamsson (1993) the centralized supply chains have higher inventory costs and decentralized supply chains have higher transportation costs. The inventory and transportation costs are important KPIs to measure.

To conclude section 2.1, the main characteristics and challenges are e.g. unpredictable demand, forecasting, fast response, large number of SKUs, heterogeneous product portfolio, single delivery network, capable of delivering different service products, pre-positioning resources for inventory management, reverse logistics, performance metrics should include product availability (uptime) and customer satisfaction should be maintained. The summary of the aftermarket challenges are shown by the authors in Table 2.2.

Table 2.2: Identified challenges from literature.

Challenge	Characteristics
Nature of demand	Stochastic/unpredictable demand due to sporadic breakdown of vehicles
Forecasting demand of spare parts	Due to unpredictable breakdowns
Responsive spare parts management	To secure the uptime of the vehicle, the right spare parts need to be at the right location and the right time
Inventory management	Difficult to manage because of the unpredictable demand
Product portfolio, number of SKUs, delivery network	The aftermarket supply chain must serve many product models, and also those that are not produced anymore
Reverse logistics	The handling of reverse logistics such as repairs, returns and other services makes the aftermarket supply chain more complex
Customer satisfaction	To meet customers requirements and promises such as uptime of the vehicle and fast repairs if breakdowns occur
KPIs (performance metrics)	the KPIs are misleading, they mostly focus on internal metrics and not on the customer

In the next section, supply chain designs and strategies are presented. These designs and strategies can be applied to the aftermarket and form a base for adapting the aftermarket supply chain for the case company.

2.2 Configuring the aftermarket supply chain design

Saccani et al. (2007, p. 53) state that "the configuration of a supply chain refers to how it is designed with respect to the activities carried out within it". In this section the configuration of the aftermarket supply chain design is accounted for, which founds the base for answering research question three, on how the aftermarket supply chain should be adapted in regard to the bundled service offers, based on the challenges identified.

2.2.1 Physical flow of material between actors

The definition of a supply chain can be perceived as a set of three or more entities directly involved in the upstream and downstream flows of different factors such as products, services, finances and information (De Leeuw & Beekman, 2008). De Leeuw and Beekman (2008, p. 57) states that "since a supply chain is a mix of processes that ties chain partners together, performance of one activity within a company may influence the performance of a supply chain as a whole." A supply chain consists of actors, which control resources and undertake activities (Gadde et al., 2010). Actors are e.g. suppliers, logistics providers, warehousing providers, dealers and end customers. According to De Leeuw and Beekman

(2008, p. 61): “The automotive spare parts supply chain contains billions of dollars in inventory, stocked at thousands of locations, with high transportation costs when shipments must be expedited.”

Physical distribution of goods aims at ensuring that supply is located where it is needed, i.e. available (Gadde et al., 2010). Availability can be secured in two ways; first, supply can be produced and then stocked, and second, companies can commit to deliveries from suppliers (Gadde et al., 2010). Regardless of how availability is achieved, the handling of physical flows requires a well-designed supply chain. A supply chain design should take three factors into consideration, namely; infrastructure, transportation means, and facilities (Gadde et al., 2010).

Infrastructure implies that there are roads, railways, ports, airports, etc. that make the physical flow possible (Gadde et al., 2010). That in turn affects the means of transport, which typically are trucks, trains, vessels, and airplanes. Facilities involve warehouses, equipment for material handling, terminals, etc. and these facilities are involved in the operation of the physical distribution of goods. Transportation between facilities can be performed by 3rd party logistics providers (Gadde et al., 2010).

Furthermore, to utilize the uttermost of the supply chain design, information has a critical role (Gadde et al., 2010). Forecasting expected volumes and planning of these are important in order to pursue flow efficiency. Next, frequency of deliveries also impacts the efficiency of physical flows. There is a tendency towards increased frequency of deliveries among many industries since the rise of just-in-time (JIT) deliveries. JIT deliveries arose with the Japanese Lean concept in order to reduce inventory levels, and have been widely adapted by the automotive industry (Gadde et al., 2010). The result is that lower volumes are distributed with higher frequency of deliveries in individual physical flows, which has increased the interdependence among supply activities (Gadde et al., 2010).

To conclude section 2.2.1, a supply chain consists of many actors, e.g. logistics providers, suppliers, etc. To enhance availability, the handling of physical flows require a well-designed supply chain that takes three factors into account; infrastructure, transportation and facilities.

2.2.2 Matching supply chains to product types (bundled service offers)

Fischer (1997) has suggested a framework on how to improve the performance of the supply chain. The framework is originally designed for physical products, but in this thesis it is adapted to fit services, the bundled service offers. The framework is not specific to the aftermarket, but it is used to explain the aftermarket supply chain as a building block for the assessment. This is possible since the bundled service offers require different types of supply chain designs or adapted supply chains to fulfill the requirements of the offers. When designing a supply chain to suit a specific product type, the key is to consider nature of demand for the product (Fischer, 1997). According to Fischer’s (1997) framework, a

product can be divided into two categories; functional or innovative. The characteristics for each product type are further accounted for in Table 2.3.

Table 2.3: Characteristics of functional and innovative product types. Adapted from Fischer (1997).

Parameter	Functional	Innovative
Demand	Predictable	Unpredictable
Life cycle	More than 2 years	3 months to 1 year
Contribution margin	5-20 percent	20-60 percent
Product variety	Low (10-20 variants per category)	High (millions of variants per category)
Average margin of forecast error at time production is committed	10 percent	40-100 percent
Average stock-out rate	1-2 percent	10-40 percent
Average forced end-of-season mark-down as percentage of full price	0 percent	10-25 percent
Lead-time required for made-to-order products	6 months to 1 year	1 day to 2 weeks

Fischer (1997) states that functional products aim to satisfy basic needs that do not change much over time. The demand is stable and predictable and the product life cycle is rather long. Functional products are also associated with low profit margins as their stable demand attracts competition. The counterpart, innovative product types, have better profit margins, but demand for innovative products are unpredictable and the life cycle is short, usually just a few months. The life cycle is decreased in comparison to the functional product since the competitive advantage of innovation is quickly diminishing due to imitators entering the market (Fischer, 1997).

To serve the requirements of the two product types, they need to be matched to the right supply chain. According to Fischer (1997), there are two types of supply chains; physically efficient ones and market-responsive ones. The differences between the two supply chains are accounted for in Table 2.4.

Table 2.4: Characteristics of physically efficient and market-responsive supply chains. Adapted from Fischer (1997).

Parameter	Efficient	Responsive
Primary purpose	Supply predictable demand efficiently at lowest cost	Respond quickly to unpredictable demand to minimize stock-outs, forced markdowns, and obsolete inventory
Manufacturing focus	Maintain high average utilization rate	Deploy excess buffer capacity
Inventory strategy	Generate high turns and minimize inventory	Deploy significant buffer stocks of parts or finished goods
Lead-time focus	Shorten lead-time without increased costs	Invest aggressively in ways to reduce lead-time
Approach to selecting suppliers	Select primarily for cost and quality	Select primarily for speed, flexibility, and quality
Product-design strategy	Maximize performance and minimize cost	Use modular design to postpone product differentiation as long as possible

Therefore, functional products should be matched with an efficient supply chain, whereas innovative products should be matched with a responsive supply chain according to Figure 2.1.

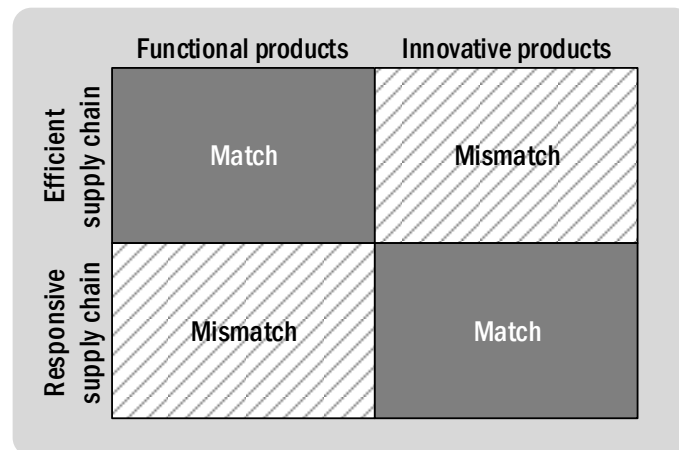


Figure 2.1: Matching supply chains with product types. Adapted from Fischer (1997).

To conclude section 2.2.2, Fischer (1997) has suggested a framework to improve the performance of the supply chain. According to the framework, products are divided into functional or innovative products. The requirements of the two product types need to be matched to the right supply chain, responsive or efficient.

2.2.3 Centralization versus decentralization

When it comes to the degree of centralization, the most common practice is centralization of warehouses, which implies that national warehouses are closed and regional warehouses are instead supposed to serve a whole region (Saccani et al., 2007), as depicted in Figure 2.2.

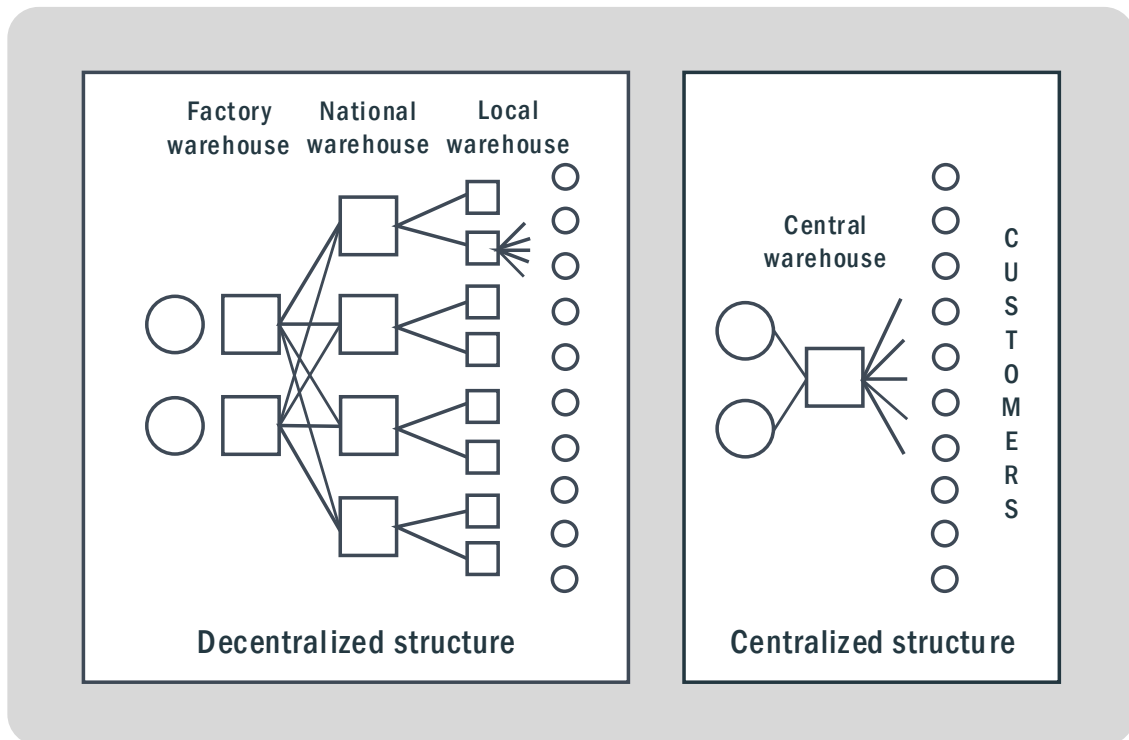


Figure 2.2: Decentralized and centralized structures. Adapted from Abrahamsson (1993).

The concept of centralization and decentralization is used to explain the aftermarket supply chain as a building block for the assessment. The concept relates to the bundled service offers because of the flow of spare parts and where the spare parts should be stored which is also dependent on how fast transportation is needed for the service offers.

Saccani et al. (2007) stress that the main reason for companies to shut down national warehouses is to reduce tied-up capital in terms of inventory and to reduce the number of warehouse locations. The study by Hilmola and Lorentz (2011) shed light on the international warehouse location criteria in northern Europe, especially Sweden and Finland. Large enterprises in Sweden and Finland participated in the survey and the findings were that warehouse location depends on three factors, namely; distribution cost, road transportation connections, and proximity of assembly and manufacturing units (Hilmola & Lorentz, 2011). Saccani et al. (2007) further specify that proximity is especially important for services since customers often participate in offline service executions. Offline services, as opposed to online services, hence require a bigger need for geographical accessibility (Cho & Park, 2013).

Cohen et al. (2000) state that the supply chain strategy can be matched with criticality. Criticality is defined as how urgent it is for the customer to get the spare parts. When criticality is top priority, national warehouses are preferred, but when criticality is less important, a central warehouse or distribution point is better from an economical perspective. It is important for companies to understand the criticality of their products and services in order for them to improve their after-sales services (Cohen et al., 2000). Low service criticality is matched with a centralized service strategy, whereas high service criticality is matched with a decentralized service strategy. Furthermore, to distinguish between the two types of strategies, Table 2.5 shows the main differences between centralized and decentralized service supply chain strategies with regard to performance targets, network structures, planning processes, and fulfillment processes (Cohen et al., 2000).

Table 2.5: Comparison of a centralized and decentralized service supply chain strategy. Adapted from Cohen et al. (2000).

Attributes	Centralized	Decentralized
Performance targets	· Achieving the highest level of inventory at the lowest cost	· Ensuring that customers can rapidly obtain any critical part
Network structure	· A small number of central warehouses and repair depots	· Inventory and repairs available from locations close to customers
Planning process	· Visibility of demand at the point of sale · Statistical forecasting of local demand and lead-times · Stocking decisions at retail locations made independently of network decisions	· Inventory and transaction visibility at all levels · Forecasting based on estimates of reliability of parts and installed base (customer region) · Stocking decisions are made based on what products are required and where they are available for all locations
Fulfillment process	· Drop-off or mail-in repairs are a viable alternative · Little fulfillment coordination needed among stocking locations · Both planning of inventory levels and physical fulfillment may be outsourced	· Parts are designed to be easily serviced by the service provider · A high level of coordination exists among all stakeholders in the supply chain · Planning of supply chain management is rarely outsourced

The centralized strategy aims at achieving cost reductions, but also the highest level of inventory turnover. As for the decentralized strategy, the main performance target is to ensure that customers are served as rapidly as possible. When it comes to the network structure, the centralized strategy has only a small number of central warehouses and repair dealers, whereas in the decentralized strategy dealers and warehouses are closer to the customer. It is important to consider the location of warehouses and dealers and the interrelationship between the two. Furthermore, the planning process is rather different for the two types of strategies (Cohen et al., 2000).

The centralized planning process is based upon visibility of demand at the point of sale, statistical forecasting of local demand and lead-times, and stocking decisions at retail locations are made independently of network decisions. On the other hand, attributes of the decentralized planning process are inventory and transaction visibility at all levels, forecasting is based on estimates of reliability of parts and installed base in the customer region, and stocking decisions are made based on what products are required and where they are available for all locations (Cohen et al., 2000).

As for the centralized fulfillment process, drop-off or mail-in repairs are viable alternatives. There is little fulfillment coordination needed among stocking locations, and both planning of inventory levels and physical fulfillment may be outsourced. For the decentralized fulfillment process, parts are designed to be easily serviced by the manufacturer. A high level of coordination exists among the stakeholders in the supply chain, and the planning of supply chain management is rarely outsourced (Cohen et al., 2000).

Furthermore, Abrahamsson (1993) has another perspective on centralization and decentralization. He describes two types of traditional theories on how to design a distribution system. The first theory is the marketing channel theory, which focuses on the geographical distance between the producer and customers, but it also depends on the customer demand (Abrahamsson, 1993). The marketing channel includes business functions in the channel, gaps between the producers and the customers and intermediaries within the channel. The gaps in the channel include a time gap, geographical gap, quantity gap and variety gap. The consequence of this gap is that producers and customers operate independently, e.g. producer's large production batches mismatch the customer demand for small quantity, etc. The middlemen should therefore create utilities in place, time quantity, assortment and possession (Abrahamsson, 1993).

The second theory is the logistics theory, which focuses on the material flows from suppliers to customers (Abrahamsson, 1993). The number of warehouses in the logistics theory is calculated with a total cost analysis where the total physical distribution cost is decided upon inventory cost, warehousing cost, transportation cost and cost of lost sales. The geographical distance also matters and the number of warehouses has an impact on the customer service. This is the reason why cost of lost sales can potentially increase when the number of warehouses is decreased. Lead-time also has an impact on the number of warehouses; if short lead-times are required, or if customer demand is difficult to predict, it is recommended to have a warehouse in closer proximity to the customer (Abrahamsson, 1993).

Both theories are based on geographical distance to the end-customers, but Abrahamsson (1993) argues that distribution structures should be time-based, and therefore focus on delivering to customers within a specified time rather than focusing on locating warehouses geographically close to the customers. By using the time-based direct distribution theory, companies can reduce inventory, reduce average lead time to customers, increase delivery performance, reduce the number of employees, decrease distribution costs and reduce

tied up capital (Abrahamsson, 1993). The general effects of using the time-based direct distribution theory are illustrated in Table 2.6.

Table 2.6: Characteristics of the time-based direct distribution theory. Adapted from Abrahamsson (1993).

Logistics cost leadership	Logistics buyer value
<p>Fixed distribution costs:</p> <ul style="list-style-type: none"> · Decreased costs for personnel, warehouses and administration. 	<p>Lead-times:</p> <ul style="list-style-type: none"> · Shorter and more reliable lead-times for all markets and for all products.
<p>Variable distribution costs:</p> <ul style="list-style-type: none"> · Reduced inventory costs. · Constant transportation costs. 	<p>Delivery performance:</p> <ul style="list-style-type: none"> · Increased on-time deliveries. · Complete orders to the customers.
<p>Savings in integration/separation:</p> <ul style="list-style-type: none"> · Sales function separated from the materials flow. · Centralized control of the materials flow – economies of scale. · Integrated distribution functions. 	<p>Differentiation:</p> <ul style="list-style-type: none"> · Customized distribution to different groups of customers. · Increased flexibility.
<p>Savings in learning costs:</p> <ul style="list-style-type: none"> · Faster introduction of new products, in the assortment. 	<p>Customer information:</p> <ul style="list-style-type: none"> · Faster and more reliable information, to the customers about discrepancy.

To conclude section 2.2.3, a supply chain can have either a centralized structure or a decentralized structure. A centralized structure is characterized by fewer warehouses whereas in the decentralized structure, inventory is stored closer to customers. Furthermore, Abrahamsson (1993) describes two types of traditional theories, the marketing channel theory and the logistics theory.

2.2.4 Speculation versus postponement

Pagh and Cooper (1998) have accounted for a postponement/speculation strategy matrix. The matrix is used to explain the aftermarket supply chain as a building block for the assessment. In order to find out what speculation/postponement strategy that is suitable for the different bundled service offers, Pagh and Cooper's (1998) matrix will be used.

According to Pagh and Cooper (1998, p. 14) postponement is defined as: "to postpone changes in inventory location downstream in the supply chain to the latest possible point." With postponement, risk and uncertainty costs are connected to different forms, locations and times of the products during the manufacturing and logistics phase. On the other hand, Pagh and Cooper (1998, p. 14) define speculation as: "the converse concept of postponement, which holds that changes in form, and the movement of goods to forward inventories, should be made at the earliest possible time to reduce the cost of the supply chain." With speculation companies can gain economies of scale in both manufacturing of the products and logistics operation and by that limit the number of stock outs

(Pagh & Cooper, 1998). The postponement/speculation strategy matrix is illustrated in Figure 2.3. The matrix includes four supply chain postponement/speculation strategies, the full speculation strategy, the logistics postponement strategy, the manufacturing postponement strategy and the full postponement strategy (Pagh & Cooper, 1998).

		Logistics	
		Speculation Decentralized inventories	Postponement Centralized inventories and direct distribution
Manufacturing	Speculation Make to inventory	Full speculation strategy	Logistics postponement strategy
	Postponement Make to order	Manufacturing postponement strategy	Full postponement strategy

Figure 2.3: The postponement/speculation strategy matrix. Adapted from Pagh and Cooper (1998).

In the full speculation strategy, the order point is set at the lowest level downstream in the supply chain. The products are distributed with decentralized distribution systems and the products are stocked downstream and therefore closer to customers. With this strategy economies of scale can be gained. The decentralized inventories are costly, in fact the most costly of all four strategies (Pagh & Cooper, 1998).

In the manufacturing postponement strategy the final manufacturing operations are done downstream in the supply chain at the point after the products have been logistically differentiated. The final operations are performed after a customer has placed an order, therefore the order point is set before the final manufacturing operations. This strategy is inventory initiated and centralized until the order point, from there, the products are distributed and stocked with decentralized distribution systems (Pagh & Cooper, 1998). Manufacturing postponement is a suitable strategy when it is important to have inventories close to customers. By using this strategy, vaster variety of differentiated products can be achieved and the inventory will be reduced. The cost and complexity with customer orders will, however, increase and economies of scale will decrease (Pagh & Cooper, 1998).

In the logistics postponement strategy, finalized products are directly distributed to customers from a centralized inventory. The order point is set upstream on a central warehouse level. The manufacturing operations are inventory initiated and the logistics operations are customer order initiated. This strategy is associated with better on-time deliveries

of complete orders, reduced inventory costs, shorter and more reliable lead-times, more stable transportation costs and quicker introduction to new products can be reached. High in-stock availability can be reached with less inventory levels due to the centralization of the inventories. However, shipment costs may be higher because of faster transportation modes and smaller shipment sizes (Pagh & Cooper, 1998).

In the full postponement strategy both the manufacturing and logistics operations are initiated by customer orders. The order point is set at the last stage of the manufacturing operations. By using this strategy, inventory costs are lowered and inventories are decreased in the distribution system (Pagh & Cooper, 1998). To conclude, characteristics of each postponement/speculation strategy is shown in Figure 2.4.

		Logistics	
		Speculation Decentralized inventories	Postponement Centralized inventories and direct distribution
Manufacturing	Speculation Make to inventory	<ul style="list-style-type: none"> • Low production costs • High inventory costs • Low distribution costs • High customer service 	<ul style="list-style-type: none"> • Low production costs • Low/mid inventory costs • High distribution costs • Low/mid customer service
	Postponement Make to order	<ul style="list-style-type: none"> • Mid/high production costs • Mid/high inventory costs • Low distribution costs • Mid/high customer service 	<ul style="list-style-type: none"> • Mid/high production costs • Low inventory costs • High distribution costs • Low customer service

Figure 2.4: Implications of all the four postponement/speculation strategies. Adapted from Pagh and Cooper (1998).

Pagh and Cooper (1998) account for decision determinants when deciding upon which postponement/speculation strategy to use. The decisions determinants analyzed are: the product life cycle, monetary density, value profile, product design characteristics, delivery time, frequency of delivery, demand uncertainty, economies of scale and special capabilities (Pagh & Cooper, 1998).

First, it is important to consider the product when deciding upon a postponement/speculation strategy, especially its life cycle, product characteristics and value. The product life cycle has different stages; introduction, growth, maturation and decline. The focus in the first two stages is on customer service but also to some extent on manufacturing and logistics. In the two last stages, a postponement/speculation strategy that reduces risk, uncertainty and costs is needed. Appropriate postponement/speculation strategies for the first two stages are from the upper-left corner of the postponement/speculations strategy matrix

shown in Figure 2.3 and for the last two stages from lower-right corner of the matrix (Pagh & Cooper, 1998). The value of the product is divided into monetary density and value profile. Monetary density is explained as the ratio between the monetary value of a product and the weight/volume of it. It is costly to store products with high monetary density but not so costly to move them, and it is of great advantages to postpone the final logistics operations. The value profile of a product relates to when and how much the value of the product increases throughout the manufacturing and logistics process. If most of the product value is added in the final operations of the manufacturing and logistics processes it is more beneficial to postpone the operations (Pagh & Cooper, 1998). The product design characteristics are either the product type or the product range. Standardized products have a limited risk of speculation but customized products will benefit greatly from postponement. Therefore, standardized and narrow product lines should use a postponement/speculation strategy from the upper-left corner of the postponement/speculation matrix, but specialized and broad product lines should use the ones from the lower-right corner Pagh and Cooper (1998).

Next, Pagh and Cooper (1998) stress that it is important to consider the market and demand for the product. The needs for customers and intermediaries must be understood in order to select the most suitable strategy. Those needs are best described by means of relative delivery time, relative delivery frequency, and uncertainty of demand. Relative delivery time refers to the average time it takes to deliver to customers in relation to average manufacturing and delivery lead-times. Relative delivery frequency is the average delivery frequency in relation to manufacturing and delivery cycle time. In case customers require short delivery times and/or high delivery frequencies, appropriate strategies are those of speculation. In case of long delivery times and/or low delivery frequencies, the appropriate strategies are those of postponement (Pagh & Cooper, 1998). When it comes to demand uncertainty, this is best described by Fischer's (1997) categorization of functional and innovative products. Pagh and Cooper (1998) stress that speculation strategies are best suited for functional products, whereas postponement is best suited for innovative products.

Lastly, it is important to consider the manufacturing and logistics operations, especially in terms of economies of scale and special capabilities. Pagh and Cooper (1998) stress that if economies of scale or special capabilities are required in the manufacturing and/or logistics processes, then it could be advantageous to use speculation to some extent. A postponement/speculation strategy from the upper-left corner could therefore be useful (Pagh & Cooper, 1998).

The determinants described above are not exhaustive but could give managers some insight into what factors should be considered when choosing a postponement/speculation strategy. Using the profile analysis will serve managers as an assistant tool for selecting the right postponement/speculation strategy and analyze how the connection between determinants and postponement/speculation strategy can be improved (Pagh & Cooper, 1998). The profile analysis concept is shown in Figure 2.5.

Some important P/S-decision determinants			Generic P/S-strategies			
			The full speculation strategy	The manufacturing postponement strategy	The logistics postponement strategy	The full postponement strategy
P r o d u c t	Life cycle	Stage	Introduction	Growth	Maturation	Mat./Decline
		Volume	Low/Med.	Med./High	Med./High	Low/Med.
		Cost/service strategy	Service	←————→	————→	Cost
	Product characteristics	Product type	Standard	←————→	————→	Customized
		Product range	Narrow	←————→	————→	Wide
	Value	Value profile	Initial stages	←————→	————→	Final stages
		Monetary density	Low	Low	High	High
		Relative delivery time	Short	←————→	————→	Long
	Market and demand	Delivery frequency	High	←————→	————→	Med./Low
		Demand uncertainty	Low	←————→	————→	High
Economies of scale		Large	Small	Large	Small	
Manufacturing & logistics	Special capabilities	Yes	No	Yes	No	

Figure 2.5: The concept of the profile analysis. Adapted from Pagh and Cooper (1998).

To conclude section 2.2.4, Pagh and Cooper (1998) introduce a postponement/speculation strategy matrix. The matrix includes four strategies, the full speculation strategy, the logistics postponement strategy, the manufacturing postponement strategy and the full postponement strategy. By using the profile analysis, which consists of decision determinants, the most suitable strategy can be found. In the next chapter, the methodology for the study is presented. Chapter four explains the current situation, the bundled service offers and the aftermarket supply chain at the case company.

3. Methodology

This chapter describes the rationale for how this study was conducted and what methods that were used. The chapter starts with section one where the research design is described. The study is threefold, and the three phases are further explained in this chapter. The phases are Current situation, Assessment, and Recommendation and cover section two, three and four. The chapter also clarifies considerations that have been taken into account and ends with an assessment of reliability and validity of the study in section five.

3.1 Research design

The purpose of this thesis is to provide the case company with recommendations on how they could adapt their aftermarket supply chain in terms of operational and organizational principles to meet the requirements of the bundled service offers they currently provide. The aftermarket supply chain of the case company has a very complex design, therefore it is of great significance to adapt the study to the contextual situation. Against the backdrop of the complexity of the aftermarket supply chain, the research design chosen was a case study, which is also recommended by Bryman and Bell (2011) as well as Yin (2014).

