LAPPEENRANTA UNIVERSITY OF TECHNOLOGY

School of Business and Management

Master's degree in Supply Management

# Master's Thesis

## Lead time reduction in Finnish commercial vehicle industry - Case Scania Suomi Oy

Author: Erik Lehtiö

Supervisor / 1st Examiner: Jukka Hallikas

2nd Examiner: Mika Immonen

## ABSTRACT


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| **Author:** | Erik Lehtiö |
| **Title:** | Lead time reduction in Finnish commercial vehicle industry – Case Scania Suomi Oy |
| **Year:** | 2018 |
| **Faculty:** | LUT School of Business and Management |
| **Major:** | Supply Management |
| **Masters thesis:** | Lappeenranta University of Technology, 61 pages, 13 figures, 1 picture |
| **Examiners:** | Jukka Hallikas, Mika Immonen |
| **Key Words:** | Lead time reduction, lean management, supply chain management, purchasing strategy, engineer-to-order |



The objective of this research is to find ways to reduce the lead time of new vehicle sales in Finnish heavy commercial vehicle industry. Theoretical background is crafted from various scientific articles and books that discuss Lean philosophy and Supply Chain Management. The production approach of the case company is classified as Engineer-to-Order, which affects the theoretical background formulation and the applicability of Lean and Supply Chain Management tools and strategies. The focus of the thesis is to study how different theoretical frameworks and tools can be applied in a real-life scenario to reach the targets mentioned above.

The empirical research results suggest that the lead time of the case company could be reduced using different methods. As these methods require resources and alternations to the current processes, the impact of the methods should be further investigated. That said, the results highly suggest that to decrease lead times, the case company should increase orientation and strategic focus towards purchasing activities and the case company order-to-delivery process. Instead of focusing on individual identified problems, the order-to-delivery process strategy should be re-examined. Much of the related information is held within different departments and regional areas, suggesting that cross-departmental and -regional cooperation should be further increased.

## ACKNOWLEDGEMENTS

As my life as a student is coming to an end, this thesis represents a remarkable milestone within my life. Although this has been an incredible journey filled with a lot of learning, new friends and many unforgettable experiences, I feel eager and pleased to face a set of fresh challenges that the surrounding world provides. During my studies in Lappeenranta I learned many terms, frameworks, formulas, patterns and models, but in my opinion the single most important thing that I came to realize is that learning is a never-ending journey. My time as a student is ending, but that certainly doesn't mean that I will stop learning. As they say, always stay curious.

I would like to thank several persons for making this all possible: I thank Jukka Hallikas for providing me with support throughout the study as my supervisor. I also thank the Scania Suomi personnel for allowing this study to take place, and especially Jukka Tiusanen who provided me considerable support within the case company during empirical studies and made this all possible. Lastly, I would like to thank my family and friends for providing me with endless support throughout my studies. I couldn't have done this without you.

In Helsinki, 27.5.2018

Erik Lehtiö

# Content

# 1. Introduction

To stay ahead of the competition, organizations should examine their business processes and improve them constantly. One important measure for manufacturing industries is the timespan required to turn customer orders into delivered products. This so-called order lead time can be a source of customer satisfaction and competitive advantage, as many customers require swift deliveries for the ordered products. In addition, lengthy lead times can decrease the return of equity for the manufacturing organization as the capital is tied down to the product throughout the manufacturing process. (Tersine & Humminbird, 1995; Lewis, 2000) Remarks noted above tend to get more significant as organizations conduct business-to-business type of transactions, and even more so when the manufacturing organization production strategy can be classified as Engineer-To-Order, due to the increasing product complexity. The issue is further complicated by the fact that many of the manufacturing organizations are purchasing a considerable portion of the components needed for the final product from other organizations. This will decrease the overall control of the production process, as the manufacturing organization is dependent on the delivery performance of the subcontractor. (Hicks et al., 2000) To mitigate risks and to shorten the lead time without compromising quality is not an easy task since there are multiple factors in play. For example, lead time compression may require the optimization of activities from marketing to the final delivery. Each of these activities interact with each other, hence a holistic approach is required.

This thesis provides a view into the Finnish commercial vehicle industry through a market leader qualitative case study. The industry provides a prominent subject for a study, as there is a lack of studies within regarding its peculiar supply chain structure and its business environment. In addition, in Finland the sales of new commercial vehicles are worth hundreds of millions of euros annually. Lastly, the performance of the new commercial vehicle supply chain can have an impact on the economy on a national level. For example, if the commercial vehicles are produced more efficiently, they are less expensive. These less expensive trucks can be used to provide cheaper transportation services within the economy. Albeit the impact is likely to be close to nominal, the transportation service industry costs impact many industries in Finland such as the forestry, retail, agricultural, mining and construction industries, that heavily rely on road transportation services. By decreasing the transportation costs such industries could sell their products cheaper than before, and thus attract more sales.

## 1.1 Target and limitations

The purpose of this research is multifold. The first objective is to develop a literature framework of lead time reduction in a Business-to-Business Engineer-to-Order type of business setting. Next, the researchers aim to bring forth information about the Finnish commercial vehicle market. Lastly, there are suggestions presented of how the case company could decrease lead times and increase supply chain performance. Based on these objectives three research questions can be outlined. The first question is viewed as the main research question.

*1: "How the case company can decrease the lead time of new vehicle sales?"*

*2: "What are the core processes of the case company, and how they are organized at the current moment?"*

*3: "Are there additional factors within the supply chain that could be developed further?"*

As the case company is in the middle of the supply chain, and the upstream is controlled by the parent company, the thesis is mainly focused on the optimization of the supply chain downstream of the parent company. The case company cannot affect the actions of the parent company in a large scale, but as the case company is dependent on the parent company performance, multiple factors that affect the lead time will be considered.

Secondly, due to the current amount and type of available data, this thesis is prone to focus on the fundamental factors of the processes, instead of the detailed specifications. As a result, this thesis will not provide numerical analysis, measurements or statistical future predictions. The purpose of this thesis is to map and inspect the case company core processes, reflect the core processes against the modern best practices while taking into account the peculiarities of the company and its business environment, and finally based on such analysis, provide the case company with practical solutions how their lead times and supply chain performance could be enhanced. Lastly, this thesis is not able to measure any possible improvements, because the timeframe of the suggested solutions does not match the timeframe of this thesis.

## 1.2 Conceptual framework

The conceptual framework of the study is as follows. To decrease lead times, in general some changes must be conducted. Some of these 'changes' that have been proven to be efficient in lead time reduction have been recognized within the academic operations management. These 'changes' are more commonly known as different tools, programs and tactics. The applicability of such tools, programs and tactics are however dependent on the organization, meaning its strategy, its value chain position, its culture and its capabilities. Further, the organization itself (and its strategy, capabilities, value chain position, etcetera) is dependent on the business environment, that lays the basis for the industry to exist. The business environment consists of multiple external and internal factors that influence the operating situation of the organization, for example customers, suppliers, competition, ownership structures, trend, and laws and regulation. To decrease lead times successfully and safely, all these factors need to be considered precisely.