According to Bryman and Bell (2011), a case study allows for qualitative research, and the emphasis is upon intensive examination of the contextual setting. Case studies favors qualitative methods since these are especially helpful in the process of achieving detailed information about the company. Qualitative methods used in this thesis were unstructured and semi-structured interviews combined with documentary data gathered from the case company's intranet. Most studies can be constructed as case studies, but what is unique for a case study per se is to distinguish exclusive features of the case. This is explained as an idiographic approach according to Bryman and Bell (2011), and also the approach that will be used in this study. This allowed for coming up with recommendations that were especially suited for the case company, and yielded case specific optimization of the supply chain regarding organizational and operational principles.

The chosen research strategy was qualitative since this is suitable for a case study (Yin, 2014). Combining case studies with a qualitative research strategy is usually associated with an inductive approach (Bryman & Bell, 2011). Inductive approaches are more open-ended and exploratory than the deductive approach. As this research required some exploration within the case company, an inductive approach was more suitable than the deductive. In order to answer the research questions specified, it was beneficial to start by gathering information, followed by seeing patterns, and then draw conclusions based on both the context and previous research, which is in line with the inductive approach that Bryman and Bell (2011) describes.

The epistemological orientation used for this thesis was interpretivism since this is suitable for qualitative research (Bryman & Bell, 2011). This means that data was gathered in the sense of understanding the current setting through an examination of how the employees

within the case company perceived the setting. Interpretivism is the most common epistemological position for qualitative research (Bryman & Bell, 2011), and it is also suitable in this case. Since there was insufficient time to communicate directly to all of the actors within the aftermarket supply chain, information about the supply chain was gathered from employees within the case company.

Bryman and Bell (2011) describe the general steps in qualitative research. The steps are shown in Figure 3.1 and how these steps were contextually adapted to this research in particular.

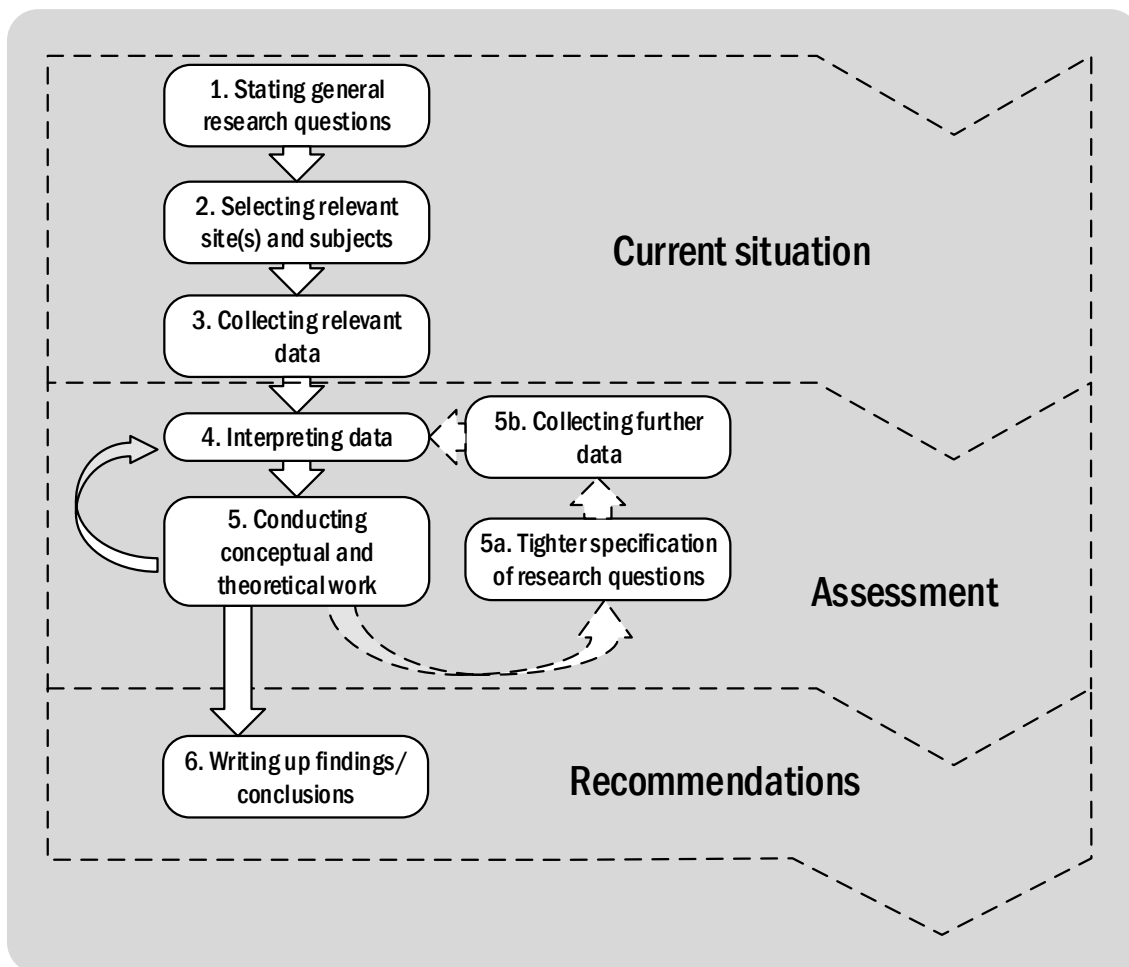


Figure 3.1: General steps in qualitative research. Adapted from Bryman and Bell (2011).

As shown in Figure 3.1, this study is divided into three phases: current situation, assessment, and recommendations, which are described in further detail in the following sections. The current situation phase accounts for stating the general research questions, selecting relevant sites and subjects and lastly to collect relevant data at the case company. The assessment phase includes interpreting the data accounted for in the previous phase, conducting conceptual and theoretical work in terms of the frameworks provided in the literature review. Bryman and Bell (2011) state that tighter specification of research questions could be done in this phase if deemed necessary, and that could in turn lead to

more data gathering. The last phase is the recommendations phase that accounts for the findings in relation to the output identified in the assessment.

3.2 Current situation

The first phase is an investigation about the current situation at the case company. In order to address the first research question on what the key challenges are with the aftermarket supply chain in regard to the bundled service offers, it was first required to map the current state of the company. The mapping includes all of the services currently offered with the vehicles as well as a mapping of the current aftermarket supply chain at the case company. Data needed was gathered through interviews with employees involved with all of the brands the case company manages. The case company's intranet, Violin, was also used for further information gathering.

3.2.1 Literature and frame of references

The initial point in this phase was to review relevant literature. In pursuance to keep this thesis as up to date as possible, but also to keep it as all covering as possible, a well-defined literature search approach was used. First, a domain based search approach was followed. The first step was to decide which subject areas to search, which keywords to use, what business sectors to examine, the geographical area, the publication period, and what literature types to use.

As for the subject areas, these are supply chain management, service management, and service marketing. Keywords, keyword variants and synonyms were used to capture all relevant articles are shown in Appendix F. The business sectors chosen were those similar to the automotive industry, which implies high-tech, unique and complex industries where no or little standardization exists. The business sectors include the automotive, aerospace, manufacturing, and defense sectors. When constraining the geographical area, mainly Europe was used, but there were also searches that were not restricted to any particular geographical area. It was also decided to only include recently published articles that were written during the last decade and until today. The reason for this was to narrow down the search even more, and to keep the articles up to date, but additionally some older and well-known articles in the supply chain area were used as well. Literature types used were peer-reviewed academic articles, books, and conference proceedings, where the first mentioned has highest priority in reliability. The validity of the sources was established simultaneously as the search was carried out, which means that attention was put on where the material was published, and whether it was empirical or conceptual. In total, there were 23 academic articles and 4 books used in this thesis.

The domain based search approach was conducted by starting with a simple search based on the above set search criteria. The number of hits were evaluated and the search criteria were adjusted until a reasonable amount of hits was left. Boolean functions were also used

to combine the keywords in different ways so the search was narrowed down. The articles were reviewed and analyzed.

In pursuance to make the literature search more robust, a second search approach was used. This approach, trusted sources search, was initiated by reviewing the subjects by highly ranked academic journals. These journals were reviewed: International Journal of Physical Distribution & Logistics Management, International Journal of Operations & Production Management, Journal of Business Logistics, Supply Chain Management: An International Journal, Journal of Supply Chain Management, and International Journal of Logistics Management.

The third search approach used was the snow-balling approach also referred to as 'backtracking' approach. This search approach was used to backtrack core articles in the thesis found by using the other two search approaches mentioned above.

Journals and articles were accessed through the library of Chalmers University of Technology, and the Summon database of the library was also used in order to do some free-based searches on keywords, such as: 'aftermarket', 'automotive', 'servicing', 'supply chain', 'uptime'. All keywords can be found in Appendix F.

3.2.2 Interviews with employees

As this research is explorative in nature, semi-structured and unstructured interviews were deemed appropriate. These contributed to detailed accounts of individuals' experiences and perceptions. Qualitative interviewing allows the interviewer to depart from the intended questions but the interviewer can also reply to the interviewee if something is unclear and needs to be discussed further (Bryman & Bell, 2011). Unstructured interviews are similar to conversations, the interviewer may ask an initial question and the interviewee can answer freely, whereas the interviewer can respond to points that seemed worthy to follow up on. In contrast to unstructured interviews, semi-structured interviews are based upon an interview guide, which has been prepared before the interview and contains questions and/or topics that the interviewer want covered. The interview guide must not be followed in the order it was written, the interviewer can intervene and ask questions in a different order and may even come up with new questions. The interview guide was prepared before conducting the interviews and can be found in Appendix D.

In total, 20 interviews were carried out and they typically lasted 45 to 90 minutes. The interviews were recorded whenever the interviewee allowed for it, which prevented information from being left out when taking notes. The interviewees are anonymous throughout the study and are referred to as respondent 1, 2, etc. A list of the interviewed respondents as well as the interview questions are found in Appendix E. Whom to interview was decided in accordance with the supervisors of the thesis, who had good overview knowledge of which to contact within the organization. Additionally, some respondents also gave some suggestions on which additional respondents to interview within their respective areas.

Qualitative interviewing is deemed appropriate when carrying out qualitative research (Bryman & Bell, 2011). However, the method is not flawless. One flaw experienced during this thesis process was that interviews are time-consuming. Scheduling the interview, conducting the interview, and the transcription of the interview takes much time (Kvale, 1996). The interviewers also need to be prepared before the interview, which requires careful preparations (Kvale, 1996). Furthermore, factors such as tone of voice, voicing an opinion, inadequate note taking, and even the interviewer's appearance may lead to errors and bias. Interviews are also prone to biases since interviewees may state strong opinion that could differ from what other people would state (Kvale, 1996). This was a challenge when assessing the interviews, and the interviewers were well-aware of that the opinions were individual and it was therefore avoided to present opinions as a general view of the case company. Furthermore, flexibility is usually the advantage with interviews, but too much flexibility may result in inconsistencies across interviews (Kvale, 1996). This was taken into account and interview guides were formed. The interview guides can be found in Appendix D. The interview guides also made sure that subjects covered were related to the research questions. The interview guides also made the assessment phase easier, since the data entry was already established from the guides.

3.2.3 Documentary data

Documentary data from the case company's intranet, Violin, covered for insufficient information from interviews, but also for triangulation purposes. The global Volvo Group Trucks webpage was also searched, both for finding relevant information about the company and its functions.

3.2.4 Secondary evidence

In order to answer research question two, on what other companies identify as supply chain challenges in regard to aftermarket services, data gathering from secondary evidence was needed. Data was gathered from consultancy reports from websites of various consultancy firms. In addition, online industry presses from the Automotive Logistics Magazine were reviewed and included if relevant. The secondary evidence was mainly used to identify challenges in the aftermarket.

3.2.5 Study visits

In order to understand the customer perspective of the bundled service offers, a dealer visit took place at a Volvo Trucks Center in Bäckebo, Gothenburg. It was important for the thesis to get the dealer perspective in regard to the bundled service offers; what advantages and drawback they see in reality. A study visit was also performed at the support warehouse in Arendal, Gothenburg. The study visits contributed to the understanding of the current aftermarket supply chain of the case company since gathered information from interviews could be demonstrated in reality.

3.3 Assessment

The assessment phase consists of findings from interviews with employees, but also findings from secondary data in terms of consultancy reports and industry presses. In this phase, the focus was on the first and second research questions.

3.3.1 Empirical scope

The bundled service offers that impact the aftermarket supply chain constitute the empirical scope in this study. The offers that were considered to impact the supply chain are those that include repair services and that have a need for availability of spare parts. For that reason, the bundled service offers we chose to focus on were the service contracts, which are further described in section 4.1 on page 35. The service contracts exist in different editions depending on what services are included in them. The service contracts are divided into the Blue contract, which is the most basic contract, the Silver contract, and then the Gold contract, which is the most advanced contract that includes a 100 percent uptime promise of the vehicle.

3.3.2 Research question 1

The first research question reads: “What are the key challenges with the aftermarket supply chain in regard to the bundled service offers?” This research question aimed at finding out about what challenges the case company currently faces. It was necessary to have an explorative question like this in order to answer the third research question, which include recommendations based on the found challenges. In order to answer research question one, the first step was to gather information about all of the offers that the case company provides. These offers are accounted for in Appendix B. When descriptions of all the offers were established, the next step was to choose which offers to focus on. The offers that impact the aftermarket supply chain constitute the empirical scope of this study as explained above. The offers that was decided to focus on are accounted for in section 4.1 on page 35.

Data about aftermarket challenges that the case company experiences was gathered from interviews with employees, mainly from a managerial perspective, but study visits were also performed. A literature review about aftermarket challenges was carried out in parallel with the empirical data gathering. The challenges found from interviews and literature are accounted for in chapter five. These challenges were then put in relation to the service contracts in Table 5.2 on page 55. When deciding which challenges that relate to which contract type, mainly one decision determinant was used, i.e. if there were contracted promises to the customer and what types of spare parts that were involved. This determinant was mainly used to distinguish between the contracts. Challenges impacting a contract’s logistics of spare parts were marked with an X. These challenges constitute the answer to research question one.

3.3.3 Research question 2

The second research question reads: “What other supply chain challenges do other companies identify as regards to aftermarket services?” Research question two is similar to research question one (RQ1: What are the key challenges with the aftermarket supply chain in regard to the bundled service offers?), but this research question served as a benchmarking study to find out about challenges from other leading companies within the aftermarket. The benchmarking study contained consultancy reports, but also industry presses. The benchmarking challenges are accounted for in chapter six. They were then put in relation to the service contracts in Table 6.1 on page 66 with the same procedure that was applied for research question one. The challenges that impacted the service contracts’ logistics of spare parts constitute the answer to research question two.

3.4 Recommendations

In the recommendations phase the assessment turned into recommendations for the case company. In this phase, the focus was on the third research question, where theoretical frameworks were applied to the service contracts in order to provide recommendations for the case company.

3.4.1 Research question 3

The third research question reads: “How should the aftermarket supply chain be adapted in regard to the bundled service offers, based on the challenges identified?” In order to answer research question three, the service contracts were analyzed with Fischer’s (1997) framework and Pagh and Cooper’s (1998) profile analysis, and these were discussed in terms of Abrahamsson’s (1993) ideas about centralization and decentralization. The frameworks were adapted to fit the case company’s service contracts, but they were originally design for physical products. The output of the two frameworks was different supply chain designs and strategies. The empirical evidence from the case company was also taken into account when the recommendations were formed as well as findings from the benchmarking study. The recommendations originate from ideas both from literature as well as the empirical findings and constitute the answer to research question three.

3.5 Reliability and validity

Reliability and validity are important factors when establishing the quality of the research, more so in quantitative research than in the qualitative equivalent (Bryman & Bell, 2011). Bryman and Bell (2011) stress that measuring validity for qualitative research is difficult since measurements are usually not carried out in qualitative studies. Therefore, there are other factors to consider when carrying out qualitative research. Literature suggests that these factors should be taken into account: credibility, transferability, confirmability, dependability and lastly authenticity (Bryman & Bell, 2011). These factors were borne

in mind from early on in the process of conducting this thesis in pursuance to establish trustworthiness and high quality research.

Credibility refers to trustworthiness of the results. The results need to be credible or believable from the participants' perspective (Sinkovics et al., 2008). The participants themselves are the only ones that are able to legitimately judge the credibility of the findings (Bryman & Bell, 2011), therefore both respondent validation and triangulation techniques were used in this study. The participants in this study were the interviewees referred to as respondents, and respondent validation was applied by recording the interviews. If something was unclear from the recording, a follow-up meeting or e-mail was established in order to validate the data provided by the respondent. Towards the end of this thesis, all data that was used from the respondents was sent to them via e-mail and validated by each participant. Furthermore, mutual content mainly regarding the current situation at the case company was also validated with another thesis group conducting their own thesis at Volvo Group Truck Operations, within Logistics Services. This was done to verify even further that the information gathered was correct. Furthermore, triangulation was applied by confirming data from respondents with documentary data from the intranet. Data from interviews was also triangulated by asking identical questions to respondents.

The next criterion of establishing trustworthiness is transferability. Transferability refers to the degree to which the conducted research can be transferred to other contexts (Bryman & Bell, 2011; Sinkovics et al., 2008). To make the theories, in this case recommendations, generalized or transferrable is the responsibility of the researchers only. Bryman and Bell (2011) stress that transferability can be enhanced by thoroughly describing the context in which the research is conducted, and also state assumptions that were made. This study focuses on the bundled service offers that the case company provides. This context can also be transferred to the bundled offers of Volvo Penta, Volvo Construction Equipment and Volvo Buses, as these offers are similar. The overview of the service offers are meant as a description that may serve as a base for partly transferring the given recommendations to these offers as well.

Furthermore, to allow for good transferability it is significant that the researchers are honest about the findings, and have a neutral or objective stance (Sinkovics et al., 2008). This is known as confirmability (Bryman & Bell, 2011). To enhance confirmability of this study, contradictory data was actively searched for in order to confirm that the data gathered was correct, but also in order to actively be reminded of scrutinizing the data and keeping an objective perspective.

Sinkovics et al. (2008) explain dependability as a criterion as for how the research will stand over time, and also the ability to replicate the research. Replicating qualitative research is difficult since it is context based, and contexts change over time. Therefore, this study is clear about the current setting at the case company, and known changes therein are accounted for. For example, the support warehouse in Eskilstuna (Sweden) is under reorganization and it was taken into consideration when developing the recommendations.

Authenticity was also taken into account when conducting this study. The authenticity criterion involves the political impact of research (Bryman & Bell, 2011). Authenticity was dealt with by interviewing many different functions within the case company. The authors of the thesis were present at the case company during the whole process, which strengthens the reliability of the study. Additionally, study visits took place at a Volvo Trucks dealer and the support warehouse in Gothenburg.

4. Current situation

This chapter includes the current situation at the case company and is thought to give a better understanding of the current situation before further assessment is carried out. The current situation is divided into two sections. The first section is a description of the Volvo Group Trucks bundled service offers which impact the aftermarket supply chain. The second section is about the current set-up of the aftermarket supply chain at the case company.

4.1 Bundled service offers

Currently, Volvo Group offers different bundled service offers to their customers. The bundled service offers aim to increase customer loyalty between OEMs, dealers and end-users and thereby also income to the Volvo Group and dealers (respondent 5). The service offers can be bundled in order to meet customer needs. The service offers are sold at the dealers that are also responsible for delivering the offers to the customers (respondent 5). An overview of all the bundled service offers Volvo Group provides can be found in Appendix B. The bundled service offers that were chosen to be focused on in this report are explained more in-depth in this section. For Volvo Group Trucks there are sixteen different bundled service offers. Volvo Penta, which offers marine combustion engines and power systems, has six different bundled service offers. Volvo Construction Equipment, which offers haulers, compact and heavy wheeled loaders and excavators, and has seventeen different bundled service offers. At Volvo Buses they offer customers eight different bundled service offers.

4.1.1 Selection of bundled service offers that impact the aftermarket supply chain

The bundled service offers that impact the aftermarket supply chain constitute the focus of this report. The offers chosen to analyze further have been narrowed down to only the ones offered by Volvo Group Trucks as previously stated in section 1.4 on page 7. The selection of what offers impact the supply chain was analyzed by interviews with appropriate employees at the case company. The offers chosen are the service contracts that are divided into a Blue contract, a Silver contract and a Gold contract depending on what is included in each contract. The service contracts impact the aftermarket supply chain through planning and forecasting of spare parts and planning of maintenance and services at the dealer. The uptime promise in the Gold contract puts emphasis on having the right parts at the right location at the right time.

4.1.2 Service contracts

With the service contracts, the truck is taken care of and made sure it is in top condition. It secures uptime of the truck and therefore deliveries to the truck owners' customers are more predictable, efficient and profitable. Three different kinds of service contracts are

offered, the Blue, Silver and Gold that are described below (Volvo Group, 2015j). Specifications of the service contracts can be found in Appendix C. Before signing a contract with a customer, various conditions of use, such as mileage, vehicle type and usage conditions, etc. are specified in the contract and that is taken into consideration when the price is decided. As services and repairs are mostly pre-planned, the customer will not be affected when the vehicle should be serviced, hence the vehicle will be serviced and repaired during hours that it should be off duty (respondent 16).

The service contract strategy is to secure parts and labor sales through increased workshop loyalty (respondent 14 and 16). There are no profit targets on the service contracts, the profit is in the parts and labor sales on workshop claims already. The goal is to reach an overall zero result (contract revenue minus contract cost) to reach break-even. Success factors are that the risks are managed and profitable growth is controlled (respondent 14). There is a partnership approach between Volvo Group Trucks, Volvo Trucks dealers and customers to secure the highest level of customer satisfaction and share of business (respondent 16). To secure effective risk management and to provide an attractive rate of return for both parties each Volvo Group Trucks Market Company has a policy to share contract risk with their dealers. Volvo Group Trucks secures truck quality supported by warranty and the home dealer is responsible for the interface with the end customers. Volvo Group Trucks has an agreement with the dealer to provide high quality services and repairs to end customers (respondent 16). Each year the result of all ended contracts for each dealer group is reviewed. If the aggregated result of all ended contracts in a year is negative and higher than 10 percent of the total contract value, the home dealer is responsible for the result of the first 10 percent and the local Market Company is responsible for the remaining cost. This is to ensure commitment from all parties involved (respondent 16).

Total sales ratio for service contracts in the Nordic market are shown in Table 4.1 below. Sales ratio is the percentage of service contracts that were delivered with a sold new truck (new refers to trucks less than 12 months old). The sales ratio only takes contracts with a duration longer than three years into consideration, and the contracts must also have a starting date within 12 months from the delivery date. The average sales ratio for the Nordic market is 55.6 percent. The Gold contract holds the highest sales ratio, the Silver holds the lowest sales ratio and the Blue has a sales ratio between the Gold and Silver (respondent 5).

Table 4.1: Total sales ratio for service contracts in the Nordic market. Adapted from respondent 5.

Market	Total (Blue, Silver and Gold)
DK	55.0 %
FI	66.1 %
NO	59.8 %
SE	47.6 %
Average	55.6 %

Blue contract

The Blue contract is the most basic contract and includes all preventive maintenance and a customer agreed service plan. With a Blue contract the uptime is improved. All technicians are certified and have access to all tools necessary for repairing and maintaining the truck. All parts exchanged during service are Genuine Volvo Parts. Customers with a Blue contract receive improved uptime, preventive maintenance and service plan, lower cost of ownership and a truck in top condition (Volvo Group, 2015). The difference between the Blue contract and the preventive maintenance offer is the payment. With the Blue contract, the customer pays a fee on a monthly basis but with the preventive maintenance the customer pays at the visit (respondent 14). Specifications of the Blue service contract can be found in Appendix C.

There is also a version of this contract that is designed for trucks that are four years or older called the Classic Blue contract. It is similar to the Blue contract but excludes some content of the preventive maintenance program. Instead, an individual service plan is set according to the customer needs (Volvo Group, 2015).

Silver contract

The Silver contract includes the same as the Blue contract but additionally all driveline repairs originating from wear and tear are included. With the Silver contract the expensive repair costs are spread over contract lifetime in a fixed monthly fee since the most expensive components are included in the contract (Volvo Group, 2015). Specifications of the Silver service contract can be found in Appendix C.

Gold contract

The Gold contract includes the same as the Blue and Silver contracts, and on top non-driveline repairs, and all wear and tear items. With the introduction of the new Volvo FH and Volvo FM trucks in September 2012 remote monitoring and 100 percent uptime are part of Gold too. The Gold contract guarantees the best possible uptime and full cost control since all preventive maintenance and truck repairs are included. With the Gold contract for new FM/FH trucks, 100 percent uptime is promised so the customer can run a carefree business (Volvo Group, 2015). If Volvo Group Trucks fails to repair the truck within a four-hour time window from the time the customer made the call until it is repaired, the first option is to offer the customer a replacement truck if possible. The second

option is to pay the customer a financial compensation. The first 4-24 hours, the compensation is 100 euros and for any additional 24 hour time period it is 150 euros. The maximum payment for each case is 2,000 euros (respondent 16).

This contract includes new service planning with online connectivity of the truck and features online where a service technician can access the vehicle remotely while the truck is in traffic. The workshop can then receive information about the crucial components in the truck, e.g. brake pads, clutch, and battery. Since it is already known by the workshop which parts that need to be replaced, these are available at the dealer when the truck is scheduled for service. All services are striven to be scheduled when the truck is off duty (Volvo Group, 2015l). The contract also includes Volvo Action Service, so in case of a breakdown of the truck the driver can call an operation service without separately having to pay the admin fee, which otherwise has to be paid (respondent 5). Specifications of the Gold service contract can be found in Appendix C.

A summary of the content in the contracts is shown by the authors in Figure 4.1.

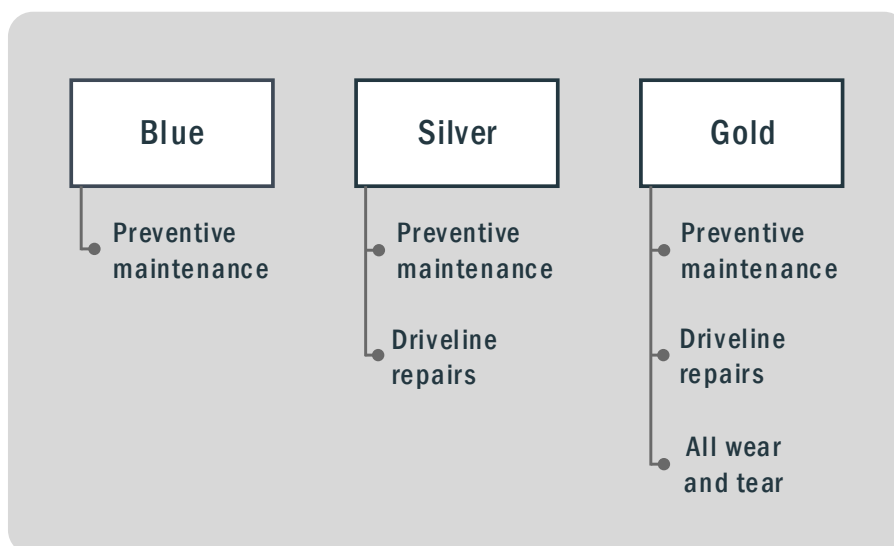


Figure 4.1: Service contract contents.

4.2 Current aftermarket supply chain of the case company

The aftermarket supply chain of the case company is designed to maximize the uptime of vehicles. According to Volvo Group (2015d), the case company's role is "to make sure that management of material, warehousing and distribution ensures the global availability of aftermarket spare parts to dealers and end customers at the right time, the right place and at the right cost." In pursuance to meet customer demands for the spare parts as well as the cost, the case company has several warehouses with optimized locations in regard to the locations of the customers. Stock levels are constantly optimized in order to reduce tied-up capital (Volvo Group, 2015d).

4.2.1 Aftermarket supply chain design

The case company's aftermarket supply chain is responsible for supply of material to spare parts warehouses, globally optimize inventory of spare parts and handle orders and deliver spare parts to dealers (respondent 3). There are over 600,000 different part numbers stored at the warehouses and Volvo Group has over 32 million order lines per year (respondent 3). The aftermarket supply chain for the Nordic market is shown in Figure 4.2 and consists of different actors with different transportation flows. The key players in the aftermarket supply chain are suppliers, transportation providers, dealers, customers and Volvo Group that manages the flow. The aftermarket supply chain consists of 5,000 suppliers and 3,000 dealers (respondent 3) and the flow of the spare parts and how it is transported between key players and warehouses in the Nordic market is shown with arrows in Figure 4.2.

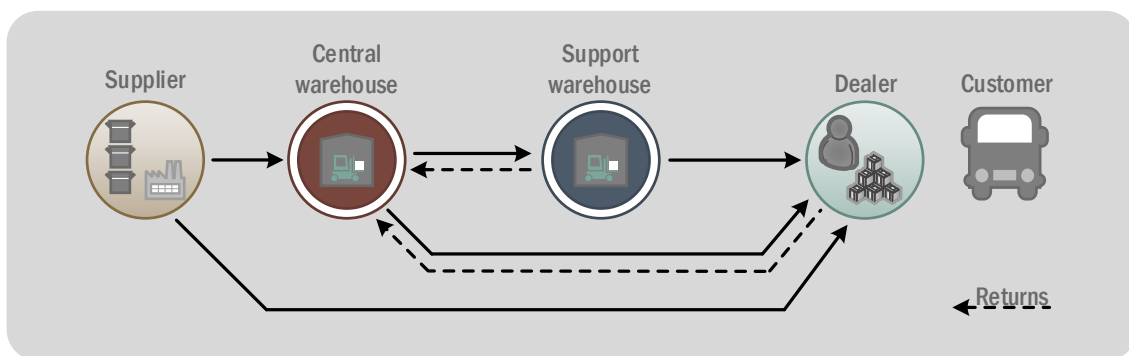


Figure 4.2: The aftermarket supply chain of the case company for the Nordic market. Adapted from respondent 3.

The transportation modes in the Nordic market are either by road, air or taxi/courier and are provided by many different transportation providers (respondent 22). Transportation from supplier to central warehouse is done by road. The case company contracts a transportation provider that picks up the goods at suppliers and then delivers the goods to the central warehouses. Transportation from central warehouse to support warehouse is done by road. From central warehouse to the dealer the transportation is done by either road or air. From support warehouse to dealer the transportation is done by road or air. Transporting goods from supplier to dealer is very ad hoc, but if it is very urgent to receive an order fast this kind of transport is a possibility (respondent 22).

4.2.2 Warehouse structure

Today's warehouse location is optimized with regard to the cost of each warehouse, warehouse operation cost, lease costs, the depreciation of building and equipment, cost of inbound and outbound transports, cost of employees, the radius of the warehouse location to the dealers and other warehouses, and dealer sales now and in the future (approximately 10 years) (respondent 3). Having warehouses closer to dealers and therefore the customers, would improve customer service in terms of shorter transportation lead-times for spare parts, but that would require more warehouses, which is expensive (respondent 3).

Currently, there are two central warehouses in Europe, one in Ghent (Belgium) and one in Lyon (France). The function of the central warehouses is to deliver full range of spare parts to regional and support warehouses and supply dealers and customers directly (respondent 8). The central warehouse in Ghent (Belgium) mainly supplies the Volvo Group Trucks brand, whereas the central warehouse in Lyon (France) mainly supplies the Renault Trucks brand. However, a small number of Volvo parts are stored in Lyon (France) for emergency purposes, and the same goes for Renault in Ghent (Belgium) (respondent 3). Furthermore, the function of the regional warehouses is to distribute stock orders and day orders to importer warehouses and dealers in the region. Due to the geographical location of the central warehouses, there are no regional warehouses in Europe, and therefore regional warehouses are not further included in this report. There are eight support warehouses in Europe located in Helsinki (Finland), Rugby (United Kingdom), Madrid (Spain), Gothenburg (Sweden), Wroclaw (Poland), Bologna (Italy), Vienna (Austria), and Bucharest (Romania) (respondent 8). In December 2015, the support warehouse in Gothenburg (Sweden) will be closed down and moved to Eskilstuna (Sweden) (respondent 3, 21, 24). The function of the support warehouses is to distribute day orders to dealers. The reason for having support warehouses is to minimize the total cost and lead-time (respondent 8).

The warehouses serving the Nordic market are depicted by the authors in Figure 4.3 where lead-times from the central warehouse in Ghent (Belgium) and the future support warehouse in Eskilstuna (Sweden) are shown. The circles represent the lead-time by road from Ghent (Belgium) and Eskilstuna (Sweden) to different locations in the Nordic market. The circles are roughly estimated by the distances between a warehouse and locations divided by 90 km/h, e.g. the lead-time from Eskilstuna to northern Sweden is approximately 15 hours. Drivers' resting times are not included in the calculations. Lead-time from the Lyon (France) warehouse is not included in the Figure 4.3 since this warehouse does not primarily support the Volvo Trucks brand. The lead-time from the support warehouse in Gothenburg (Sweden) is not included since this warehouse will be closed down.

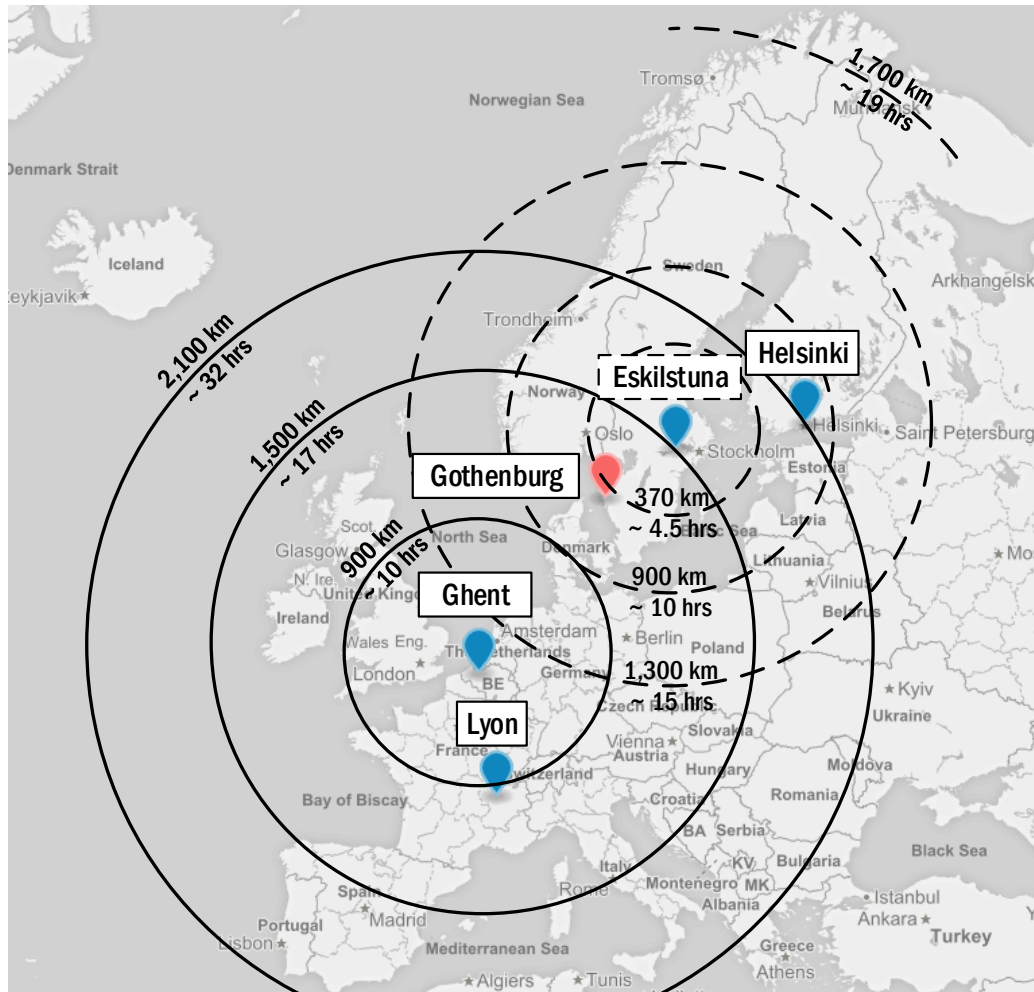


Figure 4.3: Warehouse location map with lead-times.

4.2.3 Demand and inventory planning

The demand and inventory planning function is responsible for setting the forecast towards the suppliers (respondent 10). The forecasting system only takes historical data into consideration, but in case the future will look much different, then the system must be tweaked manually. The forecast system triggers a proposal for delivery schedule that informs the suppliers when the orders should be delivered. The proposals for delivery schedules are updated on a weekly basis (respondent 10).

4.2.4 Refill from supplier to central warehouse

Replenishment from supplier to the central and regional warehouses is done by the economic order quantity formula, or Wilson formula (respondent 3). Based on the demand from the total supply chain call-offs are triggered from the suppliers to central warehouse and regional warehouses as explained in Figure 4.4. The material planning function is responsible for suppliers delivering the call-offs. These call-offs are triggered by two different flows, either the forecast (aggregated sales) or the TPOs (Time Planned Orders)

which are refill orders between warehouses that are generated by the refill function which manages the refill from central warehouse to support and regional warehouses (respondent 12, 13).

4.2.5 Refill from central warehouse to support and regional warehouses

The refill function in the Nordic market is responsible for replenishment from central warehouse to support warehouses (respondent 3) with refill orders transported by road (respondent 22). The lowest priority of orders is the stock orders that are placed automatically. These are replenished from the central warehouse to the dealer so the dealer has the right amount of spare parts available every day (respondent 3). These orders are transported by road (respondent 22). Day orders with a higher priority are sent to the dealer when needed from the support warehouses. Day orders are placed manually by the dealer as a response to actual customer demand (respondent 3) and are transported by road and in special cases by air (respondent 22). The highest priority of orders is when the vehicle is off road (VOR) and it is very urgent to get the spare parts as soon as possible to get the truck on road again to avoid high cost. VOR orders are replenished from support warehouses and if they are not available there the order is transferred upstream the aftermarket supply chain (respondent 3). The VOR orders are transported by air or road but in urgent cases they can be transported by taxi (respondent 22). The replenishment of orders is further illustrated in Figure 4.4.

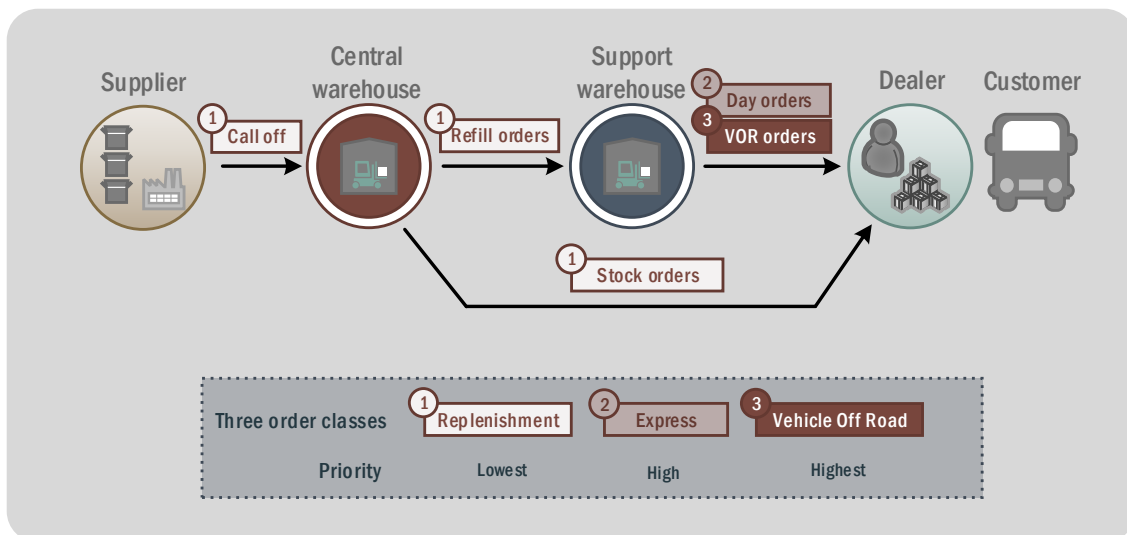


Figure 4.4: Refill of spare parts within the aftermarket supply chain for the Nordic region. Adapted from respondent 3.

In case there are excess inventory levels, excessive components should be returned to the central warehouses to pull the inventories as upstream as possible. Pulling the inventory upstream implies that all customers can be served instead of only the customers of a certain dealer or region (respondent 3).

4.2.6 Dealer inventory management

The dealer inventory management function manages the dealers' sales data and stock data into the central system. The dealer inventory management function is responsible for deciding when a part should be ordered, how much that should be ordered, and which parts that should be stocked at the dealer. To secure parts availability for end customers the case company has developed a stock management concept named LPA (Logistics Partner Agreement). The LPA concept consists of three policies: the stock holding policy, which decides what parts should be stocked at each dealer and is explained in Figure 4.5, the refill policy, that decides when a part should be refilled and at which quantity and the return policy which are the buy-backs that will be explained further below (respondent 15). The LPA concept implies that the case company takes over the inventory control from the dealers (respondent 11). The case company decides what to stock and what not at the dealer and in order to do so the case company gets the sales data from the dealers into their system so they can control what spare parts are available at the dealer for the end customers. Therefore, the case company takes responsibility for the dealers inventory for orders that have been automatically refilled by the case company. Stock that is identified as dead stock, i.e. stock that can no longer be sold will be bought back by the case company from the dealer with 100 percent compensation for automatically refilled stock orders. The dealer can also place orders manually and for those parts the case company does not take full responsibility, but the dealer can have up to 50 percent compensation if there is a demand for the parts so the case company can resell the part. Buy-backs are generally performed twice a year for each dealer (respondent 15).

Currently, planning of spare parts is done according to the stock holding policy. The stock holding policy takes mainly two factors into account: sales occasions to end customer and cost of the part, as shown in Figure 4.5. High value spare parts that are sold infrequently are stored at the central and support warehouses (listed as not to be in stock in Figure 4.5), while low value parts with frequent sales are stored at the dealers (listed as to be in stock in Figure 4.5) (respondent 3, 15).

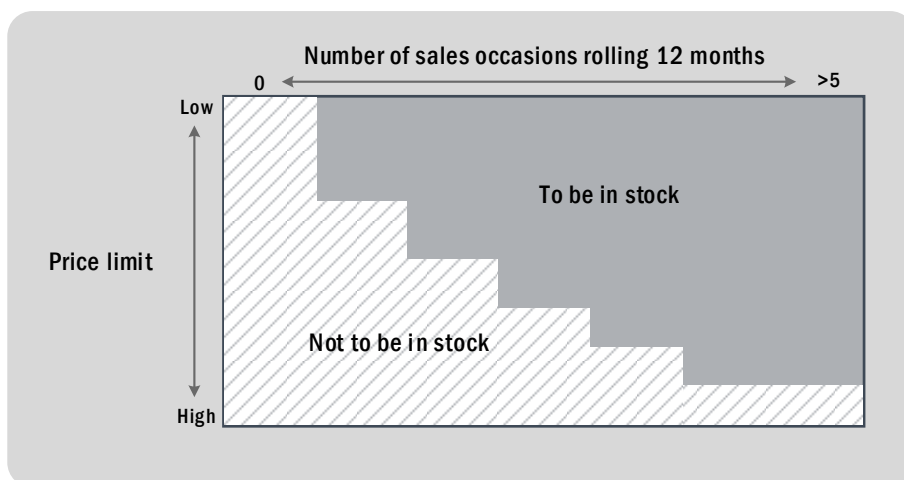


Figure 4.5: Stock holding policy. Adapted from respondent 15.

When a customer in Europe has an incident with his truck he should be able to get instant service at the dealer in 92 percent of the instances. The remaining 8 percent of instances will be automatically transferred to the support warehouses. The needed spare parts will be transported to the dealer the next morning (respondent 3, 22). The freight is prepaid in order to establish this guarantee of on-time spare parts delivery (respondent 3). This covers 99.3 percent of the instances of the demand. If the support warehouse does not have the needed spare part the order is automatically transferred to the central warehouse. The needed spare parts will be transported to the dealer before noon the day after. This covers 99.9 percent of the instances of the demand. If the part is out of stock in all of the warehouses in Europe, then Volvo Action Service tracks down the spare part from any location worldwide. The spare part can be supplied directly from the assembly line or the supplier to the dealer by using airfreight or taxi. At this point, this covers 99.98 percent of the instances of demand, but the delivery can take from 24 hours up to 3 days (respondent 3, 22). This is further illustrated in Figure 4.6.

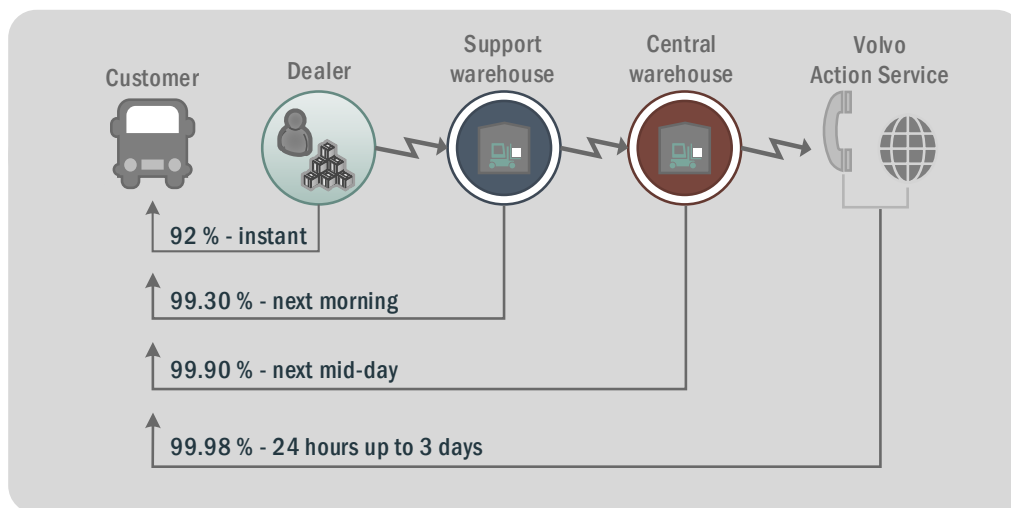


Figure 4.6: Supply chain set-up and performance. Adapted from respondent 3.

4.2.7 Backorder recovery

A backorder is an order that cannot be supplied by any of the warehouses, hence the order turns into a backorder when the part requested is not available at any of the warehouses. If the ordered spare part is unavailable at the support warehouse, the order goes to the central warehouse, and if it is unavailable at the central warehouse then it turns into a backorder. The backorders can be divided up into three order classes, the same ones as for the replenishment of stock. Those classes are the stock order backorders, day order backorders and VOR order backorders and have the same prioritizing as the replenishment orders. Regarding the VOR backorders, 3rd party logistics distributors are used in order to get the backorder parts as quickly as possible (respondent 9).

4.2.8 KPIs

KPIs that are measured at the case company are shown in Table 4.2. Each KPI has a target level and is measured in percentages (respondent 23, 26).

Table 4.2: KPIs at the case company. Adapted from respondent 23, 26.

Category	KPI	Description
Safety	Lost time accident rate	Measurement on fatal and recordable accidents with lost time: employee does not return to work next shift.
Quality	Aftermarket parts quality index	Measurement on that the parts shipped are undamaged and of right quality and quantity, etc.
Aftermarket Delivery	Dealer service index	Measurement on the customer perspective if the dealer was able to deliver the part from his stock.
	Aftermarket parts backorder recovery	Measurement for speed (time it takes to deliver the part to dealer) of recovering backorders.
	Aftermarket parts availability	Measurement for how many order lines can be delivered by the warehouses the same day the order is received.
	Aftermarket supplier delivery precision	Measurement on how well the suppliers are keeping their promises regarding deliveries.
Delivery	Transport material arrival precision	Measurement on following up and evaluating the transport material delivery precision in order to identify areas which need to be improved in order to achieve a stable performance and by that creating trust.
	Transport products delivery precision	Measurement on chassis delivered at agreed delivery point within defined delivery window, promise created when chassis are available.
	Packaging precision	Measurement on degree of packaging loaded compared to order; follow up and evaluate the availability and loading of the packaging material.
	Project business case realization	Measurement on proving the value of the logistics development activities and supporting prioritization of activities.
Cost	Aftermarket logistics cost per volume	Measurement on freight cost.

Continued on next page

Table 4.2 – *Continued from previous page*

Category	KPI	Description
	Manufacturing logistics cost per unit	Measurement on the total logistics cost per produced unit (vehicle).
	Transport price development	Measurement on valid freight rates compared to renegotiated rates (fuel impact excluded) in comparison to the total contract turnover.
	Aftermarket inventory days	Measurement on the turnover rate of the inventory in days.
	Transport products inventory days	Measurement on following the DAYS in pipeline where Logistics Services are responsible in relation to number of delivered units for that month.; $DAYS = \frac{\text{Average number of units Available \& Logistics Services related holds in the month}}{\text{average number of delivered units per day in the month}}$.
Environment	Energy usage per area	Measurement on the total use of energy in the sites excluding incoming and outgoing freight transports.
People	Sick leave ratio IWs	Measurement on sick leave ratio on industrial workers.
	Implemented improvement	Measurement on implemented improvements done by office workers and industrial workers within Logistics Services per annum.

To conclude chapter 4, section 4.1 accounted for the bundled service offers that constitute the scope of this study, i.e. the service contracts. The service contracts can be divided into the Blue, Silver and Gold. Section 4.2 accounted for the current aftermarket supply chain at the case company. The next chapter is the assessment of aftermarket challenges both from literature and the case company in relation to service contracts.

5. Assessment of aftermarket challenges in relation to service contracts

This chapter is divided into four sections and aims at answering research question one, what the key challenges are with the aftermarket supply chain in regard to the bundled service offers. The first section accounts for the unit of analysis, where the foundation for the analysis is established. The second section presents challenges found in literature from chapter two and section three presents challenges identified within the case company. Next, these challenges are put in relation to the service contracts in section four.

5.1 Unit of analysis

The unit of analysis consists of the bundled service offers that are focused on in this report. These offers are the service contracts which are dependent on availability of spare parts and service competence as shown by the authors in Figure 5.1. The two types of availability are needed in order to meet the uptime requirements of the customers. The availability of spare parts means that a part needs to be available for the needed maintenance or repair. The availability of service competence means that human resources with technical knowledge need to be available to perform the maintenance and repairs and have the necessary tools available to do so. Spare parts availability is dependent on the availability of service competence and vice versa. The uptime requirements cannot be met unless the two types of availability are present. However, availability of service competence will not be analyzed in this thesis. The focus is on availability of spare parts only.

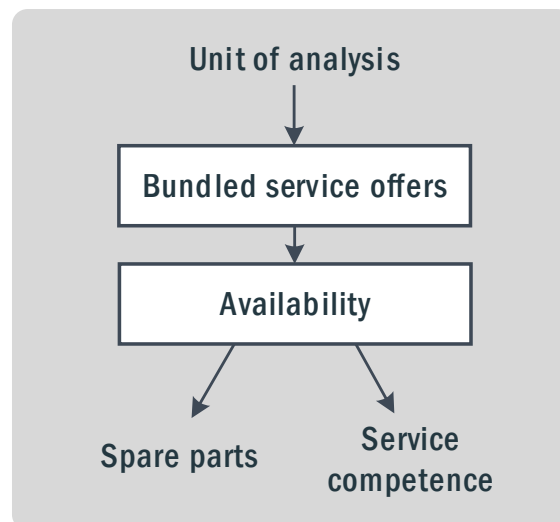


Figure 5.1: Unit of analysis.

The service contracts differ when it comes to demand and availability of spare parts as shown by the authors in Figure 5.2.

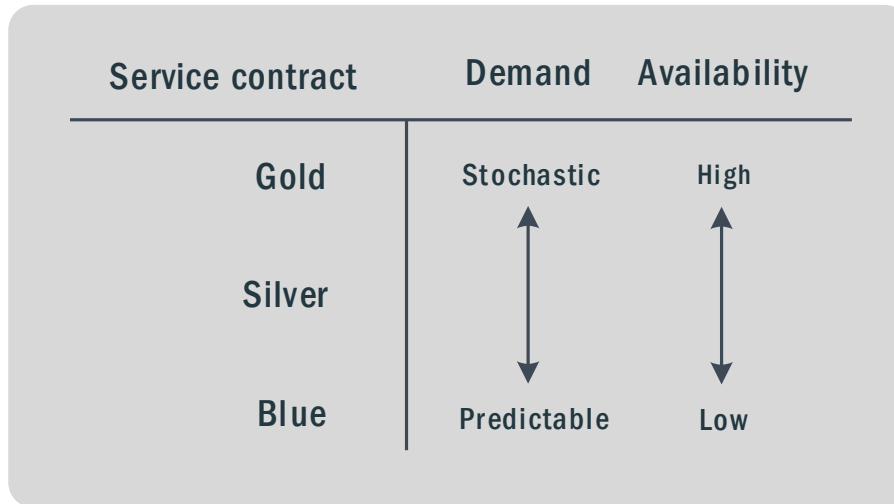


Figure 5.2: Service contract characteristics in terms of demand and availability.

There are two types of demand, stochastic and predictable. The stochastic demand is unpredictable and the predictable demand is stable. In regard to the service contracts, the Blue contract, which includes preventive maintenance, has predictable demand because preventive maintenance is pre-planned according to a vehicle specific service plan. The Silver and the Gold contracts also include preventive maintenance, which has predictable demand, but are mostly towards stochastic demand. The Silver contract includes driveline repairs, which have stochastic demand because those breakdowns occur suddenly without notice. The Gold contract includes all wear and tear repairs so the demand is extremely stochastic for that type of contract since most breakdowns occur without a warning.

The availability of spare parts also differs between contracts as well as what services are included in the contracts as further illustrated by the authors in Table 5.1. The availability for the Blue contract is low for repairs that are outside the preventive maintenance, but high for those parts that are included in the preventive maintenance since those parts and labor can be pre-planned. The preventive maintenance therefore needs to have high availability for all types of service contracts in order to follow the service plan. For the Silver contract the availability is between medium and high since the driveline repairs need higher availability to meet the uptime requirements. The Gold contract needs to have extremely high availability to meet the 100 percent uptime promise of the contract. If a sudden breakdown occurs, the case company has only four hours to repair the vehicle until the financial compensation needs to be paid to the customer. Therefore, it is very important to get the right spare parts at the right time at the right place.

Table 5.1: Contents of the service contracts.

	Gold	Silver	Blue
100 % uptime	X		
Preventive Maintenance (PM)	X	X	X
Driveline Repairs (DR)	X	X	
All Wear and Tear (W&T)	X		
Spare parts availability	PM: high W&T: high	PM: high DR: med-high	PM: high Other: low

Different types of service contracts need different types of supply chain designs because the service contracts differ in terms of what services are included in each contract. Therefore, demand and the availability of spare parts also differ between the contracts. Preventive maintenance is the same for all contracts, and the demand for preventive maintenance is predictable or stable and can therefore be considered a functional product according to Fischer's (1997) framework. The supply chain design for functional products should be towards being cost-efficient according to Fischer (1997). The unpredictable breakdowns of vehicles constitute a stochastic or volatile demand for spare parts, which implies that the spare parts can be considered innovative products according to Fischer's (1997) framework. The supply chain design for innovative products should be towards being responsive according to Fischer (1997). If Fischer's (1997) framework is integrated to the service contracts at the case company it is possible to suggest different supply chain designs for different contracts. The Gold contract needs a responsive supply chain design to meet the 100 percent uptime promise. The Blue contract should have an efficient supply chain design since pre-planning of maintenance allows for efficient material flows and cost should be kept at minimum. The Silver contract should be in-between having an efficient and responsive supply chain, since the repairs included in that contract happen unexpectedly. However, the Silver contract should be more towards having a responsive supply chain but not as responsive as the Gold contract, since the Silver contract has no 100 percent uptime promise or any financial compensation.

5.2 Aftermarket challenges from literature

The challenges from literature have already been identified in chapter two. These challenges were summarized in Table 2.2 on page 14 and are the following:

Nature of demand

The nature of demand for spare parts in the automotive industry can be either stochastic or predictable. Sporadic breakdowns of vehicles make the demand for spare parts stochastic and therefore difficult to plan. On the other hand, vehicles regularly need maintenance checks, which can be planned in advance and the demand is therefore predictable for the spare parts needed.

Forecasting for demand of spare parts

The demand for spare parts in the automotive industry is stochastic for most parts. This makes it difficult to forecast due to unpredictable breakdowns of vehicles. Forecasts for spare parts consist of probability distributions based on historical data, but this does not represent the true demand.