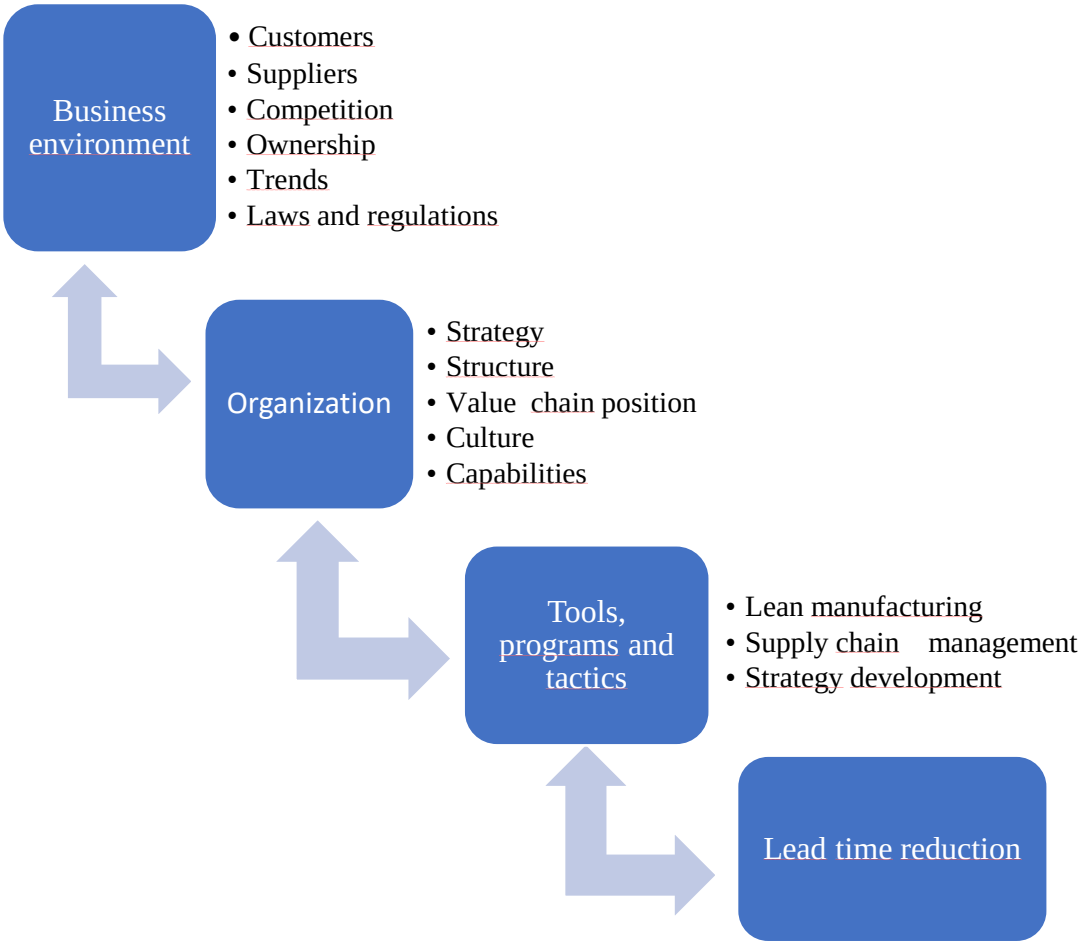


**Figure 1.** Conceptual framework.

## 2. Theoretical background

Within this section of the thesis, a theoretical background is formed from various scientific research articles and books. The material was collected by using multiple academic online journal and book databases such as the Emerald Insight, SpringerLink, ScienceDirect, Taylor & Francis and Wiley Online Library. The purpose of the theoretical background is to present some of the best available methods identified within the academia to analyse and solve problems similar to the research questions.

### 2.1 Lead time

The term lead time is used widely to describe the amount of time that is required to complete any given process. Within business literature lead time often refers to the timespan between customer order placement, and the delivery of ordered products and/or services. This so-called total lead time, also-known-as order lead time, is a source of customer satisfaction and competitive advantage (Treville et al., 2004), as customers require fast deliveries on the goods that they have ordered, and the supplying organization wants to keep the tied-up capital to the minimum (Stalk, 1990). To analyse lead times accurately, total lead time can be divided into smaller internal sections for more detailed inspection.

Within many manufacturing industries total lead time typically consists of four smaller sections, that are: (1) order handling time, (2) manufacturing lead time, (3) production lead time, and (4) delivery lead time. Some of these lead times overlap with each other, but they all should be considered to optimize the total lead time, according to Rajaniemi, 2012.

1. Order handling time represents the time required to transform the customer order into a sales order. As the customer places an order, the supplying organization must be sure that the sales order represents the customer order for example in terms of delivery dates, product specifications, prices, quantities, etcetera, so that the actual manufacturing process may begin. In many industries order handling time is instant, or it can be done during the same business day, but as many companies are international, and as product specifications get more complex, order handling time can increase significantly.

2. Manufacturing lead time is the amount of time that is required to turn the sales order into a product that is ready for delivery. In other words, manufacturing lead time is the part which measures how fast orders are fulfilled. Manufacturing lead time includes all the steps required to make the actual product, such as production planning, supplier lead times, waiting time between processes, the actual production, etcetera. Note that if the organization produces to inventory instead of according to customer order, the manufacturing lead time is 0 from the customer point-of-view, as the product is drawn from warehouse shelf. Unfortunately, this "made-to-stock" production system can include considerable drawbacks, as large inventories tie up a lot of capital, and the risk that the products within the inventory may become outdated or worthless over time. Manufacturing lead time reduction is in the centre of many lead time reduction programs, as the core competence of many organizations lie in-between the creation of sales order and the delivery of finished goods.

3. Production lead time is an important internal measurement for many factories and production sites, as it represents the actual production time. Production lead time doesn't tell how fast the organization is able to fulfil the customer order, but it tells how long it takes to produce the product. Production lead time includes factors such as processing and working on the product, queuing between processes, movement of the semi-finished product, etcetera.

4. Delivery lead time is the timespan between finishing the product and delivering it to the customer. Delivery lead time can be impacted by different transport modes, the pace of outbound shipments, and inventories after production. Usually most delivery lead times can be decreased by eliminating non-value adding activities, such as extra handling and inventories, but for example in international trade delivery times can be very significant, as intercontinental cargo ships are not built for achieving great traveling speeds.

There are a variety of ways how lead times can be reduced. For example, Hill and Khosla (1992) list multiple ways of reducing lead times though making changes in operations management, for example by developing manufacturing processes or purchasing.