Responsive spare parts management

The supply chain must respond fast in case there is a breakdown of a vehicle in order to get the vehicle up and running and to secure uptime. The right spare parts need to be at the right location at the right time for the necessary repair and maintenance of the vehicle. Due to the stochastic demand, this is of course extremely challenging.

Inventory management

It is difficult to manage spare parts inventories because of the unpredictable demand. Inventories must exist at the appropriate points in the supply chain, or the desired service levels fail.

Product portfolio, number of SKU, delivery network

The aftermarket supply chain must serve many product models, even all models that are not produced anymore. Having such a large product portfolio and therefore a large number of SKUs, requires a vast delivery network that needs to be able to deliver and store all the different products. This makes the whole aftermarket supply chain more complex and costly in terms of storage and transportation.

Reverse logistics

The handling of reverse logistics such as repairs, returns and other services makes the aftermarket supply chain more complex since the demand is stochastic for most parts needed for repairs. Regarding the returns, the unexpected returns are those of incorrect shipments or damaged shipments and these can be challenging to handle and may also result in additional costs.

Customer satisfaction

It can be difficult to meet customers' requirements and promises such as uptime of the vehicle in the aftermarket supply chain. Furthermore, customers require fast repairs if their vehicles break down. In some cases, customers believe there is a lack of quality from the manufacturer when it comes to the aftermarket support.

KPIs (performance metrics)

The challenge with the KPIs is that they are misleading, they mostly focus on internal metrics and not on the customer. Setting up the right KPIs is essential for improving the performance of the aftermarket supply chain.

5.3 Aftermarket challenges from the case company

Challenges identified from employees referred to as respondents within the case company were found within these categories:

Forecasting spare parts

A few respondents pointed out that not all data available about the vehicles is used when forecasting for spare parts. Forecasting today is based on historical demand, which implies that it is difficult to plan proactively. The available data that could possibly be used is the remote diagnostics connectivity that is found in the newest versions of the FH and FM trucks. By using this data breakdowns could in some cases be foreseen as pointed out by one respondent. Furthermore, there is available data about standard maintenance parts that needs to be exchanged, and when the parts need to be exchanged. The demand for standard maintenance parts is therefore predictable since the case company has data about how many vehicles they have on the market, which was mentioned by a respondent.

Another area of opportunity identified is 'forecasting of seasonal products' as the demand for these products is volatile. An example mentioned is heater systems for cabins and batteries, which do not have high demand during summer but have high demand during winter.

It was also mentioned that forecasting for the initial stock is challenging when Volvo Group Trucks launches new trucks. In previous experiences it has been problematic having enough parts ready when needed.

Forecasting for spare parts in the decline phase is challenging since parts need to be supplied for 15 years or more after the last vehicle in the series according to a few respondents. This is especially challenging because of the large number of spare parts, as pointed out by one respondent. It was pointed out that in some cases, a backorder occurs of a part that was manufactured some years ago. The supplier might have scrapped the tools and equipment needed to produce that part again and retrieving it would be problematic.

Key points:

- *Forecasting items in use*
- *Life-time of vehicle*

KPIs

According to some respondents, several KPIs exists, however, one viewpoint is that some important KPIs are not measured and that the existing KPIs are not measuring all the relevant factors. One important KPI mentioned that is not being measured is the total lead-time, from order entered at dealer until the order has been delivered to the dealer. The dealer can create a case in the system for e.g. availability issues of spare parts. The help desks at the support warehouses then measure the time it takes to reply to the case. However, the quality of the reply of the case is not measured, only the time it takes to answer, so in many cases the answer the help desks gives is not the solution to the problem according to one respondent .

Another issue that was pointed out is that real customer demand is not measured by

the system or over the counter availability at the dealers, meaning that information regarding lost sales is not captured. It is difficult to measure customer demand for spare parts that are not available at the dealer which results in lost sales. In order to measure this, the dealer must enter a manual registration to the system.

Key point:

- *Important KPIs not being measured or not measuring all relevant factors*

Transportation

When it comes to challenges with transportation, reducing airfreight was the main challenge according to a few respondents. Since the case company pays for all the transport from warehouses to the dealer the cost is very high for transport since dealers choose their transport method for each order and many orders are chosen to be transported by air. It was pointed out that there is no incentive for the dealer not to choose airfreight for most of their orders if that results in shortened lead-times and they are not held responsible for the transport cost that their choice causes.

Key point:

- *Reducing airfreight*

Customer satisfaction

A few respondents mentioned that there is an opportunity to improve the visibility in the system when it comes to lead-times of backorders. This means that if there is demand for a spare part and it is not available anywhere, the lead-time or the ETA (Estimated Time of Arrival) is often unknown which could result in dissatisfied customers. One viewpoint was that unknown ETAs might originate from missing contracts with suppliers, which leads to poor control of them. Customers want to be able to track their orders and know when their vehicle can be up and running again as pointed out by a respondent. Having a vehicle off road can cause the customers a financial loss as mentioned by few respondents.

Managing customer expectations is another challenge in relation to customer satisfaction, mentioned by a few respondents. Customers get dissatisfied when promised service levels are not fulfilled. One viewpoint is that if customer expectations could be managed in another way, some of the dissatisfaction could be mitigated and customers would have more realistic expectations.

Key points:

- *Missing ETAs*
- *Managing customer expectations*

Internal challenges

Several respondents have explained that there is a lack of information flow regarding the bundled service offers between the sales and aftermarket departments. One viewpoint is that the Materials Management department should be aware of the of-

fers and involved in designing them. It was also mentioned that there is a problem with information flows when the sales department launches a campaign without informing other stakeholders about it in beforehand. When launching campaigns, one aspect mentioned is that logistics and availability should be done first so parts can be available at the dealer. The campaigns cause spikes in sales, which is disadvantageous since forecasts are set according to history. Not having the parts available will only result in disappointed customers according to a respondent.

Another area of opportunity identified is when spare parts are unavailable, it does not seem to be clear to everyone how to proceed with retrieving the part. All stakeholders should have a routine or checklist on how to make the requested part available. Internal communication is important and one viewpoint was that all stakeholders should work together since parts being unavailable affect the customers.

Key point:

- *Lack of internal information sharing*

Pricing of service contracts

A few respondents pointed out that the pricing of the service contracts and how to manage the risk is a challenge. Some contracts have a negative profit and some positive. It was also mentioned that the pricing needs to be improved in some countries to make sure that they sell the contract at the right price. Another aspect is that the service contracts and the product range need to be competitive too as well as the pricing and that could be challenging since the cost needs to be matched with the price. It was also implied that pricing of spare parts is not updated according to the market. Customers can buy cheaper spare parts elsewhere in some cases. Therefore, the prices of the service contracts can be updated too since the price of the service contract is partly dependent on the market price of the spare parts as pointed out by a respondent). Another area of opportunity is that not all data is available or fully recorded e.g. how the vehicles are being driven, the climate, the operating conditions, the topography, and the road conditions that affect the life of spare parts. Because of that, there might not be enough data in order to fully utilize this to price the service contracts according to one respondent's opinion.

Key points:

- *Margin per contract varies*
- *Pricing needs to be updated in some cases*

Supplier

It was mentioned that the sourcing strategy has been troublesome for the case company. It was also pointed out that the case company wants to reduce costs and therefore they source from low cost countries but the low cost countries are not always able to supply the parts according to demand. The quality of the parts has also not been sufficient according to a respondent. Because the quality is not sufficient the

parts need to be replaced sooner than expected and the costs implicated by that exceed the cheap price they can have for the parts as mentioned by a respondent.

Key point:

- *Sourcing from low cost countries might result in unexpected costs*

Truck users

Another area of opportunity identified is the driver behavior and how much wear and tear they cause the truck. The case company should work with the drivers to avoid high service contract cost and to secure the uptime of the vehicle. There is probably a correlation between fuel consumption and wear and tear as pointed out by one respondent. If the driver drives in a way that causes high fuel consumption, the truck could experience more wear and tear, which could result in more repairs and maintenance for the truck, as mentioned by a respondent. Furthermore, the driver behavior could also impact the life expectancy of some components, which makes it difficult to predict their durability.

Key point:

- *High fuel consumption might result in more wear and tear*

Dealer

According to some respondents, the availability of spare parts at the dealer is a challenge. It was pointed out that the dealers are demanding when it comes to availability of spare parts. It was mentioned that the dealers want high quality of delivery and ordering performance, which can be challenging to meet. One aspect was that stocking up on parts at the dealers would imply better availability, but some dealers are hesitant towards holding high inventory cost.

Some respondents explained that the dealer behavior is another challenge. E.g. filters should have a stable demand, but that is not the case since volumes of filters have been going up and down as pointed out by one respondent. This could be the result of dealers being able to order manually and it is not connected to the end-customer demand, rather the dealers' behavior and how they think the true customer demand will be, as pointed out by a respondent. An area of opportunity identified is that the dealers should work more proactively and use more of the available data. Working proactively could imply better resource allocation at the dealers and better definitions of their processes on how work is carried out, as pointed out by one respondent. An example of proactivity is the remote diagnostics connectivity that it is a new technology on the market and also new to the dealer network. It was also pointed out that the dealer network does not have much experience with the remote monitoring, so it could be difficult for the dealer network to work and follow up on it.

Key point:

- *Availability of spare parts at the dealer*

Competitors

Another challenge identified is that customers can buy cheaper parts from competitors. The case company's suppliers also sell to the market, so in some cases the suppliers can also be competitors. It was mentioned that second or third owners of a truck tend to buy spare parts from competitors and not from the case company due to cheaper parts.

Key point:

- *Competition on the market*

5.4 Aftermarket challenges from the case company and literature in relation to the service contracts

In Table 5.2 challenges from the case company and from literature are presented by the authors in terms of if they affect the service contracts or not. Some of the challenges found in literature are also being experienced by the case company, hence the mutual challenges from the case company and literature have been merged in Table 5.2.

Table 5.2: Challenges from the case company and literature in relation to the service contracts.

Challenges	Service contracts		
	Gold	Silver	Blue
Nature of demand (sporadic breakdowns of vehicle make the demand unpredictable)	X	X	–
Forecasting based on historical demand rather than using the available data about the vehicles)	X	X	X
Seasonal products have volatile demand	X	–	–
Forecasting the initial stock for newly launched trucks	X	X	X
Forecasting for spare parts in the decline phase	X	X	X
Important KPIs are not measured or KPIs that are measured are not measuring all the relevant factors	X	X	X
Lack of visibility in the system regarding lead-times of backorders, leading to dissatisfied customers	X	X	X
High transportation cost due to airfreight	–	–	–
Managing customer expectations	X	X	X
Lack of information flow regarding the bundled service offers between sales and aftermarket departments	X	X	X
Lack of information flow when sales campaigns are launched	X	–	–

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Table 5.2 – *Continued from previous page*

Challenges	Service contracts		
	Gold	Silver	Blue
Lack of routines on how to recover unavailable parts	X	–	–
The pricing of service contracts and how to manage the risk	X	X	X
Insufficient quality and poor deliveries from low cost country suppliers	X	X	X
Drivers’ behavior causing deviating wear and tear	X	X	X
Availability of spare parts at the dealer	X	X	X
Dealers’ ordering behavior	–	–	–
Dealers not using available data (e.g. remote diagnostics connectivity) about the vehicles	X	X	X
Competitors	–	–	–

The unpredictable demand of spare parts primarily affects the customers that hold Gold and Silver contracts since these include repair services that are difficult to forecast (the remote diagnostics connectivity can only be used to forecast certain components). The Blue contract includes preventive maintenance, which has a stable demand for spare parts. Only basing forecasts on historical demand rather than using the available data about the vehicles to improve the forecasting affects all customers with service contracts. Planning of spare parts could be improved by using this data, both preventive maintenance and other maintenance occurring unexpectedly. Forecasting of seasonal parts affects customers with the Gold contract since this contract is the only contract that promises an uptime with a certain time-window to repair the vehicle. If a seasonal part turns into a backorder for a Gold contract customer it will have an impact on the customer satisfaction and the cost for the case company. Forecasting the initial stock for newly launched trucks and for spare parts in the decline phase affects all the service contracts, but due to the uptime promise in the Gold contract, this has the most impact on customers holding that contract.

Important KPIs are not measured or KPIs that are measured are not measuring all relevant factors affects all the customers holding a service contract. An important KPI that is not currently being measured at the case company is the total lead-time from order placed to order delivered, which will have an impact on the customer satisfaction in cases of long lead-times for all types of contracts. Lack of visibility in the system regarding lead-times of backorders affects all customers with a service contract since it leads to dissatisfied customers. An example of a KPI that is not measuring the relevant factor is that the help desks at the support warehouses measure the time it takes to reply to a case, but the quality of the reply and if the case was solved is not measured. Therefore, what is being measured does not affect the solution to the problem, hence the wrong indicator is being measured.

High transportation costs with airfreight are connected to the type of order (VOR, day or stock) and are not specified in the service contracts. The orders within the service contracts are not being prioritized depending on if it is a Gold contract with 100 percent uptime promise or a Blue contract, only the VOR, day and stock orders are prioritized. Airfreight is mostly used for VOR and day orders and needs to be reduced, but since the types of orders are not specified in the contracts it is not possible to weigh the impact on freight cost on each contract.

Managing the customer expectation has an impact on all customers with a service contract. If the customer buys a service contract and does not have realistic expectations on what is included the customer will be dissatisfied.

Lack of information flow between aftermarket departments and the sales has an impact on customers with a service contract since the aftermarket department is responsible for spare parts logistics which is a vital part of the contracts. Lack of information flow when sales campaigns are launched affects mainly the logistics of spare parts in the Gold contract because of the uptime promise, since the campaigns may cause decreased responsiveness in supplying the parts in the campaign. Lack of routines on how to recover unavailable parts mainly impacts the customer with the Gold contract because it is crucial to retrieve the unavailable part as quickly as possible due to the uptime promise.

The pricing of service contracts affect customers that hold a service contract. Some contracts have proven to have a negative profit while others have positive. In some countries the price of the contracts needs to be updated, since customers can find the spare parts they need cheaper from competitors. Insufficient quality and poor deliveries from suppliers in low cost countries also affect the logistics of spare parts involved in the service contracts. If the spare part has poor quality it needs to be replaced and the customers will be dissatisfied, the same goes for poor deliveries that will then impact the uptime of the vehicle.

Drivers' behavior causing deviating wear and tear has an impact on customers holding service contracts since more wear and tear repairs caused by the driver will both increase the cost of the contract and lower the uptime of the vehicle.

Availability of spare parts at the dealer obviously affects the customers holding service contracts. If spare parts are unavailable, the uptime of the vehicle is affected which will result in dissatisfied customers. Dealers' ordering behavior does not affect the spare parts included in the service contracts directly. Dealers stocking up on spare parts that they think will be sold has an impact on the whole planning of spare parts but do not affect the customers holding the service contracts. On the other hand, dealers not using available data (e.g. remote diagnostics connectivity) about the vehicles affect the customers that hold service contracts. The remote diagnostics connectivity used for the Gold contract is also important to follow up on to secure the 100 percent uptime promise.

Competitors do not affect the spare parts included in the service contracts directly since the spare parts are already included in the service contracts. By that, customers with service

contracts do not buy the needed spare parts, since they are included in the contract. However, competitors can affect the decisions the customers make whether to buy a service contract or not, depending on the price as stated earlier.

To conclude chapter 5, an assessment was carried out regarding aftermarket challenges from both literature and the case company and those challenges were put in relation to the service contracts. The next chapter is an assessment of the benchmarking study, where aftermarket challenges from consultancy reports and industry presses are assessed in relation to the service contracts.

6. Assessment of benchmarking study

This chapter is divided into two sections and aims at answering research question two, what other companies identify as supply chain challenges in regard to aftermarket services. In the first section, benchmarking evidence about aftermarket challenges from consultancy reports and industry presses are reviewed. The challenges found are then put in relation to the service contracts in section two.

6.1 Aftermarket challenges from benchmarking study

Bain & Company

According to Bain & Company (2012), European truck manufacturers face mainly two challenges. Firstly, competition from Asian, South American and Eastern Europe markets. Secondly, they struggle for market shares and margins on their home proximity. Although the mature European markets have a low growth rate, they are stable and profitable. However, to deal with the competition from emerging markets is ever as important. Bain & Company (2012) forecasts differentiators in the future to be fuel efficiency, cost, dealer relationships, and service offers. Truck customers are becoming difficult to please, and they are more prone to switch brands today than some years ago. The main criterion for customer disloyalty is unreliability, so key here is to produce reliable trucks, but this alone is not meaningful differentiation. Combining a reliable truck with accompanying services is the key, but the challenge is to keep this combination up to date and to continuously improve it (Bain & Company, 2012).

Key points:

- *Competition from other markets*
- *Disloyal customers*

Accenture I

Customers are increasingly turning to digital channels for services. They know that today's technology covers for outstanding service levels, which puts pressure on after-sales providers since customer satisfaction will drop unless the customers' expectations are met (Accenture, 2014). Customers have little tolerance for poor treatment, and want their desires satisfied immediately. Accenture (2014) stresses that traditional service models are no longer sufficient when it comes to meeting the needs of the customers. Traditional service channels are dependent on human interfaces, i.e. call centers and field technicians. This dependence hinders companies from extending their non-stop connected services to meet the non-stop expectations by their customers. Additionally, Accenture (2014) claims that traditional service models within departmental organizations often are tied to certain departments, where the sets of rules have little or no connection to the customers' preferences. Accenture (2014) continues stressing that back-end and front-end service operations are most often siloed. Siloed service functions make it difficult to keep track of the customers after they have been served by the call center. Furthermore, while serving customers at a call center, the performance measures that are being measured are not

aligned with the customer expectations or demands. Accenture (2014) stresses that Average Handle Time (AHT) is a measure that is not aligned with customer issue resolution. Other examples of unaligned measures are in-home execution, field execution (schedule, dispatch, routing), and resource planning (parts, labor) (Accenture, 2014).

Key points:

- *Traditional service models insufficient when meeting customer needs*
- *Siloed departments within companies*
- *Performance measures are not aligned with customer expectations*

Accenture II

According to Accenture (2010) a challenging area is spare part logistics. Yet, this area is highly developed due to its importance when it comes to having an effective and efficient footprint, shorter lead times, better service levels, and improved customer satisfaction. However, delayed service and customer dissatisfaction and disloyalty are often blamed by the dealers on spare parts unavailability (Accenture, 2010). Furthermore, interlinked with spare parts logistics is the service support, where the key is spare parts availability, but there is more to it. OEMs need to help both dealers and franchised service points to serve complex vehicles and customers with high expectations. Apart from repair ability, dealers and service points need help with 'fix right first time' procedures, which includes the OEM serving these actors with, e.g. repair manuals and technical help-desks (Accenture, 2010).

Warranty and quality receives little attention from management unless significant problems occur (Accenture, 2010). Warranty management covers for quality defects from production, and it can result in massive costs if recall campaigns were to occur or other severe defects. Preventing production defects involve collaboration between suppliers, OEMs and dealers since business process from all of these actors are involved in warranty management (Accenture, 2010).

Key points:

- *Spare parts unavailability cause customer dissatisfaction and disloyalty*
- *Dealers need assistance with 'fix right first time' procedures*
- *Warranty and quality receives too little attention*

Deloitte

Deloitte (2013) has identified spare parts supply chain management challenges that occur in China's automotive industry. Because the demand for spare parts is unstable and difficult to forecast there are numerous challenges with the spare parts supply chain management e.g. in parts planning, purchasing, ordering and logistic and other operational ones (Deloitte, 2013). According to Deloitte (2013) the Chinese OEMs believe that the major barriers are found in planning capabilities, stability of parts supply, supplier collaboration, information systems, data management and supply chain visibility. The top barriers to service excellence are further illustrated in Figure 6.1.

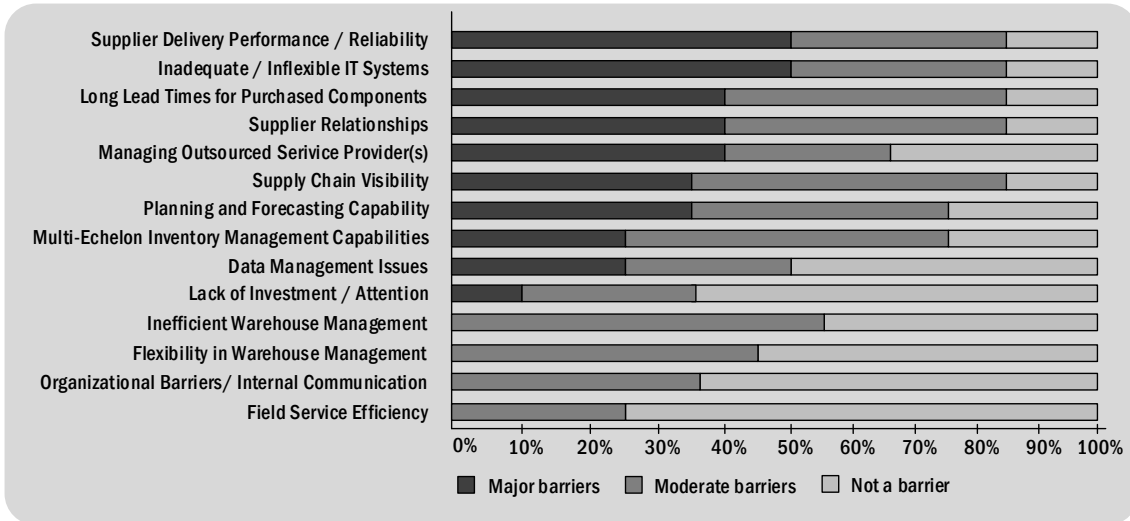


Figure 6.1: Top barriers to service excellence for Chinese OEMs. Adapted from Deloitte (2013).

Key point:

- *Unstable demand for spare parts leads to multiple supplier challenges*

Price Waterhouse Cooper (PwC)

PwC (2013) stresses that current challenges for suppliers in the aftermarket are high supply chain costs, inventory above entitlement, lack of customer responsiveness, and limited supply chain flexibility. High supply chain costs derive from poor increase in raw-material turns and poor improvements in cost of goods sold, both of which were discovered through the extensive North American supplier survey. These two factors could lead to higher inventory holding costs, poor forecast accuracy, increased expediting costs, and lastly reduced operations productivity (PwC, 2013). PwC (2013) also found that suppliers with low inventory turns tend to tie up working capital for longer than necessary. This in turn means that the suppliers’ ability to employ short-term investments is limited (PwC, 2013). Next, the lack of customer responsiveness implies poor planning and efficiency performance. If this is not working properly suppliers may not be able to secure a competitive advantage through customer incentives, shared cost savings, and on-time deliveries. Lastly, PwC (2013) stresses that low inventory turns and little reduction in cost of goods sold in relation to revenue growth make the supply chain unable to responsively react to an increase in customer demand or other changes in the market.

Furthermore, PwC (2013) gives an outline of future global megatrends and their impact on the automotive supply chain. The first megatrend is that of demographic shifts. The younger population is expected to require agile and responsive supply chains, and the aging populations are expected to put more demand on accessibility features of the vehicles instead of performance features. The next megatrend is shifts in economic power, PwC (2013) stresses that Western economies are economically dominating at this stage, but a rebalancing in economic power can already be seen in present day. This triggers growing

countries to consume more, and they will no longer only be centers of production. Challenging with an increase in vehicle demand for these countries is the infrastructure, as an upgrade of the current infrastructure as well as new infrastructure would be required to optimize the supply chain. Another challenge is the market growth in developing markets. Traditional automotive companies will likely face cost pressure due to competition from low-price markets, which in turn will drive innovative solutions that differ from those of "traditional" automotive suppliers (PwC, 2013).

The next megatrend that PwC (2013) accounts for is an accelerating urbanization. By 2015, the number of megacities (cities with a population of more than 10 million people) was forecasted to be 22 by the United Nations (UN) by 2013 year's measure (PwC, 2013). However, looking at data from 2014, United Nations (2014) reported that there were 24 megacities in the world, and as of 2030 United Nations (2014) expects the number of megacities to be 41. The automotive industry faces numerous challenges in regard to the rise of new megacities. PwC (2013) prospects that the increasing concentration of populations will put higher pressure on pollution and clean-vehicle technologies. Furthermore, infrastructure will become more congested, which puts extra demand on efficient and effective supply chains. PwC (2013) also sees that there will be additional pressure on aftermarket and service supply chains, and this will drive direct-ship capabilities as well as more service-oriented structures of the supply chains.

Next, the megatrend of climate change and resource scarcity will continue pushing for research and development in areas of alternative fuels, propulsions systems, and supplier footprints. Also, environmental concerns will likely drive recyclability to a new level, which includes maturation of reverse supply chains of vehicles. PwC (2013) also believes that European End of Life Vehicles Directive will be globally expanded. This directive stipulates that 95 percent of the vehicle by weight should be recycled (PwC, 2013). Lastly, the megatrend of technological breakthroughs is thought to drive new needs for revolutionary ideas to be adopted throughout the supply chain (PwC, 2013).

Key points:

- *Suppliers suffers from high supply chain costs, inventory above entitlement, lack of customer responsiveness, and limited supply chain flexibility*
- *Global megatrends change the operating conditions on the market*

Roland Berger Strategy Consultants

Roland Berger Strategy Consultants (2009) stresses that one challenge to consider for truck OEMs in established markets is the environmental legislations. Regulations are getting tighter and therefore the pressure on reducing emissions is high. Costs related to the tighter environmental regulations are e.g. exhaust aftertreatment in order to meet the emissions norms. Additional costs include increased material costs as well as higher fuel prices. As a result of increased costs, as well as slower economic growth, OEM customers hold on to their fleets longer and try to extend the life of the trucks. Therefore, customers postpone further investments (Roland Berger Strategy Consultants, 2009).

Another challenge found by Roland Berger Strategy Consultants (2009) is that customers have become increasingly interested in total cost of ownership (TCO). For a truck, the TCO includes initial investment, fuel, drivers, repair and maintenance costs. This put pressure on developing trucks that have low TCO. Additionally, Roland Berger Strategy Consultants (2009) stresses that trucks are becoming increasingly interchangeable and also commoditized. This makes it difficult to differentiate the trucks, hence there is greater need of developing complete solutions rather than only selling trucks as a product (Roland Berger Strategy Consultants, 2009). Offering complete solutions puts extra pressure on the aftermarket and the supply chain thereof.

To conclude, Roland Berger Strategy Consultants (2009) argues that the structure of the truck industry is under pressure due to the abovementioned challenges. Mainly, Roland Berger Strategy Consultants (2009) has shown increased consolidations in the established markets, and that this trend will continue. Consolidations have also appeared in emerging markets, and Roland Berger Strategy Consultants (2009) sees a trend in joint ventures between established and emerging market OEMs. A challenge is therefore to globally restructure supply chains.

Key points:

- *Tighter environmental legislations*
- *Pressure on developing trucks with low total cost of ownership*
- *Offering complete solutions puts extra pressure on the aftermarket and the supply chain thereof*

Boston Consulting Group (BCG)

According to BCG (2011) new regulations in Europe in the automobile industry oblige manufacturers to release electronic data for identification of replacement parts of vehicles. By this, the independent service providers in the aftermarket business will have the same access to electronic repair and diagnostic information as the authorized repairs shops and thus strengthening their position on the market. Furthermore, BCG (2011) stresses that the decreasing customer loyalty over time is a challenge. The customer loyalty to authorized repair shops is highest among new vehicle owner and business owners. For owners of older and used vehicles the customer loyalty switches towards the independent repair shops where prices can often be lower.

BCG (2011) explains that insurers, fleet operators and leasing companies that have vehicle repairs and maintenance among their highest cost drivers have made special contracts with networks of selected repair shops where customers must go for repairs and maintenance. For these selected repairs shops, it means higher business volumes. These kinds of partnerships have increased in recent years and independent repair shops are profiting from it. Meanwhile, the authorized repair shops are left behind and their market share will be decreased unless they find a solution for this challenge (BCG, 2011).

Key points:

- *Competition from independent service providers due to available data about identification of replacement parts of vehicles*
- *Customer disloyalty*

Capgemini Consulting

Capgemini Consulting and University of St. Gallen (2010) explains that winning the aftermarket is not an easy task because of the complexity it involves, large numbers of repairs and spare parts activities and crucial supply chains. Capgemini Consulting and University of St. Gallen (2010) mentions two types of markets, mature markets and emerging markets. The emerging markets are Eastern Europe, Russia, China and India and the mature market is Western Europe. Capgemini Consulting and University of St. Gallen (2010) identifies a few challenges, one of them regarding competitors that can utilize the European Union Block Exemption Regulation to gain on OEMs and OESs in the aftermarket. The regulation will attract more suppliers to the aftermarket which means that the OEMs and OESs will have to compete with copy manufacturers and independent suppliers that can offer customers lower prices (Capgemini Consulting and University of St. Gallen, 2010).

In Western Europe it is essential to offer customers innovative services with emphasis on customer requirement and customization to achieve competitive advantage and to be able to differentiate the service offers. According to Capgemini Consulting and University of St. Gallen (2010), the main strategic initiatives investments for companies to compete in the aftermarket are improving and extending the service offerings, adapting service offerings to local requirements, increasing the local market penetration and optimizing the planning processes. Furthermore, Capgemini Consulting and University of St. Gallen (2010) also mentions improving the relationships with dealers and workshops, improving the relationships with wholesalers and establishing cooperation to achieve competitive advantage.

Key points:

- *Competition from low price copy manufacturers and independent suppliers*
- *Competitive advantage through innovative service offers with emphasis on customer requirements and customization*

Industry press: DHL rolls out aftermarket concept for BMW UK

Automotive Logistics (2011) covers for the challenge of frequent shipping of parts to dealers. BMW UK signed a contract with DHL Supply Chain in order to increase dealership deliveries. The contract included many functions usually performed by the warehouses. DHL then covered for receipt, put-away, picking and dispatching of components for the aftermarket. Before the contract was signed, dealers only received nightly deliveries once a night, which implied that the customer would have to revisit the dealer in case the parts were not available during the first visit. Central dealer city distribution centers

deliver to mega-local-dealer-city-distribution centers, which replace "traditional" distribution centers. From thereon, components are distributed to micro-local dealer centers, which replace dealer-parts warehouses. This yields high frequency deliveries as well as night replenishment of the dealers, and shipments can be received up to three times a day (Automotive Logistics, 2011).

Key point:

- *Traditional distribution centers replaced by 3rd party logistics providers enabling flexible storage and delivery schedules*

Industry press: BMW battles supply chain disruption in aftermarket

According to Automotive Logistics (2013), BMW's aftermarket supply chain in Germany is having problems with its logistics software, Atlas. The consequences are delays to deliver replacement spare parts in the aftermarket, but around 10 percent of parts needed every time are not available in the central warehouse in Dingolfing in Germany which supplies other 40 distribution centers. Customers need to wait for the spare parts to be delivered before their vehicle is repaired and in some cases vehicles are waiting for weeks, in some cases if only one part is missing. The main challenge for BMW aftermarket supply chain is hence to place spare parts in stock in order for them to be available for delivery. BMW is currently offering replacement vehicles to their customers that are affected by the delays, but their workers are also working extra shifts to solve the problem. In addition, airfreight will be used to decrease transit times. About 180 customers each month are affected by the delays or around 20 percent all BMW's customers. The delays can harm BMW's reputation greatly and customer loyalty as well (Automotive Logistics, 2013).

Key point:

- *Technical software issues may result in delays to deliver spare parts, leading to harmed reputation and customer disloyalty*

6.2 Aftermarket challenges from benchmarking study in relation to the service contracts

In Table 6.1 challenges from consultancy reports and industry presses are presented by the authors in terms of if they affect the service contracts or not. Some of the challenges found from consultancy reports and industry presses are similar to the challenges from the case company and literature discovered by answering research question one (RQ1: What are the key challenges with the aftermarket supply chain in regard to the bundled service offers?) that was further discussed in Table 5.2 on page 55. Most of the challenges that have not been introduced by the case company or literature do not affect the service contracts directly, as seen in Table 6.1, but had an interesting input into this thesis.

Table 6.1: Challenges from consultancy reports and industry press in relation to the service contracts.

Challenges	Service contracts		
	Gold	Silver	Blue
Competition from other markets	–	–	–
Struggle for market shares and margins on home proximity	–	–	–
Meeting customer expectations	X	X	X
The sets of rules in siloed departments in organizations often have little or no connection to the customers’ preferences	X	X	X
The performance measures that are being measured are not aligned with the customer expectations or demands	X	X	X
Spare parts are unavailable	X	X	X
Lack of ‘fix right first time’ procedures at dealers and service points	X	X	–
Forecasting for spare parts with volatile demand	X	X	–
Supplier challenges	X	X	X
Future megatrends	–	–	–
Environmental legislations	–	–	–
Customers are increasingly interested in the TCO for trucks which put pressure on developing trucks with low TCO	–	–	–
Competition both from suppliers and dealers arising from new regulations obliging manufacturers to release electronic data for identification of replacement parts of vehicles	–	–	–

Competition from other markets does not affect customers holding service contracts per se. The competition arises from competing truck brands, which does not impact the spare parts included in the service contracts. The struggle for market shares and margins on home proximity does not affect the logistics of spare parts. Customers that become disloyal are a threat since fewer service contracts would be sold, but the performance of the service contracts are unaffected by this struggle. The challenge of meeting customer expectations impacts customers with service contracts since customers have little tolerance for poor treatment, and want their desires satisfied immediately whether they have a Gold, Silver or Blue contract.

The sets of rules in siloed departments in organizations often have little or no connection to the customers’ preferences. This impacts customers holding service contracts since the service contracts seek to satisfy a customer need, but if the departments are siloed and

have little connection to the customers' preference, then it would be difficult to deliver accordingly. The performance measures that are being measured are not aligned with the customer expectations or demands. At the case company, there is a performance measure measuring the time it takes to respond to an availability issue, however, this is a typical measure that is unaligned with the customer expectations since the measure does not focus on solving the customer's issue. Unaligned performance measures impact customers holding service contracts since the customers are keen on fast service deliveries.

Next, spare parts being unavailable is a severe issue for all customers holding service contracts since they all depend on spare parts being available so maintenance and repairs can be performed. Lack of 'fix right first time' procedures at dealers and service points mainly affects the customers holding Gold and Silver contracts since these include repair activities that could be unique due to sporadic breakdowns. Forecasting of spare parts with volatile demand mainly affects the spare parts included in the Gold and Silver contracts since they include repairs and maintenance that cannot be forecasted due to unexpected breakdowns.

The current challenges for suppliers in the aftermarket are high supply chain costs, inventory above entitlement, lack of customer responsiveness, and limited supply chain flexibility. However, these challenges could also impact customers holding service contracts since logistics of spare parts starts at the suppliers. If the suppliers are having problems with supply of material, then the spare parts included in the service contracts would be affected. Future megatrends could possibly affect customers with contracts depending on the megatrend, but it is not possible to state the impact on the customers since it is dependent on the content of the megatrend. Environmental legislations could impact the pricing of the service contracts due to increased prices of spare parts, but the legislations do not impact the logistics of spare parts directly.

Customers being increasingly interested in the total cost of ownership (TCO) that puts pressure on developing vehicles with low TCO does not affect the logistics of spare parts involved in the service contracts per se, but affects the production of the trucks. Competition both from suppliers and dealers arising from new regulations obliging manufacturers to release electronic data for identification of spare parts of vehicles does not affect the service contracts directly. Competition from suppliers and dealers can of course affect the customers' decision whether or not to buy a service contract if a cheaper option is available elsewhere, but since spare parts are included in the contracts the contracts are unaffected by this challenge.

To conclude chapter 6, a benchmarking study was carried out by assessing aftermarket challenges from consultancy reports and industry presses in relation to the service contracts. The next chapter accounts for the recommendations to the case company based on some of the identified challenges.

7. Recommendations

This chapter is divided up into five sections and aims at answering research question three, how the aftermarket supply chain should be adapted in regard to the bundled service offers, based on the challenges identified. Furthermore, this chapter provides the case company with recommendations. The first section is a recap of the current aftermarket supply chain set-up at the case company and the second section is a summary of the challenges in relation to the service contracts identified in chapter five and six. The third section accounts for organizational and operational principles in the aftermarket supply chain and puts them in relation to literature. The fourth section includes areas of improvements, the recommendations, which are summarized in the end of the section. The last section is an evaluation on how to implement the recommendations.

7.1 Current set-up of the aftermarket supply chain

The case company’s aftermarket supply chain is responsible for supply of material to spare parts warehouses, globally optimize inventory of spare parts and handle orders and deliver spare parts to dealers. The case company’s aftermarket supply chain is shown in Figure 7.1 and consists of different actors with different transportation flows. The key players in the aftermarket supply chain are suppliers, transportation providers, dealers, customers and the case company that manages the flow. The flow of the spare parts and how it is transported between key players and warehouses in the Nordic market is shown with arrows in Figure 7.1. The transportation modes in the Nordic market are either by road, air or taxi/courier and are provided by many different transportation providers.

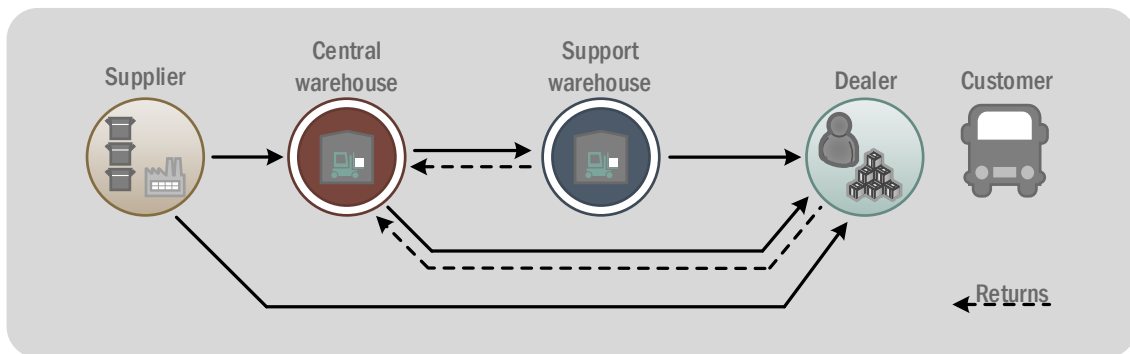


Figure 7.1: The aftermarket supply chain of Volvo Group for the Nordic market. Adapted from respondent 3.

Currently, there are two central warehouses in Europe, one in Ghent (Belgium) and one in Lyon (France). The function of the central warehouses is to deliver full range of spare parts to regional and support warehouses and supply dealers and customers directly. The central warehouse in Ghent (Belgium) mainly supplies the Volvo Trucks brand, whereas the central warehouse in Lyon (France) mainly supplies the Renault Trucks brand. There are no regional warehouses in Europe, due to the geographical location of the central warehouses and therefore regional warehouses are excluded in Figure 7.1. There are two sup-

port warehouses serving the Nordic market located in Helsinki (Finland) and Gothenburg (Sweden). In December 2015, the support warehouse in Gothenburg (Sweden) will be closed down and moved to Eskilstuna (Sweden). The function of the support warehouses is to distribute day orders to dealers.

7.2 Summary of aftermarket challenges in relation to service contracts

Table 7.1 accounts for all the challenges that impact the service contracts analyzed by the authors in Table 5.2 and 6.1. The challenges have been grouped into the categories: forecasting of spare parts, dealer challenges, customer satisfaction, lack of information flow, availability, KPIs, pricing of service contracts, supplier challenges, and driver behavior.

Table 7.1: Aftermarket challenges impacting the service contracts.

Challenges		Service contracts		
		Gold	Silver	Blue
Forecasting of spare parts	Nature of demand (sporadic breakdowns of vehicle make the demand unpredictable)	X	X	–
	Forecasting based on historical demand rather than using the available data about the vehicles	X	X	X
	Seasonal products have volatile demand	X	–	–
	Forecasting the initial stock for newly launched trucks	X	X	X
	Forecasting for spare parts in the decline phase	X	X	X
Dealer challenges	Dealers not using available data (e.g. remote diagnostics connectivity) about the vehicles	X	X	X
	Lack of ‘fix right first time’ procedures at dealers and service points	X	X	–
Customer satisfaction	Managing customer expectations	X	X	X
	The sets of rules in siloed departments in organizations often have little or no connection to the customers’ preferences	X	X	X
Information sharing	Lack of information flow regarding the bundled service offers between sales and aftermarket departments	X	X	X
	Lack of information flow when sales campaigns are launched	X	–	–

Continued on next page

Table 7.1 – Continued from previous page

Challenges		Service contracts		
		Gold	Silver	Blue
Availability	Lack of routines on how to recover unavailable parts	X	–	–
	Availability of spare parts at the dealer	X	X	X
KPIs	Important KPIs are not measured or KPIs that are measured are not measuring all the relevant factors	X	X	X
	Lack of visibility in the system regarding lead-times of backorders, leading to dissatisfied customers	X	X	X
Pricing of service contracts	The pricing of service contracts and how to manage the risk	X	X	X
Supplier challenges	Supplier challenges	X	X	X
Driver behavior	Drivers' behavior causing deviating wear and tear	X	X	X

Forecasting of spare parts

The unpredictable demand of spare parts primarily affects the customers that hold Gold and Silver contracts since these include repair services that are difficult to forecast (the remote diagnostics connectivity can only be used to forecast certain components). Only basing forecasts on historical demand rather than using the available data about the vehicles to improve the forecasting affects all customers with service contracts since planning of spare parts could be improved by using this data, both preventive maintenance and other maintenance occurring unexpectedly. Forecasting of seasonal parts affects customers with the Gold contract since this contract is the only contract that promises an uptime with a certain time-window to repair the vehicle. Forecasting the initial stock for newly launched trucks and for spare parts in the decline phase affects all the service contracts, but due to the uptime promise in the Gold contract, this has the most impact on customers holding that contract.

Dealer challenges

Dealers that are not using available data (e.g. remote diagnostics connectivity) about the vehicles affect the customers that hold service contracts. The remote diagnostics connectivity used for the Gold contract is also important to follow up on to secure the 100 percent uptime promise. Lack of 'fix right first time' procedures at dealers and service points mainly affects the customers holding Gold and Silver contracts since these include

repair activities that could be unique due to sporadic breakdowns.

Customer satisfaction

Managing customer expectations has an impact on all customers with service contracts. If the customer buys a service contract and does not have realistic expectations on what is included or gets poor treatment the customer will be dissatisfied. The sets of rules in siloed departments in organizations often have little or no connection to the customers' preferences. This impacts customers holding service contracts since the contracts seek to satisfy a customer need, but if the departments are siloed and have little connection to the customers' preference, then it would be difficult to deliver accordingly.

Lack of information flow

Lack of information flow between aftermarket departments and the sales has an impact on customers with a service contract since the aftermarket department is responsible for spare parts logistics which is a vital part of the contracts. Lack of information flow when sales campaigns are launched affects mainly the logistics of spare parts in the Gold contract because of the uptime promise, since the campaigns may cause decreased responsiveness in supplying the parts in the campaigns.

Availability

Spare parts being unavailable at the dealer is a severe issue for all customers holding service contracts since they all depend on spare parts being available so maintenance and repairs can be performed. Lack of routines on how to recover unavailable parts mainly impacts the customers with the Gold contracts because it is crucial to retrieve the unavailable part as quickly as possible due to the uptime promise.

KPIs

Important KPIs are not measured or KPIs that are measured are not measuring all the relevant factors affects all the customers holding a service contract. The performance measures that are being measured are not aligned with the customer expectations or demands. An important KPI that is not currently being measured at the case company is the total lead-time from order placed to order delivered, which will have an impact on the customer satisfaction in cases of long lead-times for all types of contracts. Lack of visibility in the system regarding lead-times of backorders affects all customers with service contracts since it leads to dissatisfied customers. An example of a KPI that is not measuring the relevant factor is that the help desks at the support warehouses measure the time it takes to reply to a case, but the quality of the reply and if the case was solved is not measured. Therefore, what is being measured does not affect the solution to the problem, hence the wrong indicator is being measured.

Pricing of service contracts

The pricing of service contracts affect customers that hold a service contract. Some contracts have proven to have a negative profit while others have positive. In some countries the price of the contracts needs to be updated, since customers can find the spare parts they need cheaper from competitors.

Supplier challenges

The current challenges for suppliers in the aftermarket are high supply chain costs, inventory above entitlement, lack of customer responsiveness, and limited supply chain flexibility. However, these challenges could also impact the service contracts since logistics of spare parts starts at the suppliers. If the suppliers are having problems with supply of material, then the service contracts would be affected. Insufficient quality and poor deliveries from suppliers in low cost countries also affect the logistics of spare parts involved in the service contracts. If the spare part has poor quality it needs to be replaced and the customers will be dissatisfied, the same goes for poor deliveries, which will then impact the uptime of the vehicle.

Driver behavior

Driver behavior causing deviating wear and tear has an impact on customers holding service contracts since more wear and tear repairs caused by the driver will both increase the cost of the contract and lower the uptime of the vehicle.

The challenges with the aftermarket supply chain are mapped by the authors in Figure 7.2.

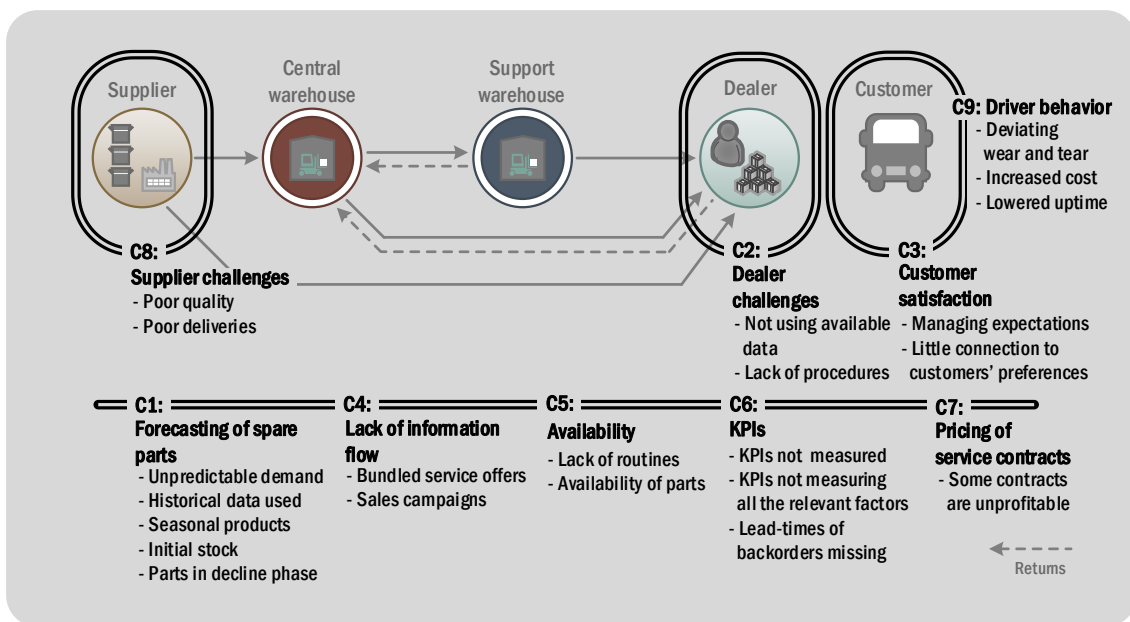


Figure 7.2: Mapping of challenges in the aftermarket supply chain.

7.3 Organizational and operational principles of the aftermarket supply chain

Supply chains develop over time and many supply chains were set up before there were bundled service offers, so the supply chains are not fully adapted to the service offerings. This puts pressure on the case company to adapt their aftermarket supply chain so the supply chain is able to meet the requirements that the bundled service offers put on it.

This adaptation can be made possible by adapting some organizational and operational principles. Organizational principles are those that relate to the organizational structure

and the people in the organization. The operational principles are those that relate to the operational performance of the aftermarket supply chain and include measures such as lead-time and stock levels. Operational principles include performance and activities, such as physical handling of spare parts. From a physical handling perspective, the current aftermarket supply chain at the case company is considered sufficient, but some adaptations could be made to further improve it. Furthermore, the operational and organizational principles in terms of administrative handling of the current aftermarket supply chain can be improved.

An aftermarket supply chain that takes organizational and operational principles into account will enhance availability of spare parts. Availability of spare parts constitutes the core in the service contracts, therefore it is important to enable availability. Enablers of availability are e.g. local availability in terms of inventories, fast transportation, delivery precision from suppliers, invoicing routines, ordering routines, and booking transports. Short lead-time is crucial for enabling availability of spare parts when unexpected breakdowns occur. Lead-time is an operational principle and can be related to both physical handling as well as administrative handling. Enablers of availability in the aftermarket supply chain are listed by the authors in Table 7.2.

Table 7.2: Enablers of availability in the aftermarket supply chain.

Lead-times	Enablers	<i>Supplier</i>	<i>Central warehouse</i>	<i>Support warehouse</i>	<i>Dealer</i>	<i>Case company</i>
Physical	E1 Local availability stock				X	
	E2 Warehousing/handling	X	X	X	X	
	E3 Transportation	X	X	X	X	
	E4 Supplier delivery precision	X				
Administrative	E5 Invoicing routines					X
	E6 Ordering routines		X	X	X	X
	E7 Booking transports					X

The enablers of availability in the aftermarket supply chain are further visualized by the authors in Figure 7.3.

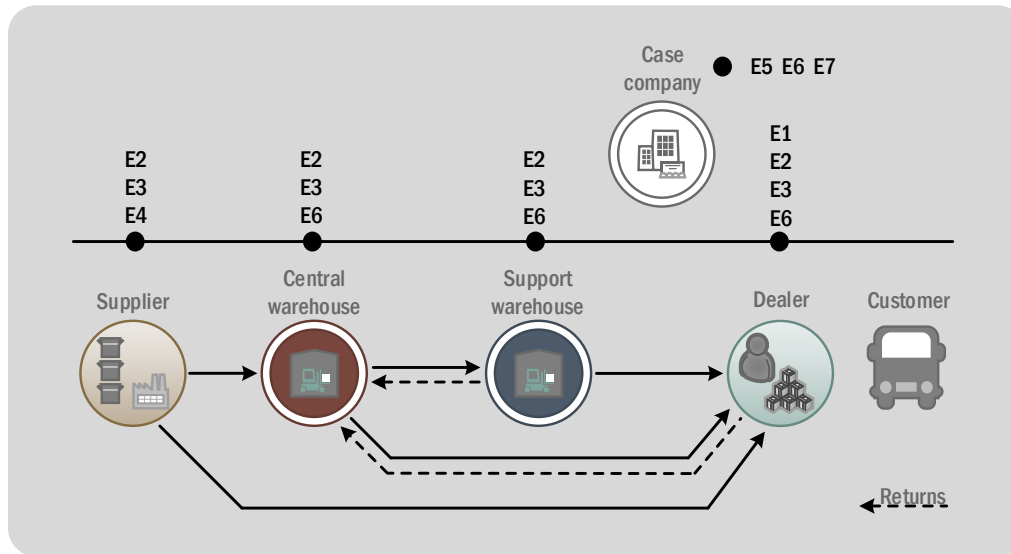


Figure 7.3: Enablers of availability in the aftermarket supply chain.

7.4 Areas of improvement

Matching the supply chain design to the product or service type introduced by Fischer (1997) can enhance availability. The frameworks used to support the recommendations have been adapted to fit services, in this case service contracts and not physical products. Different types of service contracts need different types of supply chain designs because the service contracts differ in terms of what services are included in each contract. Therefore, demand and the availability of spare parts also differ between the contracts. Preventive maintenance is the same for all contracts, and the demand for preventive maintenance is predictable or stable and can therefore be considered a functional product. The supply chain design for functional products should be cost-efficient. The unpredictable breakdowns of vehicles constitute a stochastic or volatile demand for spare parts, which implies that the spare parts can be considered innovative products. The supply chain design for innovative products should be responsive.

Considering the service contracts for the case company, it is possible to suggest different supply chain designs for different contracts. Currently, the case company serves the service contracts equally and e.g. the Gold contract customers are not handled with a higher priority. The Gold contract needs an extremely responsive supply chain design to meet the 100 percent uptime promise and to avoid paying the financial compensation. The Blue contract should have an efficient supply chain design since pre-planning of maintenance allows for efficient material flows and cost should be kept at minimum. The Silver contract should be in-between having an efficient and responsive supply chain, since the repairs included in that contract happen unexpectedly. However, the Silver contract should be more towards having a responsive supply chain but not as responsive as the Gold contract, since the Silver contract has no 100 percent uptime promise or any financial compensation. The service contracts and the recommended supply chain designs are mapped by the authors in Figure 7.4.

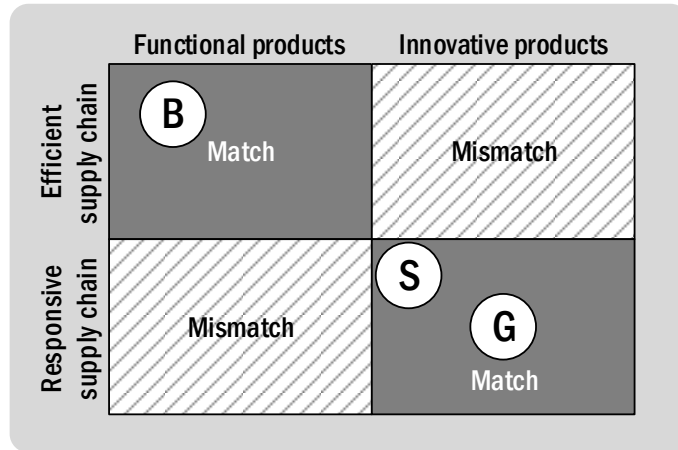


Figure 7.4: Mapping of service contracts according to Fischer's (1997) framework.

Availability can be enhanced by choosing the right strategy for the aftermarket supply chain as suggested by Pagh and Cooper (1998). Since the service contracts differ in terms of what is included in the contracts, they could have different postponement/speculation strategies. Pagh and Cooper's (1998) profile analysis was used to determine what strategies are suitable for the Gold, Silver, and Blue contracts respectively. The profile analysis was adapted to fit the service contracts and therefore some determinants were removed from the original version. The result of the profile analysis made by the authors is shown in Figure 7.5.

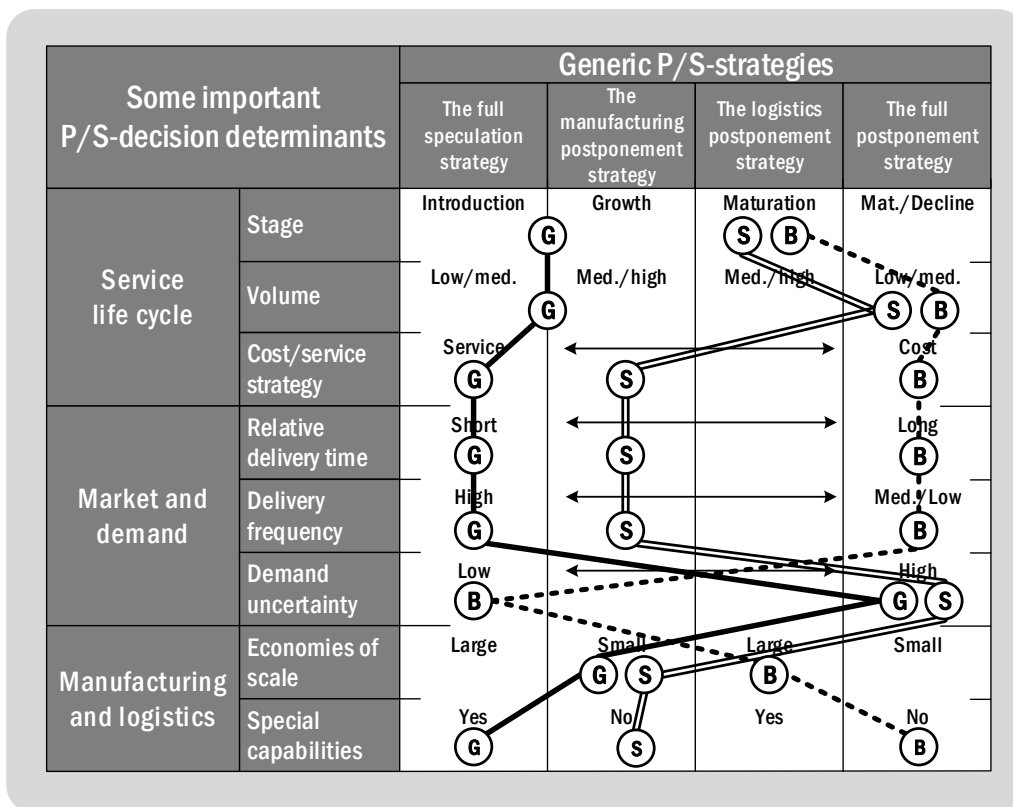


Figure 7.5: Profile analysis for the service contracts.