Manufacturing processes could be developed to decrease lead times by parallel processing, eliminating unnecessary steps within the process, carrying inventories of components with long lead times, reducing queue and setup times, enhancing manufacturing site layout, using better equipment and tools, etcetera. Within purchasing, an organization can decrease lead times for example by changing to a more responsive and capable supplier, buying vendor capacity, developing better communication channels and relationships with the suppliers, developing electronic data interchanges, paying premiums for faster deliveries, etcetera. The large amount of lead time reducing methods suggest that in order to achieve lead read time reduction, the most suitable methods must be identified by the organization. In a sense, these methods are an answer to an question, and presenting without a context doesn't possess much significance. The researchers go further and propose a mathematical model to analyse the trade-off between the costs and the benefits of lead time reduction, but the model includes considerable assumptions, simplifications, and requires such information, that it provides no real implications. Despite the limitations of the mathematical model, it is important to note that lead time can be reduced in variety of ways that are situation/organization dependent, and that the benefits of lead time reduction should be compared against the costs as precisely as possible.

## 2.2 Lean manufacturing

Growing competition in today's global business environment has encouraged organizations to adopt new strategies to improve the organizational efficiency and competitiveness. One of these strategies used in manufacturing industries that has been found useful, is called lean manufacturing. Even though lean manufacturing has taken many different names, such as lean production, lean philosophy or simply lean, the underlying principle remains; focus on delivering value to the customer while eliminating all waste (non-value adding activities) from the process. (Nordin et al., 2010) In other words, lean aims at creating more value to the customer with fewer resources. According to Shah and Ward (2002) lean manufacturing is "a *multi-dimensional approach that encompasses a wide variety of management practices, including just in time, quality systems, work teams, cellular manufacturing, supplier management, etc. in an integrated system*." Like this definition states, lean manufacturing can be viewed as a holistic philosophical approach to organizing activities and processes inside and between organizational borders.

### 2.2.1 The two levels of lean

To understand lean as a whole, a distinction between the scopes of lean can be made. According to Hines et al., (2004) lean manufacturing exists on two different levels; strategic- and operational lean. The strategic level of lean is a customer-centered way of thinking, which applies to every process and function of the organization, whereas operational lean can be viewed as a tool bag mainly focused on elimination of the waste on actual shop-floors. This is a helpful distinction when it comes to lean application; lean thinking must be conducted correctly in order to achieve operational lean. Lean manufacturing aims at delivering maximal value to the customer by eliminating waste but knowing what is valuable and what is waste cannot be discovered if the focus remains solely on an operational level. Below is Figure 2. proposed by Hines et al., (2004), and it pictures the lean framework. The figure illustrates the two levels of lean, and in addition the figure shows the connection between additional tools and lean thinking. Some of the tools are described as additional to the lean framework (thin arrows) since they haven't been developed for lean manufacturing but have been found useful in implementing and supporting a wider lean strategy. (Hines et al., 2004)

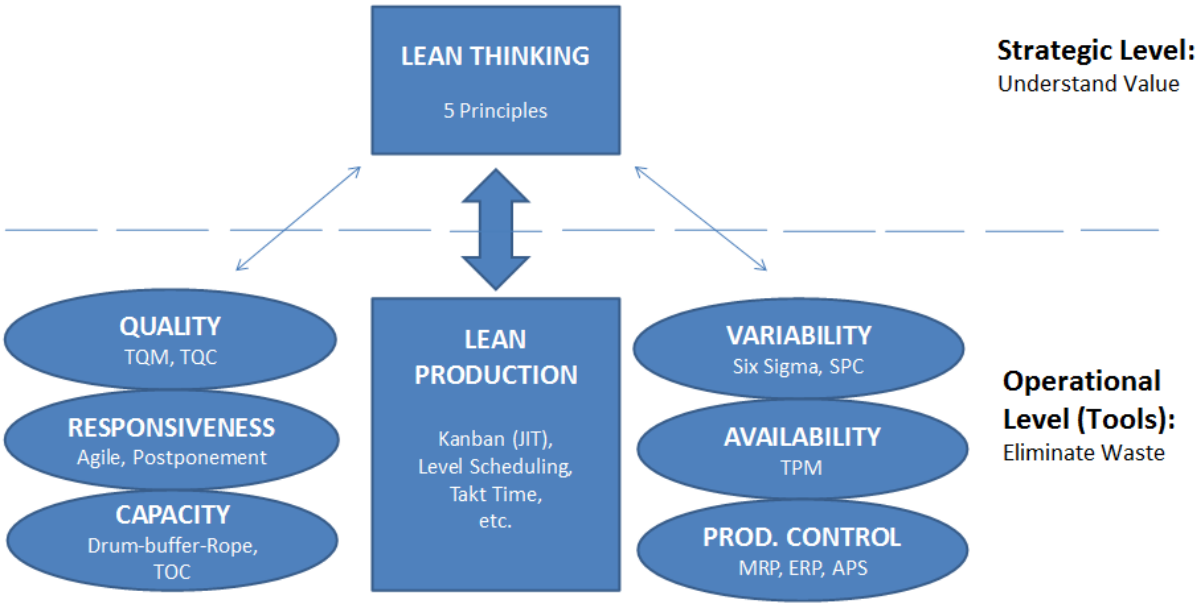


**Figure 2**. Lean Framework. (Hines et al., 2004)

The term Lean Thinking was initially named in a case-study by Womack & Jones (1996) to describe a comprehensive lean business logic. In their study Womack & Jones (1996)

researched over 50 organizations from various industries, and based on their study they identified and articulated the steps taken by the successful lean organizations. The steps are listed and explained below.

1. Define value precisely from the perspective of the end customer. Defining what the customer actually needs and appreciates in terms of products, product specifications, delivery times, price, and so forth. This is a crucial step for the successful implication of lean, since every process will be tuned according to the end customer needs. If this initial step goes amiss, there is a good chance that the organization applying lean philosophy will become highly efficient in producing and delivering waste.

2. Map the value stream and eliminate waste. Once the end goal has been determined in step 1 (delivering defined value), the next step is to map the value stream. Value stream maps can be identified for each product, product family or supply chain. Within value stream the main idea is to map all the processes and actions needed to transform the raw materials into products, and the delivery of those products to the end customer. Inspecting the value stream map almost always reveal considerable amounts of waste within the given stream.

3. Create flow. After the waste removal in step 2, the next step is to ensure that the remaining processes run smoothly, meaning that there are no waiting, scrap or downtime inside or between processes. According to Jones and Womack (2002) creating flow can be very difficult, since this requires a change in the organizational mindset of department silos. To establish flow, the departmental borders need to be forgotten, and the organization should focus on the flow of value creation throughout the supply chain. Like Jones and Womack (2002) state, most of the major breakthroughs comes from looking at the value stream as a whole.