Services:

The life cycle stage for the Gold contract is between the introduction and growth phase. It is quite newly launched, but has yet been on the market too long in order to be in the introduction stage. The Silver and Blue contracts are considered to be in the maturation stage since they have been on the market for many years now and reached maturation. In order to categorize the volumes of the service contracts, this categorization was based on the penetration numbers in Table 4.1 on page 37. The Gold contract can be considered to be between low/med and med/high since this contract has the highest penetration number. The Silver and Blue contracts are considered low/med since they have lower penetration number. Regarding the cost/service strategy, the Gold contract has a service strategy since customers are promised 100 percent uptime of the truck. The Silver contract is considered to have a service strategy too, but not to the same extent as the Gold contract. The Blue contract on the other hand is considered to have a cost strategy, where the focus is on keeping costs to a minimum.

Market and demand:

The Gold contract needs short delivery times in order to solve for availability issues within the set time frame. The Silver contract does not need as fast deliveries as the Gold contract, but yet faster than those of the Blue contract. The Blue contract can have longer delivery times since the preventive maintenance parts can be planned in advance. Regarding delivery frequency, the Gold contract should have high delivery frequencies due to the set repair time frame. The Silver contract has rather high delivery frequency too so the uptime can be improved. Since the Blue contract includes maintenance parts that can be planned in advance, the delivery frequency is medium/low. These parts are also parts that can be stocked at the dealer. Demand uncertainty is high for the Gold and Silver contracts since breakdowns occur unexpectedly and these contracts include repairs for those kinds of breakdowns. Demand uncertainty is low for the planned maintenance parts in the Blue contract.

Manufacturing and logistics:

The Blue contract can reach economies of scale due to pre-planning of spare parts at the dealer. The Gold and Silver contracts cannot reach economies of scale since they account for repairs that occur suddenly (cannot be pre-planned). Regarding special capabilities in logistics, the Gold contract needs special capabilities in order to manage the ad hoc material flows. The Silver and Blue contracts do not need special capabilities in terms of logistics.

The outcome of the profile analysis is that the Gold contract should have the full speculation strategy with decentralized inventories and a make to inventory strategy. Most of the determinants fell under the category of the full speculation strategy. The determinant 'demand uncertainty' was the only one that deviated from the full speculation strategy. The Silver contract should have the manufacturing postponement strategy with a make to order strategy and decentralized inventories. Most of the determinants fell under that category or close to it besides the demand uncertainty. The Blue contract should have the

full postponement strategy since most of the determinants fell under that category or close to it. The full postponement strategy consists of make to order strategy with centralized inventories and direct distribution. The determinant demand uncertainty was also the only one deviating from the full postponement strategy.

Looking at the service contracts, the content differs and therefore they require different supply chain designs. However, the complexity of having different designs for each contract seems unrealistic to implement so another angle to look at it would be to prioritize availability according to the service contracts. Currently, the case company only prioritizes the different order classes (VOR, stock, and day orders). The orders are not prioritized to customers with service contracts e.g. an order originating from a Gold contract customer needs higher priority in order to fulfill the service levels promised. The set time frame for repairing the truck is four hours until the case company needs to offer a replacement truck or financial compensation, so the aftermarket supply chain needs to be extremely responsive. In order to enable responsiveness, all internal functions need to be aware of the prioritization of the availability according to the service contracts. E.g. the purchasing department would have to respond quickly to orders concerning the Gold contract. Additionally, supplier delivery precision is an important enabler for availability. If the supplier does not deliver according to the expected delivery plan the part will be delayed (not available) and it might be necessary to stock up on additional inventory to secure the availability. The possibility of prioritizing the suppliers according to criticality could be further investigated, and the focus should be on the ones supplying critical parts (e.g. the ones for the Gold contract) rather than the ones supplying less critical parts.

Abrahamsson (1993) accounted for decentralized versus centralized structures of the supply chain. Currently, the case company has a rather decentralized structure, but in terms of the service contracts, the structure should differ between the contracts as shown in Figure 7.6. The Blue contract should have a centralized structure, since preventive maintenance can be pre-planned. The Silver contract should be more towards the decentralized structure, but not to the same extent as the Gold contract since this contract does not include a 100 percent uptime promise.

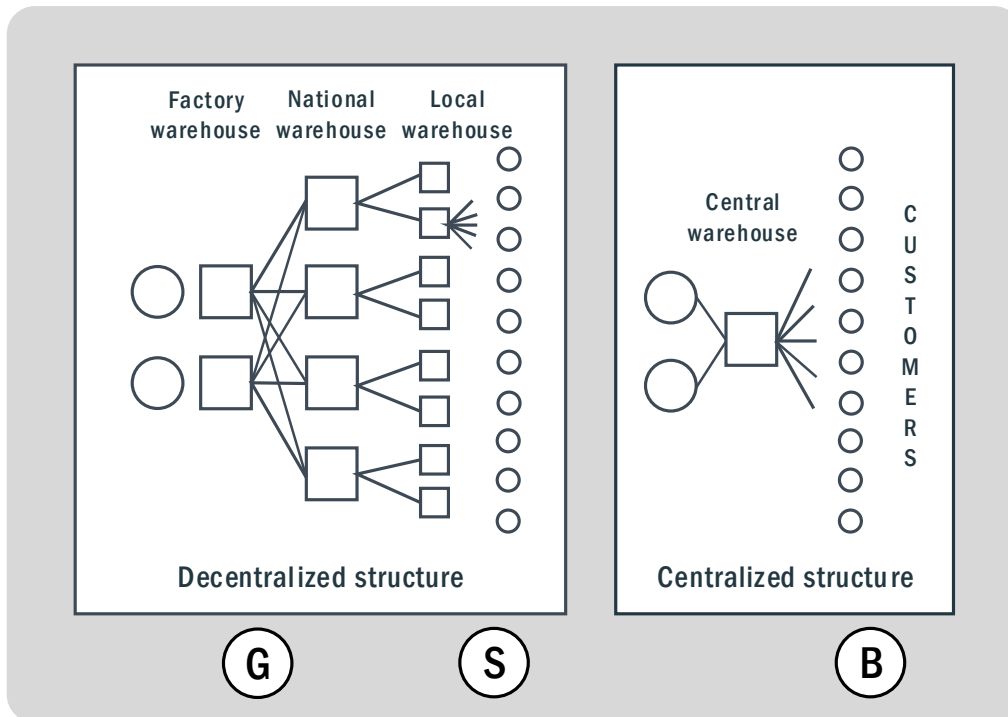


Figure 7.6: Mapping of the service contracts according to Abrahamsson's (1993) framework

A decentralized supply chain structure would include stocking spare parts closer to the dealers or even at the dealers. This would be beneficial for the Gold contract since it requires a very responsive supply chain in order to meet the demand of the customers, which implies more local availability in terms of decentralized inventories. However, in terms of inventory and transportation costs it is not possible to stock too much at the dealers to provide excellent availability and improving the uptime of the vehicle. Therefore, it is recommended to implement local hubs or mini-warehouses closer to the dealers to stock fast moving critical parts as suggested by Automotive Logistics (2011). The hubs would then be able to serve more than one dealer and the costs would be decreased and the total lead-time improved. The hubs and its services such as pick and packing would be outsourced, which would allow for more flexibility if the case company would need to make changes in its aftermarket supply chain structure.

In order to provide short lead-times and therefore improving availability, operational principles should be considered such as following up on KPIs. To be able to improve customer satisfaction with shorter lead-times the case company should measure a new KPI and follow up on the overall lead-time from an order has been entered into the system until the order has been delivered and made available at the dealer. Furthermore, following up on this KPI and setting up targets enables possibilities in identifying bottlenecks so it would be possible to see what deviations there are.

Availability can be enhanced if the sales and Material Management functions collaborate when it comes to information sharing, especially in regard to designing the service con-

tracts, but also when it comes to supply of spare parts. Currently, this collaboration seems to be inadequate when it comes to the design of the offers. Stakeholders supplying the service contract constituents, i.e. the spare parts, need to be involved in designing the offers with the sales function since the supply of spare parts constitutes the core in the service contracts. Furthermore, large sales campaigns need to be communicated to the stakeholders supplying the parts that are part of the campaigns in order to secure availability of the parts at the dealers.

The recommendations are summarized as followed:

- Prioritization of availability of critical spare parts according to service contracts orders

The current order classes do not show which contract type the order is linked to, which means that the order classes are prioritized but the service contract orders are not. Customers with a service contract need to be prioritized.

- Prioritization of suppliers according to criticality

Focus on the ones supplying critical parts (e.g. for Gold contract)

- Implementing local hubs or mini warehouses close to the dealers

Serving more than one dealer in the area, stocked with critical parts. By implementing the local hubs, it could be avoided to stock more at dealers and availability of parts would be increased.

- Measuring the lead-time from order entered at the dealer until the order has been delivered to the dealer

Following up on this KPI could improve delivery lead-times and enhance customer satisfaction. Setting up targets enables possibilities in identifying bottlenecks.

- Internal information sharing, especially in regard to designing the service contracts, but also when it comes to supply of spare parts

Supply of spare parts constitutes the core in the service contracts, therefore, the aftermarket function should be involved in designing the offers as well as being informed about large campaigns in beforehand to secure availability of parts.

7.5 Evaluation of implementing the recommendations

The five areas of improvements, the recommendations, have now been presented. The recommendations are in relation to the challenges identified in the report and summarized in Table 7.1 on page 69. In this report, the focus was on the availability challenge since that is the most severe problem in the aftermarket at the case company. Some additional challenges were also solved within the following categories: customer satisfaction, information sharing, KPIs and supplier challenges.

The first recommendation, regarding prioritization of availability of critical spare parts according to service contracts orders, aims to solve the challenges: customer satisfaction and availability. By prioritizing the service contract orders, the availability would be improved for customers holding a service contract and therefore also the customer satisfaction. The second recommendation, regarding prioritization of suppliers according to criticality, aims to solve the challenges: availability and supplier challenges. By prioritizing the suppliers according to criticality, availability would be improved since suppliers supplying critical parts would be focused on. The third recommendation, regarding implementing local hubs or mini warehouses close to the dealers, aims to solve the challenges: customer satisfaction and availability. Implementing local hubs would improve availability of parts and that would lead to improved customer satisfaction. The fourth recommendation, regarding measuring the lead-time from order entered at the dealer until the order has been delivered to the dealer, aims to solve the challenges: customer satisfaction, availability and KPIs. By following up on this KPI, it would be possible to shorten the delivery lead-times and by that improve customer satisfaction. The last recommendation, regarding internal information sharing, especially in regard to designing the service contracts, but also when it comes to supply of spare parts, aims to solve the challenges: customer satisfaction, information sharing and availability. By improving information sharing it would be possible to secure availability of parts and therefore customer satisfaction.

The remaining categories are forecasting of spare parts, dealer challenges, pricing of service contracts and driver behavior. Those challenges all involve difficulties to solve and some were out of the scope of the thesis. Forecasting of spare parts is problematic, but that is always the case, especially since breakdowns occur suddenly and therefore it is impossible to plan according to that. The dealers lack incentives to solve for the dealer challenges such as using the available data about the vehicles. The pricing of service contracts is problematic in some countries and the case company has analyzed that to some extent and updated the price. In this thesis, this was an area considered out of the scope. Driver behavior is also an interesting area to investigate further but was also considered out of the scope of this thesis.

When it comes to the implementation of the recommendations, some would be quite easy to implement but some requires further assessment in terms of analyzing relevant data. The first two recommendations regarding prioritization of service contract orders and prioritizing suppliers according to criticality could be implemented in the case company's systems, but that requires that the segmentation project at the case company is finished to be able to identify the critical parts. The KPI recommendation could also be implemented quite easily in the system as other KPIs are measured and the data for measuring that KPI already exists. Regarding the implementation of local hubs, this could be further assessed with relevant data, both when it comes to the cost of unavailable parts, but also when it comes to the location of those hubs. In some cases the main dealers could also be used as local hubs. A clear benefit with implementing local hubs would be the shorter transportation lead-times. However, the tied-up capital may increase some, but not to

the same extent as if the stock at the dealers would be increased. Improved information sharing between the aftermarket department and the sales department would also result in clear benefits for securing availability of spare parts. This area is difficult to implement and requires all stakeholders internally at the case company to be involved and open to improving the communication between different functions.

Overall, the recommendations would solve for many challenges identified at the case company and they have a strong potential in being implemented. By implementing those recommendations, the aftermarket supply chain at the case company would be better adapted to the service contracts.

To conclude chapter 7, recommendations for the case company were discussed and formed. The recommendations were supported by frameworks from literature and consists of five areas of improvement. At the end of the chapter, the recommendations were evaluated in terms of implementation. The next chapter is the discussion, where the findings are discussed in relation to literature.

8. Discussion

In this chapter the findings from the assessment are further discussed in relation to literature. The thesis consists of three research questions that aim at answering the purpose of the thesis. The first research question is:

1. What are the key challenges with the aftermarket supply chain in regard to the bundled service offers?

The research question was answered through findings from a literature review and data from interviews taken at the case company. Many aftermarket challenges identified were the same or similar, which shows that the aftermarket challenges the case company faces are not unique in the industry. To get a broader perspective, industry presses and consultancy reports were also reviewed to identify aftermarket challenges. This was done in order to answer research question two, which is:

2. What other supply chain challenges do other companies identify as regards to aftermarket services?

The consultancy and industry presses had some similarities to the challenges identified from research question one, but the ones that were not related to literature nor the case company still had a valuable and interesting input to this thesis. The findings from research question one and two found a starting base for the third research question, which is:

3. How should the aftermarket supply chain be adapted in regard to the bundled service offers, based on the challenges identified?

Supply chains develop over time and many supply chains were set up before there were bundled service offers, so the supply chains are not fully adapted to the service offerings. This puts pressure on the case company to adapt their aftermarket supply chain so the supply chain is able to meet the challenges that the bundled service offers put on it. This adaptation can be made possible by adapting some organizational and operational principles. From a physical handling perspective, the current aftermarket supply chain at the case company is considered sufficient, but some adaptations could be made to further improve it. Furthermore, the operational and organizational principles in terms of administrative handling of the current aftermarket supply chain can be improved. The main findings of the report were that availability should be prioritized according to customers with service contracts, the total lead-time from order placed at the dealer until the order has been delivered to the dealer should be measured to improve the overall performance. Also, the internal information sharing regarding the service offerings and sales campaigns is inadequate and the dealer stock should be reconsidered according to the service contracts.

Prioritizing the availability of spare parts according to service contracts could increase responsiveness from the supply chain when reacting on a service contract specific spare parts order. Responsiveness is one of the main challenges in the context of automotive aftermarket supply chain that is presented by literature. Fischer's (1997) and Pagh and Cooper's

(1998) frameworks suggest different supply chain designs/strategies for different types of service contracts. However, this is unsuitable in the case company context since the aftermarket supply chain must serve orders other than those belonging to service contracts only. The solution was therefore to prioritize the orders according to the customer and also prioritizing suppliers according to criticality. From literature it was identified that customer satisfaction is important to consider when setting up sufficient KPIs in order to measure performance of the supply chain. This is in line with recommending the case company to measure the total lead-time. Following up on this KPI enables possibilities in shortening delivery lead-time, which would enhance customer satisfaction. The lack of information sharing internally is a common challenge within many organizations especially if many stakeholders are involved. This area was, however, not identified in literature but was strongly emphasised on by respondents during the research. Stakeholders supplying the service contract constituents, i.e. the spare parts, need to be involved in designing the offers with the sales function since the supply of spare parts constitutes the core in the service contracts. The Gold contract requires a very responsive supply chain, so in order to meet the demand of this contract there needs to be more local availability in terms of decentralized inventories, which was supported by literature. It is therefore recommended to implement local hubs close to the dealers that serve more than one dealer in the area and are stocked with critical parts. Pushing more inventories of critical parts (parts for the Gold contract) to the local hubs would improve availability and the response time for serving the customer.

This thesis confirms the majority of the challenges found in literature since these were identified at the case company. Some of the challenges identified by consultancy reports were not identified at the case company, and were not relevant for the study area. Part of the thesis was to study bundled service offers, however, it was found that service offers are to some extent new to literature. Therefore little information from literature was found about the service offerings. The frameworks were originally designed for physical products, but in this thesis they were adapted to services. This is a new area of application, but since the aftermarket is a growing business area this could be further researched.

9. Conclusion

The purpose of this thesis was to study the bundled service offers in order to provide recommendations for adaptations of the aftermarket supply chain. In order to deliver the recommendations, an investigation of the key challenges with the aftermarket supply chain in regard to the bundled service offers currently offered by the case company will be conducted, as well as a benchmarking study on what other companies identify as supply chain challenges in regard to aftermarket services. From research question one (RQ1: What are the key challenges with the aftermarket supply chain in regard to the bundled service offers?) and research question two (RQ2: What other supply chain challenges do other companies identify as regards to aftermarket services?) the challenges identified that could be related to the service contracts were forecasting of spare parts, dealer challenges, customer satisfaction, lack of information flow, availability, KPIs, pricing of service contracts, supplier challenges, and driver behavior.

In order to answer research question three, (RQ3: How should the aftermarket supply chain be adapted in regard to the bundled service offers, based on the challenges identified?) the challenges from research question one and two were taken into account when suggesting recommendations on adaptation of the aftermarket supply chain to meet the requirements of the service contracts. From a physical handling perspective, the current aftermarket supply chain at the case company is considered sufficient, but some adaptations could be made to further improve it. Furthermore, the operational and organizational principles in terms of administrative handling of the current aftermarket supply chain can be improved.

The first area of improvement is the prioritization of availability of critical spare parts according to service contract orders. As for now, the system cannot see what contract type an order is connected to, the orders are only prioritized to stock orders, day orders and VOR orders but the service contracts are not included in the prioritization. The orders need to be prioritized to customers with service contracts e.g. the Gold contract customers orders needs to be handled with higher priority than the Blue customers orders. The Gold contract promises 100 percent uptime of the truck within a four hours time-window for repairing the truck until the case company needs to offer a replacement truck or pay the customer financial compensation so it requires a very responsive supply chain. Therefore, these orders need to be handled differently than the current order classes. Furthermore, all internal functions need to be aware of the prioritization of the availability according to the service contracts. E.g. the purchasing department would have to respond quickly to orders concerning the Gold contract.

The second area of improvement is prioritizing suppliers according to criticality. Supplier delivery precision is an important enabler for availability. If the supplier does not deliver according to the expected delivery plan the part will be unavailable and it might be necessary to stock up on additional inventory to secure the availability. The possibility of prioritizing the suppliers according to criticality could be further investigated, and the

focus should be on the ones supplying critical parts (e.g. the ones for the Gold contract) rather than the ones supplying less critical parts.

The third area of improvement is implementing local hubs or mini-warehouses close to the dealers. The Gold contract requires a very responsive supply chain, so in order to meet the demand of this contract there needs to be more local availability in terms of decentralized inventories. It is therefore recommended to implement those local hubs that could serve more than one dealer in the area with stocked with critical parts. This service would be outsourced and it could be avoided to increase the stock at the dealer and therefore increase the costs. Pushing more inventories of critical parts (parts for the Gold contract) to the local hubs would improve availability and the response time for serving the customer.

The fourth area of improvement is measuring the lead-time from order entered at the dealer until the order has been delivered to the dealer. Currently, this KPI is not measured, but it should be in order to follow up and improve the customer satisfaction. Following up on this KPI enables possibilities in shortening delivery lead-time, which would enhance customer satisfaction. Furthermore, for the Gold contract, short lead-times are vital for the 100 percent uptime promise. Also, following up on this KPI and setting up targets enables possibilities in identifying bottlenecks so it would be possible to see what deviations there are.

The last area of improvement is internal information sharing, especially in regard to designing the service contracts, but also when it comes to supply of spare parts. Collaboration between the sales function and the Materials Management function regarding the service contracts seems to be inadequate when it comes to the design of the offers. Stakeholders supplying the service contract constituents, i.e. the spare parts, need to be involved in designing the offers with the sales function since the supply of spare parts constitutes the core in the service contracts. Furthermore, these stakeholders need to be informed about large sales campaigns to secure availability of the parts at the dealers. Communication is key for enabling internal information sharing.

The five areas of improvement in relation to the aftermarket supply chain are shown by the authors in Figure 9.1. R1 represents the area of improvement where the prioritization of availability according to the service contracts is recommended. R2 represents the area of improvement where the prioritization of suppliers according to criticality is recommended. R3 represents the area of improvement where the implementation of local hubs close to the dealers is recommended. R4 represents the area of improvement where measuring the total lead-time is recommended. Lastly, R5 represents the area of improvements where collaboration between functions and information sharing is recommended.

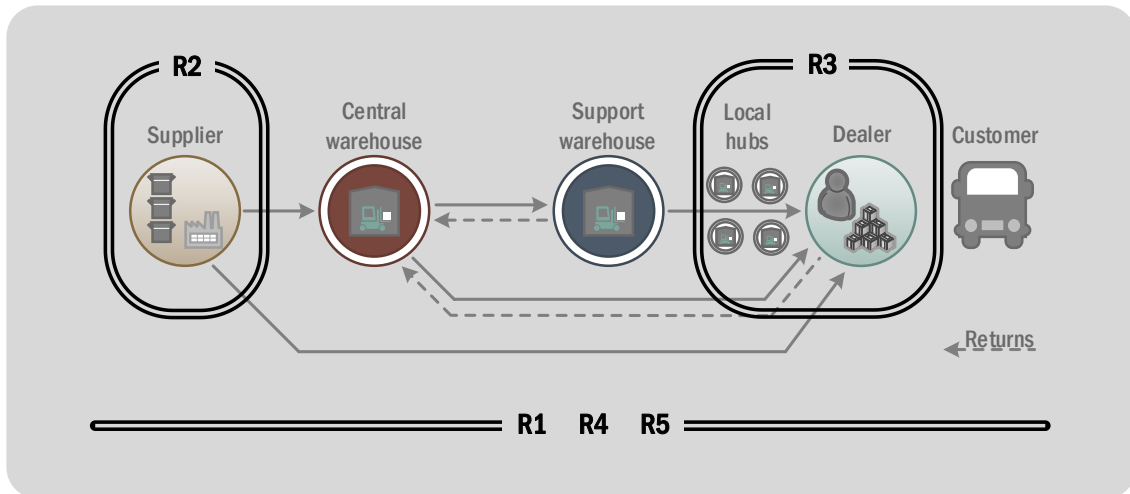


Figure 9.1: Areas of recommendations in the aftermarket supply chain.

There were additional areas of improvement that were found through interviews that could be further investigated. It was pointed out that there might be a correlation between fuel consumption and wear and tear. The driver development service could investigate this further to strengthen the service contracts being more profitable so the trucks would require less wear and tear repairs by educating the drivers since driver behavior affects fuel economy. Another area of opportunity is the use of the connectivity data about e.g. brakes and clutches. This is a new area, and should be further investigated and used as an advantage for the case company. By using this data the customer satisfaction could be increased and availability improved. It was mentioned that if a needed spare part is not available in any warehouse and the dealer needs to place an order in the system, the lead-time for that spare part is unknown for the dealer and the customer. This is very important information, and should be further investigated e.g. reconsider the supplier contracts.

For future research, there is an opportunity for the ongoing segmentation project at the case company to include segmentation of the customers according to which type of service contract they have. The segmentation project could be extended to include the prioritization of availability according to service contracts as recommended in this thesis. Furthermore, to further strengthen the recommendations relevant data including cost of unavailable parts could be analyzed for future research purposes.

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Appendix A: Proposal

VOLVO

Volvo Group Trucks Operations

Introduction

Group Trucks Operations encompasses all production of the Group's engines and transmissions as well as all production of Volvo, Renault, Mack and UD trucks. Group Trucks Operations also includes spare parts supplies to the Group's customers as well as logistics.

Logistics Services is part of Group Trucks Operations. We are situated on more than 60 locations world-wide. Our job is to design, handle and optimize the supply chain for all Volvo Group brands and for selected customers within the automotive industry.

The scope for Logistics Services includes making sure that material is transported to the production facilities, that packaging is available, that vehicles are distributed to the dealers, and that management of material, warehouses and distribution ensures the availability of parts everywhere in the world. We make sure all logistics services are delivered with world class operational excellence.

Background of thesis project

'After-market services' are no longer an 'afterthought'; companies within e.g. automotive and aerospace supply chains see opportunities in extending business models beyond "point of sale" and to engage with their products and customers at the "point of use". For OEM's in the automotive supply chain this means offering service bundles to their customers, where the key performance criterion is 'up-time' of the vehicle. A key enabler herein is IT and 'connected vehicle' technology, that allows for direct monitoring of the vehicle both its condition and usage. Customer offers such as 'Remote Diagnostics', '24/7 roadside assistance' and 'full contract maintenance services' require operational excellence in securing availability of spares at different locations around the world. Bundling physical products (in this case, trucks) with after-market services enhances the value of the core product; this constitutes a new stream of revenue generating, enhances user experience, and supports customer retention.

A key step in achieving this is the design and management of an effective distribution structure in the supply chain. The challenges companies are facing include a huge number of SKU's, uncertainty in demand for spares (an area where OEM's have often been 'kept in the dark'), and perhaps most importantly, understanding what kind of supply and distribution networks are required to operate in and deliver to the promising and growing but also complex area of after-market services, where the OEM takes on an increased responsibility of the customer's own processes.

The shape of the distribution network determines the flow of spare parts from the supplier based to multiple clients (e.g. service stations, dealers, truck owners/users, OEM's internal customer). OEM's must understand how to upgrade and transform their supply and distribution network in order to seize the promising opportunity of the after-market, and to deal with the complexity of the task. What type of distribution network is appropriate given the performance requirements of the bundled services? What role will dealers, third-party service stations and logistics providers play in this? What characterizes the relationship between the OEM and the various actors in the distribution network? What types of supply and distribution networks can be considered on short term and long term? How should spare part supply be planned and controlled in the networks?

Description of the thesis work

Against the backdrop of the potential and complexity of the after-market supply chain, the topic for the first master thesis is: Supply chain design/distribution structures for bundled service offers to the after-market in the automotive supply chain.

The task of this master thesis is threefold:

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Registration No.
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Registered Office
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1. Current situation (literature review, secondary data, case study):

a. Describe various types of bundled offers that are currently offered to different customer segments, and analyze the logistics implications of these for the OEM.

b. Identify and discuss various types of distribution structures in the after-market supply chain and the role key players (e.g. OEM's, logistics providers, dealers, service stations) may have in each of these. This can be seen as a benchmarking study based upon secondary evidence (reports and short articles available on the Internet).

2. Assessment (conceptual framework, case study, analysis):

a. Determine key performance indicators (current performance profile) for distribution in the after-market supply chain.

b. Evaluate current bundled offers at Volvo (identified in 1.a) relative to the impact, opportunities, and requirements on the distribution structures (identified in 1. b)

3. Positioning and recommendations (analysis and deliverables):

a. The repositioning from conventional to after-market supply chain must be based upon sound principles of distribution in the after-market supply chain' that:

-Identify key players and their key functions

-Integrates logistics to the bundled offers

-Explains the efficiency in / risk profile of delivering the offer

b. Discuss inter-organizational governance required between the OEM and various types of clients in the distribution network.

Student profile and application

Master students Chalmers

Application deadline is 14 December, 2014

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Appendix B: Bundled service offers

Bundled service offers for Volvo Trucks

Information regarding service offers for Volvo Trucks is strongly based on company reports, respondents 1,5,14,16 and websites (Volvo Group, 2015h, 2015i, 2015j, 2015k, 2015l).

Selected Supplier Products

With the Selected Supplier Products, customers are offered trailer parts and tires. Additionally, there is a system called Truck Shop Europe where they handle the administration of these trailer parts and tires excluding the chassis.