4. Produce only what the customer wants only when the customer wants it. Once the processes flow smoothly, it is easier to deliver products as they are needed. This allows the customer to "pull" the product, instead of the "push", in which products are typically produced to inventory, and sold later. Womack and Jones (2010) state in their book when moving from batch-and-queue to continuous flow with pull from the customer, that if the organization is not able to double productivity, cut throughput time and

inventories by 90%, the organization is likely doing something wrong in its lean implementation process. These numbers are of course somewhat figurative since every organization is different, but as they are derived from case studies, it does illustrate the fact that applying lean manufacturing has the potential to transform the organizational performance.

**5.** Perfection. When value is accurately specified from the perspective of the end customer, the specified value stream is identified and mapped, value-creating processes flow smoothly, and the customer starts to pull the value from the organization, it is time to implement the last principle of lean, pursuing perfection. According to Jones and Womack (2002) the people taking part in lean implementation quickly realize that the process of reducing costs, effort, time, space and defects while offering superior value to the customer is a never-ending process, and it should be worked on constantly. According to the research, one of the main facilitating factors of perfection is transparency between the supply chain members. When everyone within the supply chain can see every step of the way, it is easier to discover new ways to improve the delivery and the creation of value throughout the supply chain. The strategic level of lean, or the 5 principles of lean can be summarized, according to Womack & Jones (1996), into a process chart Figure 3. displayed below.

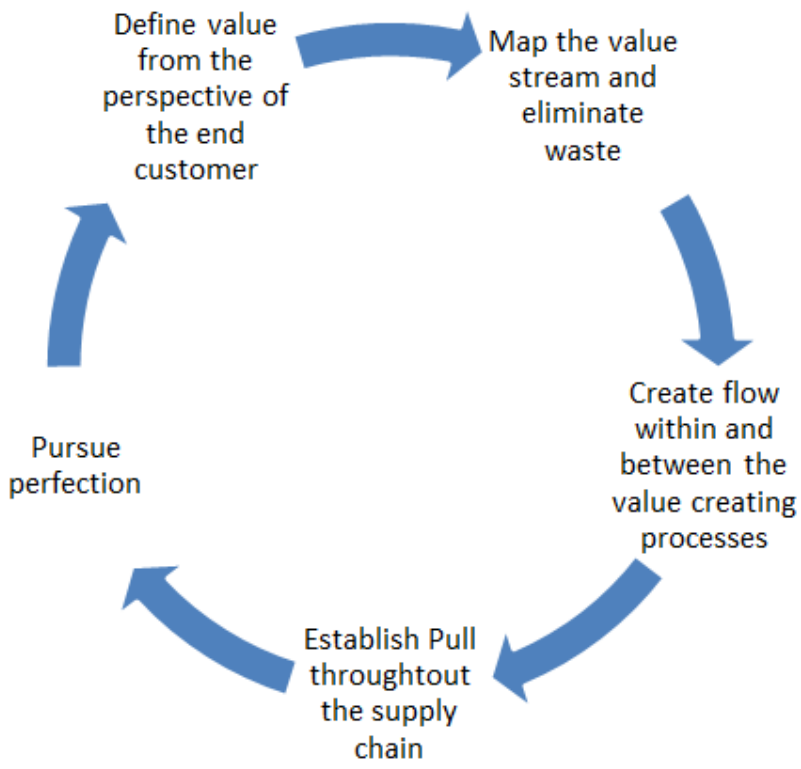


**Figure 3.** 5 lean principles. Womack & Jones (1996)

### 2.2.2 Tools - Value Stream Mapping

After the organization has defined the value from the perspective of the end customer, the actual process development may begin. As common sense would suggest, in order to develop anything, the starting point must be acknowledged first. Otherwise any improvements made can be declared as ineffective as the progress is difficult to measure and to prove. In addition, acknowledging the starting point helps organizations to locate new sections in need of improvement. One of the best ways to help the organization to see how the actual material and information flows inside the organization and the supply chain, is a tool called Value-Stream-Mapping (VSM) (Rother & Shook, 1998).

According to Rother & Shook (1998) value stream can be defined as "all the actions (both value added, and non-value added) currently required to bring a product through the main flows essential to every product: (1) the production flow from raw material into the arms of the customer, and (2) the design flow from concept to launch", whereas VSM can be defined as

process of identifying and mapping all those actions. VSM is a simple pen and paper tool, in which the organization presents visually (in a diagram) the flow of materials and information as the product travels through the value stream, and the use of that information as the basis for improvement. VSM can be used, among other things, to detect unnecessary inventories, improve lead times, and calculate what percentage of the activities are value adding, non-value adding, and necessary but non-value adding (Rohac & Januska, 2015; Monden 1993). In addition, VSM can be viewed as a language, it's easy to demonstrate what is wrong with the value stream in a visual form, especially when the recipient of the message is not a process optimization professional per se. (Rother & Shook, 1998) Albeit the initial step of VSM is quite straightforward, there are factors that need to be considered in order to derive the maximal value that this tool offers.

#### 2.2.3.1 Current and Future State Maps

VSM starts with the decision of which product or product family will be mapped. The mapped product process has some preliminary requirements, such as the capability to influence the process, finding a way to influence the process, and that the improvement efforts are financially effective (Rohac & Januska, 2015). Once the mapped process has been chosen and it fulfils the listed pre-requirements, the mapping usually starts from the activities that are carried out within the organization, meaning that the mapping begins when the raw materials or composites enter the organization facility, and ending when the finished product leaves the property. Each step of product movement is categorized either as operation, storage, transport, inspection, or delay. Following categorization each step is described in more detail, including factors such as cycle time, changeover time, yield, travel distance, inventory, waiting time, etcetera. Which factors to use will be dependent on the given organization strategic objectives, as they must decide their own Key Performance Indicators (KPI) to focus on (Parmenter, 2015). Tapping & Shuker (2002) state that the successful implementation of VSM requires standardized measurements, so that calculations are accurate, consistent and easy to understand. In addition, those measurement results need to be communicated throughout the organization to the people that need it. Lastly, Tapping & Shuker (2002) state that the function of measuring is to provide information, and the active sharing of that information is the glue that keeps the value stream management project together.

Besides the product movement, the map visualises the movement of information regarding the product movement, whether it be manually exchanged information, automatically exchanged information, and whether the system is based on Push or Pull method. Alongside the product and information movement, a quality filter map can be applied. Quality filter map can be used to detect where quality improvements are required, typical quality problems are product defect, service defect and internal scrap. As VSM is a visual tool, it is best described in a visual form; an example current state map Figure 4 is displayed below, in which the researchers map in detail the foundation building process of a house.

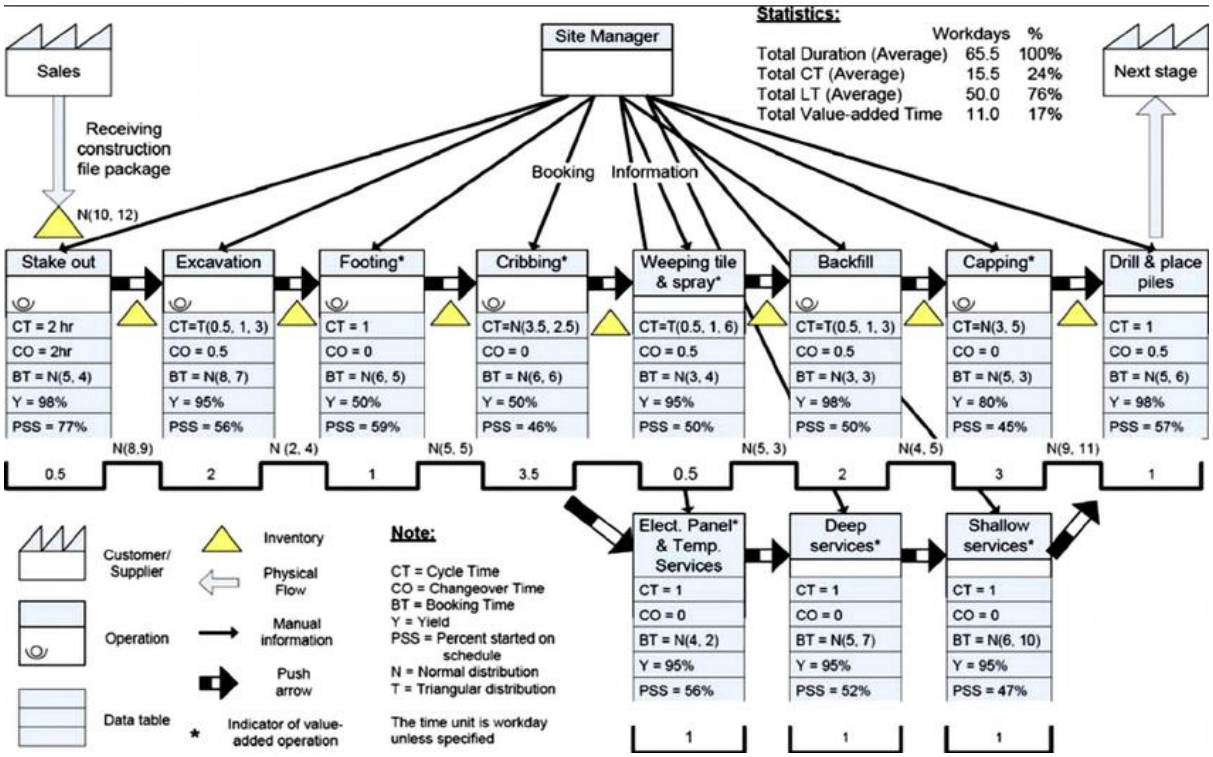


**Figure 4.** The current state map. Adopted from Yu et al., (2009).

After the organization has mapped the current state of a given process, they can move on to formulate the desired state, the so-called Future State Map (FSM). According to Lovelle (2001) FSM should be viewed as the blueprint for ideal state of lean. As the waste is identified within the mapped process, lead times and cycle times are known, organizations can start to carry out improvement projects. Note that reaching the FSM is not an easy task as it requires time, persistence and determination, but as many case studies demonstrate, achieving the desired

state is possible. One of the best tips regarding the formulation of FSM, that can be used as a rule-of-thumb, is the elimination of waste. Waste can be defined in the lean framework as anything that doesn't add value. The 7 types of waste, originating from Toyota Production System, include overproduction, delay / waiting, transportation, unnecessary motion, inventories, over-processing and rejects / defects. Like Rother & Shook (1998) state, the formulation of FSM becomes easier as these waste factors are turned into questions; how much the organization should produce? How often should the organization produce a given product, so that there are no large inventories and customers are satisfied? Where the organization can establish flow, so that there are no unnecessary delays, inventories, motion, etcetera? What other process improvements should be done, so that the value stream becomes more efficient? These questions are multi-criteria decision-making processes that needs to be evaluated carefully. For example, an investment in a new production machine can impact the economic performance, the personnel, the capacity, the flexibility, the process quality, the factory layout, etcetera. Therefore, it's essential for the successful implementation of a lean program that all of these factors are taken into consideration. This usually requires a lot of cross-functional discussion and cooperation, so that the program doesn't overlook possible risks and drawbacks caused by the process modification.

## 2.3 Supply chain management

Supply chain management (SCM) can be defined according to La Londe (1997) as *"the process of managing relationships, information, and materials flow across enterprise borders to deliver enhanced customer service and economic value through synchronized management of the flow of physical goods and associated information from sourcing to consumption."* SCM has been a popular concept for the past decades both in academia, and in managerial practices (Mentzer et al., 2001). There are multiple reasons why SCM has gained so much popularity, such as more demanding customers in terms of product quality, price and delivery time, shorter product life cycles, product portfolio proliferation, and organizational flexibility (Kannan & Tan, 2005; Chen & Paulraj 2004). In addition, one factor that highlights SCM is the so-called globalization of supply; products can be sources from all around the globe, as the information exchange around the globe has become instant with the use of internet technology, transportation has improved tremendously, the capital is allowed to travel across national borders freely as countries join trade deals and customs unions, and the developing nations has provided a lot of cheap labour to the global labour markets. This will force organizations to focus on their core

competence, as almost everything else can be outsourced; components, products, bookkeeping and call centers, just to name a few. As a result, outsourcing will put great emphasis on the coordination of the supply process. Like Lambert and Cooper (2000) state, one of the biggest paradigm shifts in business management, which has occurred during the past decades, is that individual organizations do not compete as isolated entities, but rather as supply chains. To provide a comprehensive model of supply chain activities, functions and outcomes, a framework of supply chain is displayed below according to Mentzer et al., (2001) in Figure 5.