Preventive Maintenance

With the Preventive Maintenance offer, the customer will hand over the maintenance planning for his entire Volvo fleet to a Volvo Trucks dealer. The dealers use a software called VOSP, where they update the service plans with mileage, etc. and the service plan is made for maximizing the trucks availability. With Genuine Volvo Service the customers receive an optimized individual service plan for each truck to meet the needs of the truck and the business. All service work should be handled when the truck is in for scheduled maintenance.

Volvo Action Service

With Volvo Action Service, customers are offered road assistance service available 24 hours a day, 7 days a week. Therefore, if something happens to a customer's truck it is possible to call a number and get assistance from a Volvo operator that talks the driver's own language. The Volvo operator will further assist the driver to solve the problem and get the necessary service and repairs that he needs for an admin fee. All authorized Volvo Action Service dealers have Volvo Action Service vans that go on the road and repair the trucks. In case it is not possible to repair the truck on the road, the truck will be towed to the nearest dealer.

Volvo technicians have undergone continuous training to use the right service methods and tools and to be able to service with new products. Volvo Action Service also offers financial assistance if the driver has e.g. unexpected expenses that he is not able to pay at that time. Furthermore, they offer legal assistance in cases when driver has some problems with the authorities. Truck and trailer repairs are also supported by Volvo Action Service, but the customer must cover the repair expenses unless it is covered by a service contract. When a truck is being repaired, Volvo Action Service can arrange a rental truck or trailer. Furthermore, if a driver is forced to abandon his truck because of a breakdown or any other reason Volvo Action Service can arrange transport to get the driver home.

Also, in Volvo Action Service the VAS On Call button is included in the new versions of the trucks, the new FH, FM and FMX trucks. The customer can press a button in the truck if immediate assistance is needed. When the customer presses the button, he will immediately be connected to the VAS team in Ghent (Belgium) to get assistance. The

advantage with this service is that the personnel on call know the location of the truck and which dealer is the closest. There is also a call center in Rugby (United Kingdom), but this center does not serve the Nordic market.

Volvo Towing Assistance

With the Volvo Rowing Assistance service, customers are offered towing of the truck and trailer, unlimited number of towings, towing cost up to 3,500 Euros, Volvo Action Service, damage protection during towing, and a wide European network of towing partners. This service is available 24 hours a day, 7 days a week in the geographical area of Europe and the European part of Russia. To use this service, the truck driver calls Volvo Action Service or presses the VAS On Call button, the driver is then directed to a VAS person that speaks his native language, and this person handles the errand until it has been solved. If the truck cannot be repaired on site, it is towed to the nearest authorized Volvo workshop. Volvo Towing Assistance can only be included in a service contract, i.e. it cannot be bought as a separate service.

Dynafleet

With the Volvo Trucks fleet management system, the customer constantly gets up-to-date information about trucks and drivers. This information helps the customer to show which areas can be improved to gain more profit. By using Dynafleet, the customer can for example benefit from improved fuel efficiency, better vehicle usage and reduced administration. There are five different Dynafleet service offers, Fuel & Environment, Driver times, Positioning, Positioning+, and Messaging. The Fuel & Environment offer is about saving the customer's time and effort by analyzing the vehicle and driver data and assist with finding potentials to cut fuel costs and emissions. The Driver times offer helps you monitor the driver's activities at all times as well as giving you proactive alerts to secure compliance with driver hours legislations. The tachograph data is downloaded fast and easy and benefits the customer by including less manual work and administration. With the positioning offer the customer has a detailed map with constant updates (every ten minutes) on the location of the trucks and loads. With this service offers it is easier to plan and find free capacity for upcoming job, as well as to follow cargo in real time which the truck's customers can find beneficial. The Positioning+ offer is similar to the Positioning offer, but is constantly updated every minute. The messaging service offer keeps the driver informed and responsive to changes in plans. This service also allows work orders to be communicated directly to drivers, thus making the order system work smoothly. It is also possible to integrate Dynafleet data into other systems the customer uses, e.g. order planning systems, etc.

Fuel Advice

The Fuel Advice service is a support system for the customer on how to save fuel. The system is a support for customers to keep track on their drivers, if they are speeding and resting at the right times, etc. With the Fuel Advice service a personal coach enables a reduction in fuel consumption by up to 5 percent. The coach is located at a dealer in the Nordic market and analyzes drivers' driving techniques and gives advice to an assigned

fuel coach at the client on how to achieve more sustainable savings. The assigned fuel coach addresses the advices to the drivers in the company. In addition to the coach, there is a toolbox that supports the work.

Driver Development

With the Driver Development service, the customer is offered to take five courses. Since 2009, professional truck drivers need to take 35 hours of courses in order for them to keep their certificate of professional competence, and this has to be renewed every fifth year. Therefore, Volvo Trucks offers these five courses, each seven hours long. The courses are efficient driving, safe driving and customer focus, transport business and legislation, health and first aid, and secure transports. In the efficient driving course, the driver receives practical advice regarding efficient driving in distribution, construction, as well as long-distance traffic. Drivers taking this course have a potential of saving fuel up to 10 percent. The safe driving and customer focus course focuses on risk consciousness and how the truck's safety equipment should be utilized. This course also contains customer meetings and how to act at the scene of accident, e.g. CPR. The transport business and legislation course deals with the understanding of why legislation such as rest times and the tachograph are instituted. It also covers how the drivers can protect themselves and the goods from theft, smuggling, etc. Next, the health and first aid course teaches the drivers about ergonomics, food, alcohol, drugs, stress and tiredness and how these factors impact their ability to handle different situations on the roads. Lastly, the secure transport course educates the drivers in avoiding fines and preventing accidents that occur due to incorrectly secured goods. Customers are also offered customized training beyond the driver certificates of professional competence courses.

Truck Rental

At Volvo Truck Rental customers can rent a truck when in need. Volvo Truck Rental offers a vast rental fleet with different vehicles and models enabling the customer to find the right truck that is needed whether it is for distribution, long haul or construction. Volvo Truck Rental only rents to companies and it is possible to rent a truck from one day up to two years. Insurance, tax and fuel service is included in rental price and therefore the fuel and the driver are the only things that are exclusive.

Volvo Truck Accessories

With Volvo Truck Accessories, customers are offered extra accessories that they could need for a more comfortable truck and more efficient operations. The accessories include interior, exterior, and software accessories such as extra lights, extra upgrades to the audio system, extra safety features, software, etc.

Volvo Card

With the Volvo Card, the customers are offered a credit limit with different discounts on products. The card is thought as an insurance for the driver, if a sudden accident occurs, e.g. during nights and when most personnel is not available to reach.

Transport Company Consulting

With the Transport Company Consulting customers that do not have transport as their core business are offered a consultancy service within the transport area. The customers are assisted with e.g. order invoicing and booking maintenance. The main purpose with this offer is to allow the customer to focus on his core business and Volvo Group Trucks handles the transportation service.

Customer Financing

With the Customer Financing, the customer is offered a financing service that can be either of these three: Truck lease, financial lease, or truck loan. The truck lease is a package containing truck, financing, insurance, repairs and maintenance. This service offer allows the customer to focus entirely on his core business. Volvo Group Trucks owns the truck, which also means that the economic risk is handled by Volvo Group Trucks and not by the customer. The financial leasing is similar to the truck lease, but when the last monthly leasing fee has been paid, the ownership is transferred from Volvo Group Trucks to the customer. Safety insurance is also included in the financial leasing service. This insurance accounts for protection of the hauler's key people (owner, part-owner, and CEO) during all hours of the day and also during spare time. Lastly, the truck loan is a cost efficient way of owning the truck without investing all capital at once. This service makes the customer the legal owner of the truck immediately after the purchase. The customer pays a one-time fee in cash, and the rest is paid on a regular basis for a contracted period of time. This service does not include repairs, maintenance or insurance, but it includes the safety insurance for natural key people within the hauler organization. The Customer Financing offer is handled by Volvo Financial Services, but in Sweden there is also a second company called Volvo Finans.

Volvo Insurance

With Volvo Insurance, customers are offered a range of insurance products that are adapted to the customer needs of the transport operator and to local conditions. The Volvo Insurance offers are available through Volvo Financial services, the finance and insurance branch that work in collaboration to offer the customer a suitable insurance solution. With the Volvo Insurance offer the customer can get fixed monthly premiums for three years and therefore budget the cost for insurance in advance. The customer also gets immediate accident repairs if a sudden breakdown occurs. If a truck less than one year old breaks down, the customer will receive a new replacement truck.

Genuine Volvo Parts

With the Genuine Volvo Parts offer, customers are offered to purchase new, exchange, and used parts. The exchange parts and used parts differ from the new parts. The exchange parts are used parts that have been renovated to the original condition, and these have the same warranty as the new parts but they are sold to cheaper price. Quality and functionality is exactly the same for exchange parts as for new parts. The used parts are a beneficial option if the customer wants minimize the uncertainty that a non-Volvo used part could mean. The used parts are divided into three warranty/price levels depending on the customer's requirements on the parts.

Volvo Used Trucks

With the Volvo Used Trucks offer, customer can buy used trucks from Volvo Trucks dealers. All used trucks have undergone thorough inspections and customer will be provided with the same support and services as if they would buy a new one hence the high quality is always guaranteed. Volvo Used Trucks also provides customers with the Selected used truck program and the Selected+ used truck program where customer can find used trucks with the highest standards that are problem free. The trucks are high quality, safe and have a proof of good service history. The trucks have passed a long series of tests so the customer can be assured that his truck is a safe purchase from the used truck market. The Selected trucks are less than six years old and come with six or twelve month's international driveline coverage.

Bundled service offers for Volvo Penta

Information regarding service offers for Volvo Penta is strongly based on company reports, respondent 4 and the website (Volvo Group, 2015g).

Service Agreements

With the Volvo Penta Service Agreements the customer can benefit from various things such as maximize the uptime, lower the total cost of ownership, improving cost control and therefore giving the customer more time to focus on his core business. The contract can be tailored to the customer operating needs and budget. The service agreement is made between the customer and the dealer and at the same time a good relationship between the two parties involved is established and maintained with the contract. There are four levels of service agreement available for customers to choose from depending on what suits their needs.

The first offer, the Volvo Penta White agreement includes:

- A program of regular engine inspections carried out by the Volvo Penta trained technicians.
- Comprehensive inspection reports to help with preventative maintenance and repair.
- Regular proactive engine analysis to assist in ensuring ongoing maximum productivity.

The second offer, the Volvo Penta Blue agreement includes:

- A specialist program of engine inspection and preventive maintenance carried out by Volvo Penta trained technicians.
- Engine software update to keep up with improvements.
- The option of professional maintenance for additional equipment.

The third offer, the Volvo Penta Silver agreement includes:

- A specialist program of preventive maintenance and repair, complete flexibility in the way the agreement is put together.
- Allows the customer to spread the cost of inspections, maintenance and major repairs to reduce the impact on cash flow.
- Excellent engine history when it comes to resale, with everything verified by Volvo Penta service trained technicians.

The last offer, the Volvo Penta Gold agreement includes:

- Full service agreement for complete availability of the customers Volvo Penta engine or equipment.
- Fixed costs guaranteed for the life of the agreement (excluding site damage).
- No need for any on-site engineering facility.
- Excellent machine history when it comes to resale, with everything verified by Volvo Penta service trained technicians.

Service and Repair Kits

Volvo Penta offers Service and Repair Kits that are developed for specific service events. Those kits include original spare parts such as O-rings, gaskets and others from the product portfolio that are required for maintenance and repairs. Therefore, in case of a breakdown the customers do not need to purchase the individual parts needed. The Service and Repair Kits are developed based on product expertise and application experience in order to include the service and repair operations that occurs the most often. Customers can gain great benefits from those Service Kits, e.g. it saves them time over ordering necessary part individually, it secures the quality of the service events ensuring all proper parts are replaced, it lowers the price compared to buying an individual part itself, it minimizes the downtime and the installation is reliable with fully documented tested parts. The spare parts kits are divided up into three levels. The first one is the Service Kit or the Maintenance Kit. The second one is the Repair Kit for e.g. pumps, turbos, etc. The third one is the Overhaul Kits that include vital parts such as cylinder liner kits, etc.

Volvo Action Service

Volvo Action Service is a service offer for customers, which acts as a support if a sudden breakdown occurs. The Volvo Action Service offers assistance 24 hours a day, 7 days a week as there is an action service operation available ready to help. The operator supports the customer throughout the whole case and if needed gets the customer in contact with a Volvo Penta industrial dealer with the right competence, for example if on-site assistance or technical support is needed.

Volvo Penta Extended Coverage

The Volvo Penta Extended Coverage offer is a warranty offer beyond the international or national limited warranty. The Extended Coverage can be tailor made for the customer and may cover the complete engine or just major components. The time span is up to five

years or up to 10,000 operating hours (whichever occurs first). The contract must be signed upon the buy of the engine or at the latest three months after the start of operation.

Volvo Penta Oil Analysis

The Volvo Penta Oil Analysis is a service offer that allows for planning of maintenance by taking a sample of the engine oil. First, samples of the oil are taken and these are sent to a Volvo Penta laboratory. Second, the samples are analyzed at the laboratory with advanced diagnostic equipment. Factors analyzed are; water/coolant content, fuel, contaminants, viscosity, and metal content. Third, the results from the analysis are turned into immediate recommendations. This service is a health check that enables proactive actions in order to prevent downtime and expensive repairs.

1,000 hours Oil Change Service Intervals

The 1,000 hours Oil Change Service Intervals offer applies to all Volvo Penta industrial diesel engines. This service offer requires the Volvo Penta Oil Analysis service and also the use of genuine Volvo Penta Oil Filters as well as fuel containing maximum 500 parts per million sulphur and minimum Volvo's own diesel engine oil, VDS3. Customers get a competitive offer in terms of maintenance intervals, and Volvo Penta increases their sales of genuine maintenance items when providing this offer as well as building customer loyalty between servicing dealer and operator that in the long run ensures high customer satisfaction. With this offer, Volvo Penta has doubled the time between regular maintenance services allowing for less downtime and therefore more value to the customer. Allowing for Oil Change Intervals of 1,000 hours is possible by letting the engines run on the already mentioned criteria above. no additional filter arrangements are needed and the engines are not run on additional amounts of oil.

Bundled service offers for Volvo Buses

Information regarding service offers for Volvo Buses is strongly based on company reports, respondent 7 and the web site (Volvo Group, 2015e).

Volvo Bus Service Contracts

With the Volvo Bus Service Contracts the customer is offered three different kinds of contracts, Blue, Silver and Gold. The Blue Service Contract is the most basic contract and includes a service check, service plan and a price discount on the spare parts. The Silver contract includes the same as the Blue contract with additional full coverage of the driveline components. The Gold contract includes the whole vehicle where all maintenance and repairs are included.

Volvo Bus Hybrid Battery Contract

With the Hybrid Battery Contract, customers are offered battery performance. Operating data from the vehicle's hybrid and battery system is analyzed by Volvo Buses to make sure that the technology is working optimally and it is known when the battery needs to be replaced in the vehicle. This service offer also implies that expensive battery replacements can be avoided.

Turnkey Solution

With the Turnkey Solution offer, customers are provided with a “total business solution” to be able to run a city operation. Customers receive fully ready trucks that they can pick up in the morning and hand over at the end of the day. Volvo Buses owns the bus and is responsible for refueling, cleaning, maintenance, repairs and all the service that the bus needs. This offer is developed together with the customers. The customer is aware of the costs that this offer implies, the customer knows that some costs are fixed and some are variable. If the vehicle has technical issue, Volvo Buses is responsible for that and they receive a penalty for failing to deliver. In order to prevent penalties, there is additional capacity in terms of available vehicles that customers are offered in those kinds of situations.

Volvo Bus Financing

With the Volvo Bus Financing offer, customers can choose either of three financing choices; financial lease, operational lease, or installment credit. Financial lease implies fixed payments for a contracted period of time, and it is also possible to extend the contract period for a yearly payment. Volvo Buses own the bus, and all risk that comes with it. With operational lease, the customer rents the vehicle for a fixed and low cost. This offer eliminates the customer’s risk of residual value of the bus. Lastly, if the customer opts for installment credit, then the customer pays off the loan regularly with fixed payments during the contracted period of time.

Volvo Action Service

With the Volvo Action Service offer, customers get assistance 24/7 with repairs, financial and legal issues, transport etc. The driver of the bus only needs to call a Volvo Action Service operator that will assist him in his own language if needed. All Volvo owners are automatically members of the Volvo Action Service offer.

Used Buses

With the Used Bus offer, customers can buy used buses or coaches. All used buses and coaches have undergone thorough inspections and customer will be provided with the same support and services as if they would buy a new one, hence the high quality is always guaranteed.

Volvo Bus Telematics

With the Volvo Bus Telematics offer, the customer can survey their bus or whole fleet and withdraw information about how they are driven, how much fuel they use, where they are located, etc. The Telematics offer contains three services; Vehicle management, fleet management, and traffic management. Firstly, vehicle management deals with maintenance of the bus. A maintenance plan is developed for the bus, and the development of this plan is updated according to the data obtained through telematics. A service called Adaptive Maintenance Planning sends out reminders and help the customer book maintenance and service, but it also provides the customer with information about how much time is needed in the workshop as well as what spare parts that are needed.

Secondly, the fleet management service the customer can survey the whole fleet and obtain information about fuel usage, emission of air pollutants, driver profiles, events and positioning, which are the fundamental features. There is detailed information about each of these features and they serve as a base for planning and measures to take regarding fuel usage, wear and tear, emission, and passenger comfort.

Thirdly, traffic management deals with real time information about the operating hours and possible deviations from the plan. This data is used for real time updates to the passengers, as these require knowing about delays and when the bus will arrive to the final destination. This service provides real time information on board of the bus, at the control center, as well as the bus stops. Passengers are informed and the business can be controlled.

Refurbishment

With the Refurbishment offer, customers can refurbish their busses, e.g. if the vehicles are to be moved into new assignments where colors and equipment need to be refreshed. The refurbishment offer brings new life into the vehicle concerning interior, exterior and mechanical upgrades. Refurbishment of a Volvo Buses vehicle includes genuine Volvo spare parts, and the service technicians performing the refurbishment have much experience and know these products in-depth.

Bundled service offers for Volvo Construction Equipment

Information regarding service offers for Volvo Construction Equipment is strongly based on company reports, respondent 2 and 6 and web site (Volvo Group, 2015f).

Customer Support Agreements

With Customer Support Agreements, customers are offered three different service programs for their machines; White, Blue, and Gold. The White agreement includes inspections of all vital parts and functions, and the customer receives recommendations on maintenance, service and repair. Next, the Blue agreement expands the White agreement by including preventive maintenance and flexible payment solutions. Analysis tools and services such as Care track, Volvo Oil Analysis and MATRIS analysis help monitor the machine and early indications on wear can be discovered. Costs are known for preventive maintenance and service. Lastly, the most comprehensive agreement is the Gold agreement. It differs from the other agreements by providing known costs for all maintenance, service and repairs. This offer is ideal for customers with high expectations on machine availability and productivity.

Customer Financing

With the Customer Financing offer, customers are offered three choices of financing; hire purchase, finance lease, or operating lease. The hire lease means that the customer owns the machine throughout the working life of it. The payments are fixed and predictable and can be tailored to the customer, e.g. so it fits the company's cash flows. Finance lease is suitable for operators who want to take full advantage of writing down allowances for their newly purchased machines. The finance lease is tax-efficient, and by adding a lump

sum into the agreement, monthly payments can be reduced drastically. The operating lease implies that Volvo owns the machine, and the customer pays for using the machine for a contracted period of time. After the contracted time, the customer returns the machine to Volvo, and thereon Volvo takes care of the equipment.

Expander Bolts

With the Expander Bolts offer, customers are offered a bolt concept that fixes problems caused by wear in the machine. Wear may cause play in attaching points and holes may be worn. The expander bolt consists of two expanding sleeves, which fill the gap between the attaching eyes, and therefore solves for play and holes. This is a cost-efficient way to reduce the need for repairs and downtime costs.

Filters

With the Volvo Filters, customers are offered to buy multiple filters; engine oil filters, hydraulic oil filters, fuel filters, air filters, as well as breather filters. The Filters are especially designed for the Volvo machine and replacement of these at the recommended change intervals may prevent premature component repairs.

Genuine Volvo Parts

With the Genuine Volvo Parts, customers are offered high quality and high-performing machines through the usage of Volvo parts. The parts are tested and approved which ensures high quality according to Volvo standards for enhanced operational safety. The global dealer network ensures that parts are available anywhere and anytime to reduce downtime of the machine. Service intervals are prolonged if Volvo parts are used, since these guarantee reliability of the machine. The Genuine Volvo Parts have an all-covering one year warranty.

Volvo Classic Parts

With the Volvo Classic Parts, customers are offered Genuine Volvo Parts for older machines. This offer is the same as the Genuine Volvo Parts offer, but for older machines.

Volvo Oil Analysis

With the Volvo Oil Analysis, customers are offered an oil test service that allows for planning of maintenance by taking a sample of the engine oil. First, samples of the oil are taken and these are sent to a laboratory. Second, the samples are analyzed at the laboratory with advanced diagnostic equipment. Factors analyzed are; water/coolant content, fuel, contaminants, viscosity, and metal content. Third, the results from the analysis are turned into immediate recommendations. This service is a health check that enables proactive actions in order to prevent downtime and expensive repairs.

Eco Operator Training

With the Eco Operator Training, customers are offered to take a course which goal is to improve the driver's technique, knowledge and consciousness about how to drive ecologically and economically. The training is a one day course that is performed at the driver's construction site. The course includes an introduction and theory, practical exercises, as well as tests and certification. Follow-ups can be arranged if needed.

Volvo Tooth System

With the Volvo Tooth System, customers are offered patented teeth and adapters to the machine's bucket. These teeth and adapters withstand high force and stress levels, they are self-sharpening due to the design, and wear material provide maximum wear life. Because of the parts high quality, they lower the total cost of ownership and ensures high performance of the machine.

Volvo Reman

With Volvo Reman, customers are offered to buy remanufactured Volvo parts to the same quality as new parts, but to a lower price. The Volvo Reman parts include all types of parts, so independently of which component that has been replaced, the old part is sent to a Volvo Reman facility. If the old part meets the Volvo quality standard, it is remanufactured and tested, and after that it is considered a Volvo Reman component.

Seats

With the Seats offer, customers with special needs can order a seat that meets these needs. This offer also covers for worn out seats, i.e. if customers want to change the worn out seat to a new one. Offered seats are, e.g. seats equipped with heat, air suspension, or weight adjustable seats.

Care Track

With the Care Track offer, customers have access to the telematics system of Volvo Construction Equipment. The telematics system provides information about the machines fuel usage, operating hours, speed and geographic location. This information is accessed through a web portal, where services can be scheduled too. Care Track provides alerts through text messages and emails in order to prevent unexpected machine break down. The data from Care Track can be used to identify unnecessary and unproductive operating hours, so costs can be minimized. It also allows for remote diagnostics, so these can be performed more easily. This offer is standard on most Volvo machines, and is offered as a six year free subscription.

Care Kits

With the Care Kits, customers are offered three different types of kits; overhaul and repair, maintenance, and uptime kits. Overhaul and repair kits include engine overhaul, cylinder head overhaul, cylinder liner, and pin and bushing kits. Next, the maintenance kits contain filters recommended to change at each service interval. Lastly, the uptime kits contain kits for O-rings, bulbs, fuses, electrical connectors and hydraulic hose replacements. The Care Kits include exactly the right spare parts that are needed for repairs, maintenance and service in order to minimize downtime.

Volvo Lubricants

With Volvo Lubricants, customers are offered specially developed lubricants for Volvo Construction Equipment machines. The lubricants are diesel engine oil, hydraulic oil, axle and transmission oil, as well as grease. These contain additives that bind water, sludge, carbon and metal particles, reduce wear, and neutralize acids in order to improve

the performance of the machine, extend the service life, as well as reduce both fuel and oil consumption.

Volvo Undercarriage Parts

With the Volvo Undercarriage Parts, customers are offered a full product range of undercarriage parts that have been developed and tested to meet the customers' expectations. The parts provide effective and safe operations, low operating costs and long service life. The customer is recommended to schedule wear inspections on a regular basis to ensure downtime is minimized and the machine's cost per hour is reduced.

Genuine Volvo Batteries


With the Genuine Volvo Batteries offer, customers are offered batteries that require little maintenance and have 25 percent more starting power than the equivalents. The batteries recharge rapidly, have 20 percent longer service life than the equivalents, and are 100 percent leak resistant under normal usage conditions.

Software Options

With the Software Options offer, customers can opt between softwares that, e.g., increase safety and productivity or reduce fuel consumption. The software is installed at dealers, which is easily done since no hardware is required to do the installation. Software options include engine auto shutdown, engine shutdown timer, increased engine protection, speed limiter as well as engine lock.

Appendix C: Service contracts

Below follows factsheets about the service contracts including which parts and repairs that are included in the different contracts.



Volvo Trucks. Driving Progress

VOLVO BLUE CONTRACT

PREVENTIVE MAINTENANCE AND SERVICE PLAN




With all preventive maintenance taken care of and your truck covered by an agreed service plan, uptime is secured and you can run a more profitable business.

Add value to your truck – and your business
All maintenance is done when it suits you and follows a predetermined schedule to minimise disruptions to your operations.

All our technicians are certified, use Genuine Volvo Parts and have access to all necessary special tools. They perform the operations needed to ensure uptime and functionality and this guarantees that your truck is in great shape when it leaves us.

For you, this saves time and effort. You also get better cost control – and a lower total cost of ownership, thanks to your truck running more smoothly and with fewer standstills.



Volvo Blue Contract – main benefits:

- Maximum uptime.
- Preventive maintenance and service plan.
- Lower cost of ownership.
- The truck is always in top condition.

Find out more about all our service contracts: Talk to your local dealer or visit volvotrucks.xx/xx
Please turn to the next page to see everything that's included in a Volvo Blue Contract.

VOLVO

Volvo Truck Corporation
www.volvotrucks.com

2012-09-06 ENG Version 01



VOLVO BLUE CONTRACT

VOLVO SERVICE CONTRACTS

PREVENTIVE MAINTENANCE

LUBRICATION, OIL AND FLUID LEVEL CHECK

- Chassis lubrication
- Cab lubrication
- Check oil levels in different compartments and change filters
- Change engine oil and filter
- Change gearbox oil and filter
- Change axle oil
- Filter change in power steering
- Check fluid levels
- Check air dryer

IN THE CAB

- Check warning and indication lights
- Check fault codes
- Function check of parking heater
- Check of engine control in cab
- Check retarder controls
- Start of engine and check of starter element
- Check of pressure regulator operation
- Check of compressor function and condition
- Check of brake system
- Check of parking brake and blocking valve

PREVENTIVE MAINTENANCE

- Check of engine brake
- Check gear shift linkage and clutch pedal
- Check of bogie lift
- Check of hinges, locks, and sealing stripes

EXTERNAL

- Check of lights, wipers and washers
- Check rear view mirrors and reflectors
- Change of air filter for ventilation system
- Check of refrigerant tank, condenser, pipes and hoses
- Check of air intake and air deflector
- Check cab attachment, hydraulic system, locking devices, grille and cab tilting
- Check of batteries – dirt, leakage, attachment, specific gravity of battery acid, fluid level, connections and battery box
- Check battery fixing and connections
- Check fuel tank
- Check water separator for fuel system, draining of condensed water
- Check tyre wear

ENGINE COMPARTMENT

- Check all mountings
- Check all electrical connections and cables
- Check drive belts
- Check of compressor for ventilation system
- Pressure testing of cooling system
- Check coolant
- Check radiator and radiator fan
- Check intercooler
- Check sealings, hoses, pipes and lines
- Check for exhaust leakage
- Check power steering
- Check of air intake between air intake and turbo
- Check of turbocharger and EP governor
- Check of pump coupling for injection pump
- Check of tightness on servo pump, oil lines and steering gear
- Check of sound baffles for engine
- Check valve clearance (if applicable)
- Check unit injector clearance (if applicable)

FRONT SUSPENSION, STEERING GEAR

- Check gaiters and clearance for ball joints
- Check of steering link system
- Check of front shock absorbers
- Check of steering knuckle bearing
- Check of front wheel bearings
- Check of front wheels

CHECKS BENEATH THE VEHICLE

- Check of tightness, bearing clearance and ventilation on driving front axle (where fitted)
- Check clutch/record thickness
- Check gearbox, transfer gearbox and power take-off
- Check speedometer sensor and joint coupling
- Check retarder
- Check rear axle and hub reduction
- Check propeller shafts
- Check exhaust pipe and silencer of particulate filter
- Check springs and u-bolts
- Check of anti-roll bar
- Check of rear shock absorbers
- Check of bogie lift
- Check of air suspension
- Check of chassis frame and cross-members

- Check lubrication system (central lubrication)
- Check of compressed air lines and hoses
- Check of rear wheels
- Check of differential locks
- Check of brakes
- Check of load sensing valve
- Check wheels fit correct torque
- Record brake line thickness
- Record road brake performance
- Road test
- Check valve performance
- Check driving controls



Volvo Trucks. Driving Progress

VOLVO SILVER CONTRACT

PREVENTIVE MAINTENANCE, SERVICE PLAN AND DRIVELINE REPAIRS



With preventive maintenance taken care of according to a service plan and all driveline repairs included, you can run your business with better cost control.