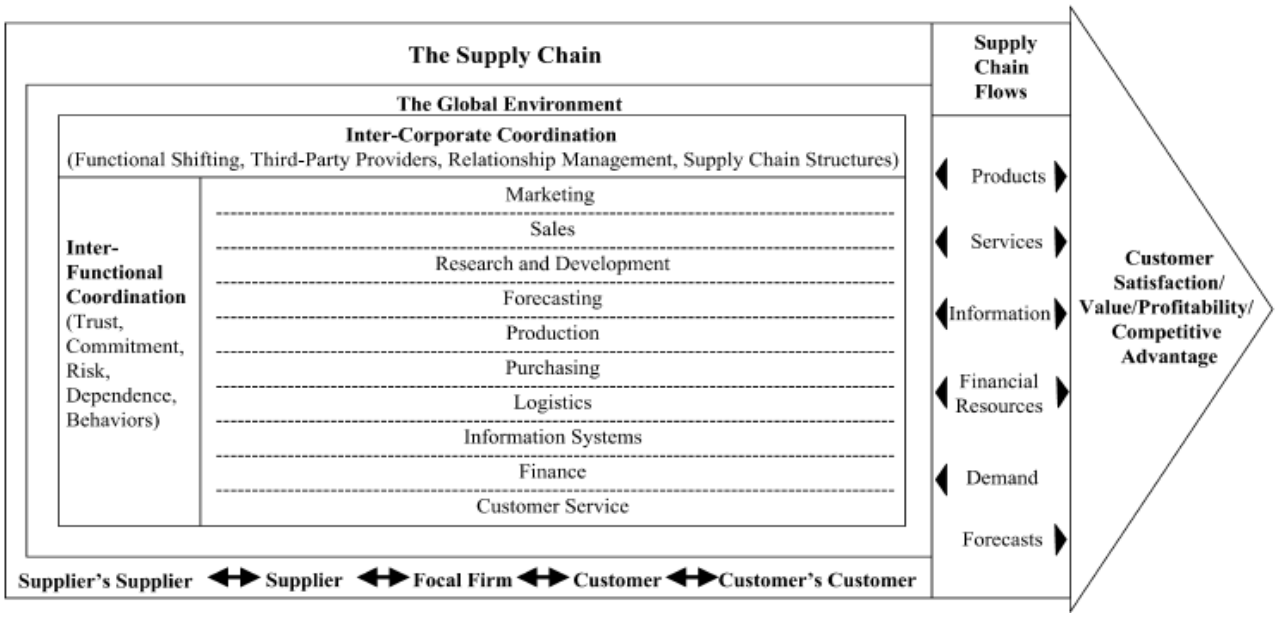


**Figure 5.** A Model of Supply Chain Management. Adopted from Mentzer et al., (2001).

Supply chain management has historically caused some confusion in the academic literature, as the coverage of the field is so vast. In addition to the multiple actions and processes that it affects, such as production, logistics, marketing, sales, R&D, information transfer, etcetera, supply chain management can be viewed from multiple perspectives, ranging from SCM as a process to SCM as a philosophy. (Ellram et al., 2014; Mentzer et al., 2001, McKee & Ross 2009) Further, almost every single produced good has their unique supply chain, so that the best practises and tools found in case studies may have severe limitations in other types of supply chains. Due to these issues, the following text will discuss supply chains and supply chain management from an Engineer-To-Order (ETO) production point of view, instead of more traditional mass production styles such as Make-To-Stock, Make-To-Order and Assembly-To-Order. These production methods have emerged as a response to differing customer requirements, as the purchasing decision making process and criterion of buying a

pencil considerably differs from the decision-making process of buying a cargo ship. That said, the underlying principles of the supply chain management remains; managing the flows of products and information inside and between entities, so that the supply chain delivers the most value to the customer. Now the question becomes what the customer values, and how the supply chain should be orchestrated to deliver that value in the most efficient way possible.

### 2.3.1 Engineer-To-Order supply chain management

As stated earlier, there are almost an infinite number of different supply chains and supply chain networks, so more precise definitions are needed to examine supply chain management in more distinct scenarios. Many supply chain frameworks use customer order decoupling point (CODP) as a way to optimize and match supply chain manufacturing strategies to specific market needs. Generally speaking, CODP is the point in value chain where the specific product is linked to a specific customer order. Determining CODP according to the market needs can be helpful in various industries (make-to-stock, make-to-order, assembly-to-order) as standardized parts, components or products can be produced to inventory according to a forecast, and customized / assembled later, when the actual customer order is received. This way the organization can combine the benefits derived from push and pull production strategies. (Olhager, 2010) Unlike in the make and assembly production strategies, supply chain can be classified as ETO when the CODP is located at the design or the engineering phase, meaning that the whole production process will be conducted according to a specific customer order. The difference in CODP is best described in a visual form, presented below in Figure 6.

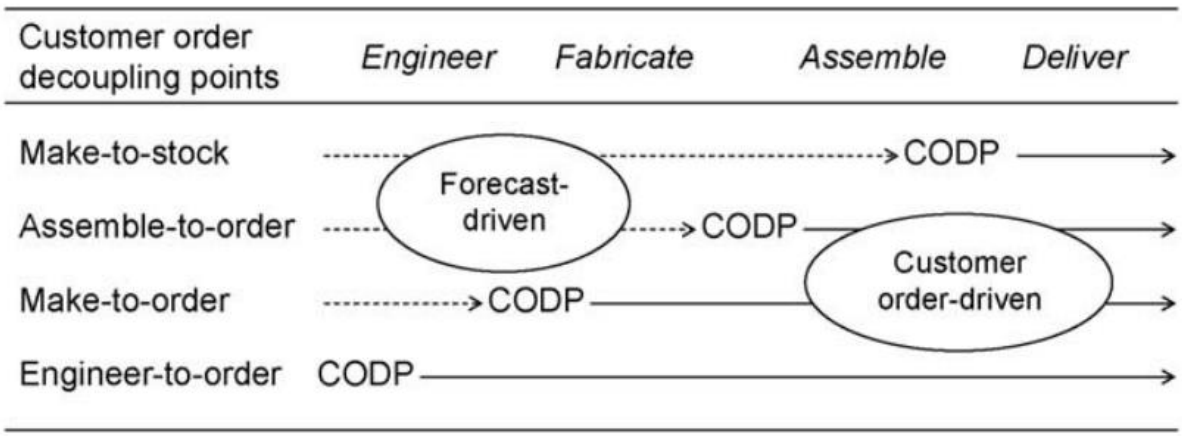


**Figure 6**. The Customer order decoupling points. Based on Sharman (1984).

ETO supply chain management is suited for organizations, in which existing designs are modified to order (Rahman et al., 2003), new designs are developed to order (Bertrand & Muntslag, 1993), or for project environment with specific demands, or one of a kind delivery (Donselaar et al., 2001). Typically, these include for example costly capital equipment, specialized software and constructions. As ETO supply chains are described as low volume, or even one of a kind production, many of the traditional supply chain management tools and practises may not be suited, as they are constructed primarily for make-to-stock or make-to-order production systems with large production volumes. Many SCM related tools, such as warehouse management, demand forecasting, etcetera, may be unessential for some ETO supply chains, or they can include severe constraints regarding their applicability to the ETO supply chain improvement projects (Gosling et al., 2015). Therefore, the peculiarities of ETO supply chain management need to be addressed, so that ETO supply chain can be optimized appropriately.

The ETO sector includes many types of entities that design and produce a wide range of different type of products and solutions. The products are usually complex, resulting in assembly process requiring multiple phases. In addition, these products are usually assembled from a diversity of components, some of which are used in low volumes, and others in medium or large volumes. Some of the used components are highly sophisticated and customized, whereas some are simple and standardized. Further, the purchasing of components can be challenging as the product specifications are not finalized until the design process has been completed. Typically, the high level of customization of ETO products will lead into higher costs, increased risk and long lead times. As Hicks et al., (2000) have demonstrated, many companies recognize these problems, but many attempts to control the problem with product standardization and modularization has failed due to the diverse customer demand.