Add value to your truck – and your business

With all work on your truck being done when it suits you, we minimise any disruptions to your operations.

All our technicians are certified, use Genuine Volvo Parts and have access to all necessary special tools. They perform the operations needed to ensure uptime and functionality and this guarantees that your truck is in great shape when it leaves us.

For you, this saves time and effort – and cut costs as driveline repairs and expensive components are included. This, and a smoother running truck, lowers your total cost of ownership.



Volvo Silver Contract – main benefits:

- Most expensive components included.
- Driveline repairs at no extra cost.
- Increased uptime.
- Preventive maintenance and service plan.
- Lower cost of ownership.
- The truck is always in top condition.

Find out more about all our service contracts: Talk to your local dealer or visit volvotrucks.xx/xx
Please turn to the next page to see everything that's included in a Volvo Silver Contract.

VOLVO

Volvo Truck Corporation
www.volvotrucks.com

2012-09-06 ENG Version 01



VOLVO SILVER CONTRACT

VOLVO SERVICE CONTRACTS

DRIVELINE REPAIRS

ENGINE

- Cylinder head, cylinder block, cylinder liner and seals
- Flywheel housing
- Valve mechanism and valve cover
- Pistons
- Timing mechanism
- Camshaft
- Crank mechanism
- Connecting rods and bearings
- Oil pump and oil cooler
- Fuel pump
- Injection pump
- Inlet and exhaust manifolds
- Volvo engine brake/exhaust brake
- Turbocharger
- Radiator

- Coolant pump
- Fan
- Intercooler
- Engine ECU
- Electric air pre-heater
- PTO housing (engine)
- Turbo compound
- Unit injectors
- Starter motor
- Alternator

TRANSMISSION

- Gearbox housing
- Clutch housing
- Gearbox ECU (gearchange)
- Gears, bearings and shafts
- Powertronic / Geartronic / I-Shift

- Synchronising parts
- Oil pump and oil cooler
- Drive shafts
- Differential unit gears
- Hub oil seals
- Propshaft
- Hub reduction gears
- Differential lock gear-selector
- Differential unit casing
- Front drive axle casing (optional)
- Transfer box (front wheel drive) (optional)

GENERAL

- Compressor
- Brake ABS Unit

PREVENTIVE MAINTENANCE

LUBRICATION, OIL AND FLUID LEVEL CHECK

- Chassis lubrication
- Cab lubrication
- Check oil levels in different compartments and change filters
- Change engine oil and filter
- Change gearbox oil and filter
- Change axle oil
- Filter change in power steering
- Check fluid levels
- Check air dryer

IN THE CAB

- Check warning and indication lights
- Check fault codes
- Function check of parking heater
- Check of engine control in cab
- Check retarder controls
- Start of engine and check of starter element
- Check exhaust pressure regulator operation
- Check of compressor function and condition
- Check of brake system
- Check of engine brake
- Check of parking brake and blocking valve
- Check gear shift linkage and clutch pedal
- Check of bogie lift
- Check of hinges, locks, and sealing stripes

EXTERNAL

- Check of lights, wipers and washers
- Check rear view mirrors and reflectors
- Change of air filter for ventilation system
- Check of ref rig
- Check of air intake and air deflector
- Check cab attachment, hydraulic system, locking devices, grille and cab tilting

- Check of batteries – dirt, leakage, attachment, specific gravity of battery acid, fluid level, connections and battery box
- Check battery fixing and connections
- Check fuel tank
- Check water separator for fuel system, draining of condensed water
- Check tyre wear

ENGINE COMPARTMENT

- Check all mountings
- Check all electrical connections and cables
- Check drive belts
- Check of compressor for ventilation system
- Pressure testing of cooling system
- Check of coolant
- Check radiator and radiator fan
- Check of intercooler
- Check sealings, hoses, pipes and lines
- Check for exhaust leakage
- Check power steering
- Check of air intake between air intake and turbo
- Check of turbocharger and EP governor
- Check of pump coupling for injection pump
- Check of tightness on servo pump, oil lines and steering gear
- Check of sound baffles for engine
- Check valve clearance (if applicable)
- Check unit injector clearance (if applicable)

FRONT SUSPENSION, STEERING GEAR

- Check gaiters and clearance for ball joints
- Check of steering link system
- Check of front shock absorbers
- Check of steering knuckle bearing
- Check of front wheel bearings
- Check of front wheels

CHECKS BENEATH THE VEHICLE

- Check of tightness, bearing clearance and ventilation on driving front axle (where fitted)
- Check clutch / record thickness
- Check gearbox, transfer gearbox and power take-off
- Check speedometer sensor and joint coupling
- Check retarder
- Check rear axle and hub reduction
- Check propeller shafts
- Check exhaust pipe and silencer of particulate filter
- Check springs and u-bolts
- Check of anti-roll bar
- Check of rear shock absorbers
- Check of bogie lift
- Check of air suspension
- Check of chassis frame and cross-members
- Check lubrication system (central lubrication)
- Check of compressed air lines and hoses
- Check of rear wheels
- Check of differential locks
- Check of brakes
- Check of load sensing valve
- Check wheels fit correct torque
- Record brake line thickness
- Record road brake performance
- Road test
- Check vehicle performance



Volvo Trucks. Driving Progress

VOLVO NEW GOLD CONTRACT

100% UPTIME, REMOTE MONITORING, TRUCK REPAIRS AND PREVENTIVE MAINTENANCE



On our new Volvo FH and Volvo FM trucks you can get 100% uptime – giving you the maximum amount of time to focus on improving the profitability of your business. You can expect a lower cost of ownership too.

100% uptime made possible

The online connectivity of the new Volvo FH and Volvo FM makes it possible for the workshop to receive information about the status of crucial components while the truck is in traffic. This way we can plan and prepare your service visit in good time. And since the workshop has been informed what parts need to be exchanged, these are available already when the truck arrives for service.

By combining the advanced truck technology with skilled Volvo technicians and your specific way of working, we can secure that your truck is always ready to deliver. If a time consuming repair is required, a replacement truck or financial compensation will be offered.



Benefits of New Gold Service Contract:

- A service plan adapted to your needs
- Maintenance only when required
- Fast repairs, workshop ready when you arrive
- Strive to do all service when the truck is off duty
- Remote workshop connection
- VAS – On call service
- Optimal residual value
- Carefree ownership
- The truck is always in top condition
- A unique promise of 100% uptime

Find out more about all our service contracts: Talk to your local dealer or visit volvotrucks.xx/xx
Please turn to the next page to see everything that's included in a Volvo Gold Contract.

VOLVO

Volvo Truck Corporation
www.volvotrucks.com

2012-09-06 ENG Version 01



VOLVO NEW GOLD CONTRACT

VOLVO SERVICE CONTRACTS

GOLD CONTRACT REPAIRS

ENGINE

- Cylinder head, cylinder block, cylinder liner and seals
- Flywheel housing
- Valve mechanism and valve cover
- Pistons
- Timing mechanism
- Camshaft
- Crank mechanism
- Connecting rods and bearings
- Oil pump and oil cooler
- Fuel pump
- Injection pump
- Inlet and exhaust manifolds
- Volvo Engine Brake / exhaust brake
- Turbocharger
- Radiator
- Coolant pump
- Fan
- Intercooler
- Engine ECU
- Electric air pre-heater
- PTO housing (engine)
- Turbo compound

- Unit injectors
- Exhaust muffler and pipe
- Particle filter (CRT)
- Ventilator belts
- Water hose
- Flywheel
- Drivebelts

TRANSMISSION

- Gearbox housing
- Clutch housing
- Gearbox ECU
- Gears, bearings and shafts
- Selector fork
- Synchronising parts
- Oil pump and oil cooler
- Clutch pressure plate
- Powertronic / Geartronic / I-Shift
- Clutch disc
- Thrust bearing
- Clutch cylinder
- Gearlever and gearbox brackets

DRIVE UNIT

- Propeller shaft and bearings

- Differential housing
- Differential gear
- Differential lock
- Rear and front axle casing
- Drive shaft
- Hub reduction
- Sealings

ELECTRONICS

- Battery
- Alternator
- Starter motor
- Tachograph
- Infosystem
- Relays
- ECU's
- Cable harness
- Dashboard instruments
- Windscreen wipers motor
- Electrical central box
- Volvo Immobiliser

BRAKE

- Brake discs/linings
- Brake drums/linings
- Brake valves
- Brake pipes
- Load sensing valve

- Compressor / Pressure governor
- Airdryer
- ABS control unit / EBS control unit
- ABS brake valves / EBS brake valves
- ABS sensors / EBS sensor

WHEEL SUSPENSION AND STEERING

- Steering knuckle bearing
- Wheel studs/nuts
- Stabiliser bushings/ mountings
- V-stay bushings
- Gaiters and ball joints
- Steering link system
- Steering pump/pipework
- Steering box
- Drag rod and drag link
- Bogie lift and pump
- Rear axle brackets
- Power steering pump

CHASSIS, SPRINGS, SHOCK ABSORBERS AND WHEELS

- Air springs
- Solenoid valves and level valves
- Air pipes
- Shock absorbers
- Air bellows
- Hubs and wheel bearings/ seals
- Central lubrication

CABS AND INTERIOR

- Air conditioning unit
- Heat regulation and exchanger
- Cab mountings
- Drivers seat mechanism
- Roof hatch
- Rearview mirrors and heating
- Door locks
- Window mechanism

PREVENTIVE MAINTENANCE

LUBRICATION, OIL AND FLUID LEVEL CHECK

- Chassis lubrication
- Cab lubrication
- Check oil levels and change filters
- Change engine oil and filter
- Change gearbox oil and filter
- Change axle oil
- Filter change in power steering
- Check fluid levels
- Check air dryer

IN THE CAB

- Check warning and indication lights
- Check fault codes
- Function check of parking heater
- Check of engine control in cab
- Check retarder controls
- Start of engine and check of starter element
- Check of exhaust pressure regulator operation
- Check of compressor function and condition
- Check of brake system
- Check of parking brake and blocking valve
- Check of engine brake
- Check gear shift linkage and clutch pedal
- Check of bogie lift
- Check of hinges, locks, and sealing stripes

EXTERNAL

- Check of lights, wipers and washers
- Check rear view mirrors and reflectors
- Change of air filter for ventilation system
- Check of refrigerant tank, condenser, pipes and hoses
- Check of air intake and air deflector
- Check cab attachment, hydraulic system, locking devices, grille and cab tilting
- Check of batteries – dirt, leakage, attachment, specific gravity of battery acid, fluid level, connections and battery box

- Check battery fixing, connections
- Check fuel tank

PREVENTIVE MAINTENANCE

- Check water separator for fuel system, draining of condensed water
- Check tyre wear

ENGINE COMPARTMENT

- Check all mountings
- Check all electrical connections and cables
- Check drive belts
- Check of compressor for ventilation system
- Pressure testing of cooling system
- Check of coolant
- Check radiator and radiator fan
- Check of intercooler
- Check sealings, hoses, pipes and lines
- Check for exhaust leakage
- Check power-steering
- Check of air intake between air intake and turbo
- Check of turbocharger and EP governor
- Check of pump coupling for injection pump
- Check of tightness on servo pump, oil lines and steering gear
- Check of sound baffles for engine
- Check valve clearance (if applicable)
- Check unit injector clearance (if applicable)

FRONT SUSPENSION, STEERING GEAR

- Check gaiters and clearance for ball joints
- Check of steering link system
- Check of front shock absorbers
- Check of steering knuckle bearing
- Check of front wheel bearings
- Check of front wheels

CHECKS BENEATH THE VEHICLE

- Check of tightness, bearing clearance and ventilation on driving front axle
- Check clutch/record thickness
- Check gearbox, transfer gearbox and power take-off
- Check speedometer sensor and joint coupling
- Check retarder
- Check rear axle and hub reduction
- Check propeller shafts
- Check exhaust pipe and silencer of particulate filter
- Check springs and u-bolts
- Check of anti-roll bar
- Check of rear shock absorbers
- Check of bogie lift
- Check of air suspension
- Check of chassis frame and cross-members
- Check lubrication system (central lubrication)
- Check of compressed air lines and hoses
- Check of rear wheels
- Check of differential locks
- Check of brakes
- Check of load sensing valve
- Road test
- Check wheels fit correct torque
- Check vehicle performance
- Record brake line thickness
- Record road brake performance
- Check driving controls

REMOTE MONITORING

Appendix D: Interview guides

Four different interview guides were prepared in beforehand. They were created to be used as guidelines when preparing questionnaires before interviews were carried out. The interview questions were further adapted to each respondent by using one or more interview guides and in some cases additional questions were added. The interview guides differ from what respondents were being interviewed. The four interview guides are listed below.

1. Interview guide for bundled service offers overview (Penta, Buses, VCE)

The goal is to obtain general information about the current bundled service offers (for each brand; Trucks, Penta, Buses, and VCE depending on who we are interviewing)

- What bundled service offers do you currently offer?
- How are these set-up or what do the offers include?
- How are the bundled service offers categorized?
- Do you have any additional material to give out about the bundled service offers we can use?

2. Interview guide for bundled service offers (Trucks)

Use interview guide 1 - bundled service offers overview

1. How are the bundled service offers decided?
 - (a) What factors are considered when deciding upon new offers?
 - (b) Do you evaluate the offers? (Follow up the value of the offers)
2. What bundled service offers impact the aftermarket supply chain? (Narrow down for focus)
 - (a) How do they impact the aftermarket supply chain?
3. What are the challenges with the bundled service offers in regard to the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of those? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location

- (b) Do you have any additional challenges, beside the ones we mentioned regarding the bundled service offers in the aftermarket supply chain?
- 4. Do you have any suggestion how the bundled service offer can be improved somehow, especially in regard to the aftermarket supply chain in the Nordic market?

3. Interview guide for aftermarket supply chain

- 1. How does the aftermarket supply chain look today?
- 2. How are the spare parts inventories handled by Volvo Group today? (Jointly managed, collaboration between all actors?)
- 3. How does Volvo Group measure spare parts availability today?
- 4. What are the challenges in the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
 - (b) Do you have any additional challenges, beside the ones we mentioned in the aftermarket supply chain?
- 5. What performance measurements do you use?
- 6. Are you experiencing problems with the current set-up, what are they?
- 7. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

4. Interview guide for the dealer

- 1. How do your customers get information about the bundled service offers? (How do you sell the offers, do you promote them?)
- 2. Do the customers plan their maintenance visits a week in advance or are the visits already planned?
- 3. Are spare part deliveries accurate? Are you satisfied with the delivery schedule?
- 4. When you place an order manually, is it done after a customer order or do you forecast?

5. How do you perceive that the spare parts availability is? Are you able to provide 92 percent of the spare parts instantly?
6. What are the challenges with the bundled service offers in regard to the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
 - (b) Do you have any additional challenges, beside the ones we mentioned regarding the bundled service offers in the aftermarket supply chain?
7. Do you have any suggestion how the bundled service offer can be improved somehow, especially in regard to the aftermarket supply chain in the Nordic market?

Appendix E: Interview questions for respondents

Interview with respondent 1 on 5th of February, 2015

1. What bundled service offers do you currently offer for Volvo Trucks?
2. How are these offers set-up or what do the offers include?
3. How are the bundled service offers categorized?
4. Do you have any additional material to give out about the bundled service offers.
5. How are the bundled service offers decided?
 - (a) What factors are considered when deciding upon new offers?
 - (b) Do you evaluate the offers? (Follow up the value of the offers)
6. What bundled service offers impact the aftermarket supply chain? (Narrow down for focus)
 - (a) How do they impact the aftermarket supply chain?
7. What are the challenges with the bundled service offers in regard to the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of those? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
 - (b) Do you have any additional challenges, beside the ones we mentioned regarding the bundled service offers in the aftermarket supply chain?
8. Do you have any suggestion how the bundled service offer can be improved somehow, especially in regard to the aftermarket supply chain in the Nordic market?

Interview with respondent 2 on 9th of February, 2015

The goal is to obtain general information about the current bundled service offers for Volvo Construction Equipment.

1. What bundled service offers do you currently offer for VCE?
2. How are these set-up or what do the offers include?

3. How are the bundled service offers categorized?
4. Do you have any additional material to give out about the bundled service offers?

Interview with respondent 3 on 17th of February, 2015

1. How does the aftermarket supply chain look today when it comes to distribution structure?
2. What factors are considered in deciding how to design the distribution set-up?
3. Is the distribution structure centralized or decentralized?
4. How do you know that the warehouse locations are optimized?
5. How are the spare parts inventories handled by Volvo Group today? (Jointly managed, collaboration between all actors?)
6. How does Volvo Group measure spare parts availability today?
7. When or if do you use 3rd party logistics?
8. What performance measurements do you use?
9. Are you experiencing problems with the current set-up, what are they?
10. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

Interview with respondent 4 on 19th of February, 2015

The goal is to obtain general information about the current bundled service offers for Volvo Penta.

1. What bundled service offers do you currently offer for Volvo Penta?
2. How are these set-up or what do the offers include?
3. How are the bundled service offers categorized?
4. Do you have any additional material to give out about the bundled service offers?

Interview with respondent 5 on 2nd of March and 8th of April, 2015

1. What bundled service offers do you currently offer?
2. How are these set-up or what do the offers include?
3. How are the bundled service offers categorized?
4. Do you have any additional material to give out about the bundled service offers?
5. How are those bundled service offers decided?
 - (a) What factors are considered when deciding upon new offers?

- (b) Do you evaluate the offers? (Follow up the value of the offers)
- 6. What bundled service offers impact the aftermarket supply chain? (Narrow down for focus)
 - (a) How do they impact the aftermarket supply chain?
- 7. What are the challenges with the bundled service offers in regard to the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of those? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
 - (b) Do you have any additional challenges, beside the ones we mentioned regarding the bundled service offers in the aftermarket supply chain?
- 8. Do you have any suggestion how the bundled service offer can be improved somehow, especially in regard to the aftermarket supply chain in the Nordic market?

Second interview:

1. When the driver has called Volvo Action Service, what happens next? Will a Volvo Action Service vehicle come to the driver and escort the truck to the nearest dealer? Or is that function outsourced to another company, which?
2. How is the VAS contract defined?
 - (a) Do you buy this service or is it offered to everyone?
 - (b) Is this only defined as a call operator service or is the maintenance and repairs included?
3. Do you have some sort of a document to show what is included in VAS?
4. Is it possible to get the data regarding the percentage on how many trucks have a Gold, Silver and Blue contract in the nordic region?
5. Is the cost measured for each contract? E.g. How much have delays of spare parts cost Volvo Group? Is it calculated?

Interview with respondent 6 on 3rd of March, 2015

The goal is to obtain general information about the current bundled service offers for Volvo Construction Equipment.

1. What bundled service offers do you currently offer for VCE?
2. How are these set-up or what do the offers include?
3. How are the bundled service offers categorized?
4. Do you have any additional material to give out about the bundled service offers?

Interview with respondent 7 on 12th of March, 2015

The goal is to obtain general information about the current bundled service offers for Volvo Buses.

1. What bundled service offers do you currently offer for Volvo Buses?
2. How are these set-up or what do the offers include?
3. How are the bundled service offers categorized?
4. Do you have any additional material to give out about the bundled service offers?

Interview with respondent 8 on 18th of March, 2015

1. How is refill between central warehouses and regional and support warehouses done today?
2. In regard to refill of warehouses, what are the challenges in the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
 - (b) Do you have any additional challenges, beside the ones we mentioned in the aftermarket supply chain?
3. What performance measurements do you use?
4. Are you experiencing problems with the current set-up, what are they?
5. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

Interview with respondent 9 on 18th of March, 2015

1. How is backorder recovery handled by Volvo Group today?
2. With regard to backorder handling, what are the challenges in the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
 - (b) Do you have any additional challenges, beside the ones we mentioned in the aftermarket supply chain?
3. What performance measurements do you use?
4. Are you experiencing problems with the current set-up, what are they?
5. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

Interview with respondent 10 on 20th of March, 2015

1. How is demand and inventory planning handled by Volvo Group today?
2. How are the spare parts inventories handled by Volvo Group today? (Jointly managed, collaboration between all actors?)
3. How does Volvo Group measure spare parts availability today?
4. With regard to demand and inventory planning, what are the challenges in the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location

- (b) Do you have any additional challenges, beside the ones we mentioned in the aftermarket supply chain?
- 5. What performance measurements do you use?
- 6. Are you experiencing problems with the current set-up, what are they?
- 7. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

Interview with respondent 11 on 23th of March, 2015

- 1. In regard to refill of warehouses, what are the challenges in the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
 - (b) Do you have any additional challenges, beside the ones we mentioned in the aftermarket supply chain?
- 2. What performance measurements do you use?
- 3. Are you experiencing problems with the current set-up, what are they?
- 4. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

Interview with respondent 12 and respondent 13 on 24th of March, 2015

- 1. How is material planning done today at Volvo Group?
- 2. How are the spare parts inventories handled by Volvo Group today? (Jointly managed, collaboration between all actors)
- 3. How does Volvo Group measure spare parts availability today?
- 4. What are the challenges in the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur

- iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
- (b) Do you have any additional challenges, beside the ones we mentioned in the aftermarket supply chain?
5. What performance measurements do you use?
 6. Are you experiencing problems with the current set-up, what are they?
 7. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

Interview with respondent 14 on 25th of March and 31st of March, 2015

1. Could you explain the service contracts more in-depth? (We know the general content of them, what is found on the website)
2. What is the strategy behind the Service Contracts? What is the reason behind them?
3. Do you have any calculations on if you can really promise this 100 percent uptime for the Gold contract for example?
4. How is uptime defined?
5. Do you have specifications about the contracts and VAS and PM, what exactly is included and what requirements are there from a Materials Management perspective, but also from a customer perspective?
6. What are the challenges with the service contracts in regard to the aftermarket supply chain in the Nordic market?
7. Do you have any suggestion how service contracts can be improved somehow, especially in regard to the aftermarket supply chain in the Nordic market?

Interview with respondent 15 on 26th of March, 2015

1. How is dealer inventory planning handled by Volvo Group today?
2. How often does Volvo Group buy back in the LPA concept per year?
3. How are the spare parts inventories handled by Volvo Group today? (Jointly managed, collaboration between all actors)
4. How does Volvo Group measure spare parts availability today?
5. With regard to dealer inventory planning, what are the challenges in the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?

- i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
- (b) Do you have any additional challenges, beside the ones we mentioned in the aftermarket supply chain?
6. What performance measurements do you use?
 7. Are you experiencing problems with the current set-up, what are they?
 8. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

Interview with respondent 16 on 26th of March, 2015

1. Could you explain the Service Contracts more in-depth? (We know the general content of them, what is found on the website)
2. Is Preventive Maintenance included in all Service Contracts? (Blue, Silver, Gold)
3. Can Preventive Maintenance also be bought separately if you don't have a Service Contract?
4. What is the strategy behind the Service Contracts?
5. Do you have specifications about the contracts and VAS and PM, what exactly is included and what requirements are there from a Materials Management perspective, but also from a customer perspective?
6. What are the challenges with the service contracts in regard to the aftermarket supply chain in the Nordic market?
7. Do you have any suggestion how service contracts can be improved somehow, especially in regard to the aftermarket supply chain in the Nordic market?

Interview with respondent 17 on 31st of March, 2015

1. How is spare parts availability handled by Volvo Group today?
2. How does Volvo Group measure spare parts availability today?
3. How is forecasting of spare parts handled today by Volvo Group?
4. What are the challenges in the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?

- i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
- (b) Do you have any additional challenges, beside the ones we mentioned in the aftermarket supply chain?
5. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

Interview with respondent 18, respondent 19 and respondent 20 on 8th of April, 2015

1. How do your customers get information about the bundled service offers? (How do you sell the offers, do you promote them?)
2. Do the customers plan their maintenance visits a week in advance or are the visits already planned?
3. If a customer does not have a service contract, and the driver pattern is unknown, how do you plan for maintenance? Do you plan for maintenance in that case?
4. If a customer has a service contract, the driver pattern is therefore known, do you use the data to plan for maintenance that is predictable?
5. Are spare part deliveries accurate? Are you satisfied with the delivery schedule?
6. When you place an order manually, is it done after a customer order or do you forecast?
7. How do you perceive that the spare parts availability is? Are you able to provide 92 percent of the spare parts instantly?
8. How does remote diagnostics work?
9. Do you use the data you get from remote diagnostics?
10. What are the challenges with the bundled service offers in regard to the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material

- iv. Customer satisfaction
 - v. Warehouse structure and location
- (b) Do you have any additional challenges, beside the ones we mentioned regarding the bundled service offers in the aftermarket supply chain?
11. Do you have any suggestion how the bundled service offer can be improved somehow, especially in regard to the aftermarket supply chain in the Nordic market?

Interview with respondent 21 on 16th of April, 2015

1. How are orders handled in the support warehouse today?
2. What are the challenges in regards to the support warehouse in the aftermarket supply chain in the Nordic market?
 - (a) We have identified some challenges from literature, do you experience some, or all of these? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
 - (b) Do you have any additional challenges, beside the ones we mentioned in the aftermarket supply chain?
3. Are you experiencing problems with the current set-up of the support warehouse, what are they?
4. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

Interview with respondent 22 on 20th of April, 2015

1. What types of transportation modes are used and when are they used? (In which situation according to the figure below, so e.g. between supplier to central warehouse)
2. Looking at this picture [show picture], taken from a Volvo Group presentation, isn't there a link missing between support warehouse to dealer and vice versa?
3. For different types of order (day order, stock order, VOR orders) what kind of transportation is used?
4. What are the challenges in regard to the support warehouse in the aftermarket supply chain in the Nordic market?

- (a) We have identified some challenges from literature, do you experience some, or all of these? How?
 - i. Forecasting spare parts to meet demand
 - ii. Responsiveness when sudden breakdowns occur
 - iii. Physical distribution of material
 - iv. Customer satisfaction
 - v. Warehouse structure and location
 - (b) Do you have any additional challenges, beside the ones we mentioned in the aftermarket supply chain?
5. Do you have any suggestion how to improve the aftermarket supply chain in the Nordic market?

Interview with respondent 23 on 20th of April, 2015

- 1. What KPIs are measured at Volvo Group, within Logistics Services?
- 2. Can you elaborate on those KPIs, what do they measure and why are they measured?
- 3. Do you think the current set-up of those KPIs is sufficient?
- 4. Do you think the KPIs could be improved somehow or do you think some KPIs are missing?

Additional respondents not being interviewed formally:

Respondent 24, respondent 25, respondent 26, respondent 27 and respondent 28.

Appendix F: Keywords

Keywords, keyword variants and synonyms combined formed the search strings which constituted the input to the databases.

Keywords	Keyword variants/synonyms	
Aftermarket	After-market	
Supply chain	Supply network	Distribution structure
Automotive industry	Automotive	
Servitization	servicing	service
Inventory		
Bundled service offers	Service offers	Service offerings
Uptime	Up-time	
Supply chain design	Supply chain structure	Supply chain distribution
Material	Materials	
Challenges	Implications	
Spare parts	Spares	
Reverse logistics		
Performance measurements	Operational metrics	KPIs
Warehousing		
Demand		
Forecasting		
Remote diagnostics		