### 2.3.2 ETO business processes

According to Hicks et al., (2000) ETO business processes between the buyer and supplier can be divided broadly into three different phases, that are (1) marketing, (2) answering to the request for quotation, and (3) activities that follow after the contract has been awarded. The initial phase of marketing consists of relationship marketing, in which the organization can

identify trends, customer requirements and criterion. The decision to be made at this initial phase is whether to answer to a request for quotation. This decision is based on the customer requirements, the supplying organization's capabilities, and the business environment.

The second phase, responding to the request for quotation, includes the preliminary design and the breakdown of the required major components. The subcontractors are included to the process at this point, as the supplier requests quotations on the outsourced components. The received information is used to estimate the costs and lead times. The negotiations with the subcontractor can include multiple rounds so that the specifications, costs, lead times, delivery terms, etcetera will truly match the end customer requirements. (Hicks et al., 2000) Answering requests for quotations successfully can be difficult as Konijnendijk (1994) estimated in his study, only less than 30% of the answered requests for quotations led into a signed contract in ETO companies.

The last phase begins after the contract has been signed. This usually starts with formulation of the overall project plan, and the finishing of the preliminary design. After the design is completed, the purchasing activities are carried out, so that all the needed components are at hand. After purchasing, the physical activities of manufacturing, construction, assembly, etcetera, are carried out. The involvement level of the supplier itself varies greatly, as some organizations are involved in the design, manufacturing and assembly of the product, whereas some organizations purely focus on the product design and the coordination of subcontractors. The extent of vertical integration is a result of the corporate strategy, that responds to the market needs and opportunities. (Hicks et al., 2000)

When the customer requests for the initial quotation, the organization can experience difficulties in defining delivery dates. This is partly due to the external suppliers and subcontractors, as they can have multiple requests for quotations at hand waiting for responses, that will affect the available subcontractor production capacity. These floating quotations are inherent to ETO supply chains, as the information must flow back and forth between and inside organizations, so that every party is in agreement. The quotation process can be further complicated by inexact product specifications that can have a notable impact on the work content and duration. Due to the hazy nature of the quotation process, delivery performance is one of the key competitive factors in ETO markets. Delivery performance can be further divided into two sections; providing accurate lead time estimates and the total lead time. Lead

time can be reduced for example by improving individual processes or conducting activities simultaneously instead of conducting them in a sequence. (Hicks et al., 2000) Also, component standardization and modularity can be suitable lead time reduction strategies for some products (Perera et al., 1999), but as stated previously, in some cases it can be next to impossible due to the diverse customer demand. Lead time estimates may be improved for example with project management IT systems that provide more accurate information to the supply chain members and decrease the likelihood of unexpected redesign (Hicks et al., 2000).

### 2.3.3 ETO procurement

Procurement activities within ETO organizations are based on the product design, that defines the specifications of the required components. As effective procurement is dependent on the designed component specifications, the level of detail of those specifications must be comprehensive and correct. If the specifications are incorrect or inaccurate, there is a good chance that for example the costs will increase, or that the quality will decrease. On the other hand, explicitly detailed technical specifications can limit the problem-solving capability of the subcontractor, as the amount of available design choices are decreased. In some cases, this can lead into longer lead times and increased costs as the subcontractor cannot use their specialized expertise to the full extent. (Hines et al, 2000) One possible alternative solution can be found from the Toyota Production System supply chain, in which Toyota does not specify technical specifications of the procured parts, but only the functional specifications. For example, Toyota doesn’t specify that the procured brake discs would have to be stainless steel, but instead they give out functional specifications; brake discs would have to fit inside the 15inch rim, and they needed to stop the car weighing X amount, from Y speed, in Z distance. This allows the subcontractor to use their expertise to develop the braking system and to increase the overall quality of the final product. (Womack & Jones, 1990) Note that this style of procurement strategy is not suited for many ETO situations as many purchases can be technically specified without problems but purchasing organization shouldn’t instantly overlook the opportunities that can be derived from subcontractor specialized know-how. Lastly, since most ETO products are expensive, many customers wish to eliminate risks and purchase products that have a proven performance record. According to Hicks and McGovern (2009) this risk adverse manner of approach by the customer is often a barrier to innovation, albeit understandable due to the risks involved.

In general, purchasing in ETO organizations can be challenging for multiple reasons. For example, the end customer may choose subcontractors that they are familiar with, or they can present such requirements that only a limited number of subcontractor can be used. Customers also may alter the required product specifications as changes emerge in their own business operations. In addition, some of the components may be interconnected so that changing one component would require multiple changes to the initial design. Further, some subcontracted components can have such long lead times, that they need to be ordered early on during the design phase. (Hines et al, 2000) Lastly, ETO organizations can purchase different components and services with different purchasing requirements. For example, the organization can purchase stainless steel, gas turbines and specialized software, and all of these can have different purchasing strategies depending on the market situation, supply risk, relationship power and dependence, demonstrated for example by the Kraljic purchasing matrix (Caniels & Gelderman, 2005; Kraljic, 1983). Because of these reasons, among other things, most academics suggest that purchasing should be viewed as a strategic process that should be managed as such. For example, Matthyssens & Van den Bulte (1994) suggest that purchasing should evolve into a strategic process, and buying centers and decision-making units can be used to coordinate the purchasing activities. Vaughan (1996) suggests that purchasing should be viewed as a strategic function to which the organization participates as a whole, and that purchasing should be conducted in cross-functional teams. The strategic aspect and the importance of it is further highlighted by Quintens et al., (2006) as they state "*...in many of today's globalizing industries, purchasing is one of the strategic functions with the highest potential impact on a firm's long-term profitability.*" Indeed, in a case study conducted by Jahnukainen & Lahti (1999) the companies studied, the purchased parts and components made up 50-90% of the production costs. To improve the organizational performance in ETO industries various tactics and strategies can be developed, but as Barratt (2004) state, each individual supply chain will require a different strategy and a different culture to support the developed strategy. As a result, the importance of the purchasing strategy development process should be emphasized.

## 2.4 Purchasing strategy

Defining the term 'purchasing strategy' precisely is not an easy task, as it can be viewed from multiple viewpoints, such as the resource-based view, transaction cost economics approach and core competence approach. In addition to the multiple viewpoints, the purchasing strategy can

also be viewed from multiple hierarchical levels. Purchasing strategy operates on at least three levels; strategic, tactical and operational levels. The strategic level addresses the question of overall competitiveness at the top level of management, the tactical level deals with how these objectives can be reached, and lastly, the operational level is concerned with the actual purchasing and its results, such as the price, volume, quality, risk, flexibility, service, etcetera. (Nollet et. al, 2005) The purchasing function is concerned with issues such as the make-or-buy decision, supplier technology, desired supplier relationship type, external factors, and how purchasing can support the organization competitive strategy (Elram & Carr, 1994). Resultingly, there are many definitions used concurrently within the academia with different focal points, but for the purpose of this study a definition is adopted from Watts et al., (1995):

*"The procurement strategy can be viewed as the pattern of decisions related to acquiring the required materials and services to support the operations activities that are consistent with the overall competitive strategy of the company."*

The importance of purchasing strategy is something that can be considered self-evident for many manufacturing industries, as they usually relay heavily on external suppliers that form a significant proportion of the final product. Next, the process of developing a purchasing strategy is discussed in more depth.

## *2.5* Purchasing strategy development

Generically speaking, in the field of strategic management most strategy development processes consists of several subsequent phases, such as internal and external environment analysis, action planning, objective setting, implementation planning and implementation. There are hundreds different separate tools and programs available that the organizations can use to improve and develop their organization strategy (SWOT-analysis, PESTEL-analysis, TOWS-matrix, Five Forces-analysis) manufacturing strategy (Lean Manufacturing, Kaizen, Just-in-Time, 5-S, Business Process Reengineering, Value Steam Mapping, Kanban), purchasing strategy (Kraljic-matrix, Spend-analysis, Supplier Ranking, Purchase Centralization, Supplier Relationship Management), etcetera. In addition to the vast number of individual tools and programs, there frameworks targeted for developing a successful

purchasing strategy, one of which is proposed to be used by industrial companies. The framework allows organizations to develop purchasing strategies based on the most critical elements of each purchase, align the developed purchasing strategies to the corporate strategy and other function strategies, and to implement the developed strategies to the organization. Also, the usage of the framework doesn't attach the strategy development approach to a certain presumption that are included within many of the strategy development tools. In a sense, applying for example supplier relationship management to the purchasing function may include the assumption that cooperation with a limited number the suppliers or partnerships often yields the best possible results, yet there are many scenarios where competitive bidding and increasing competition amongst the supplier base can be far more lucrative approach. One of the biggest advantages that the application of strategy development framework brings forth, is the neutral and analytical approach towards purchasing strategy development. This is not to say that individual tools and programs shouldn't be applied, on the contrary, but the application of each tool and program should be considered individually for the developed strategy. To be successful, the developed purchasing strategy should make use of both - cooperation and competitive - dimensions (Virolainen, 1998). The framework is presented below in Figure 7. Note that the framework is no way complete, as there is parallel processing within each phase, but it can be used as a reference point as the phases, affecting factors, alternative frameworks and the hierarchy of the decision-making processes are discussed.

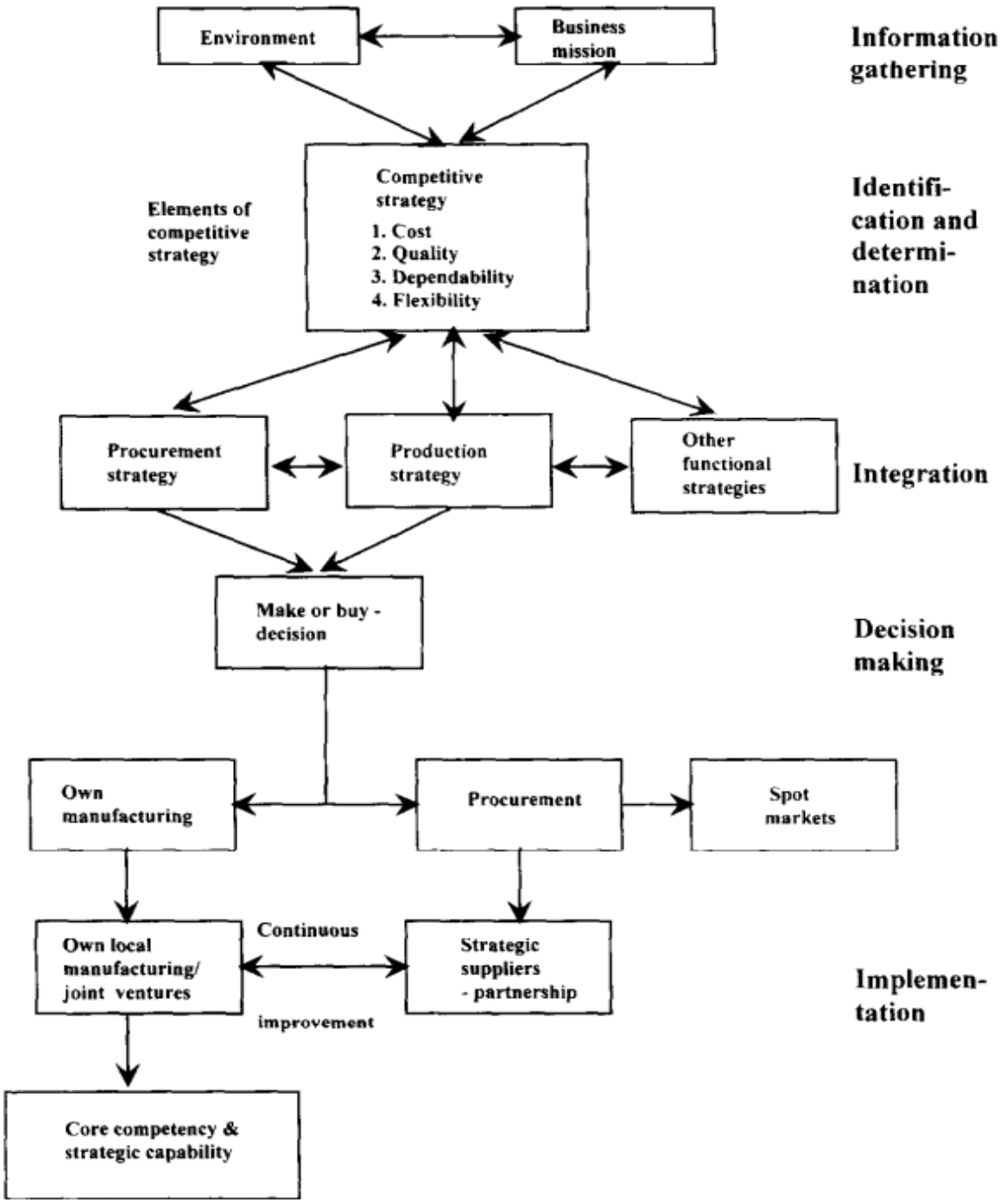


**Figure 7.** Framework for integrated purchasing strategy development. Adopted from Virolainen (1998).

### 2.5.1 Information gathering phase

The first step to developing an integrated purchasing strategy is to determine all the internal and external factors that affect the purchasing function, also described as the environment. For purchasing strategy, the environment includes factors such as the nature of the supply market, logistics, production strategies, production processes, function in marketing, organizational goals, customer service requirements, government laws and regulations, competitive position and the economy in general. These factors can be divided into 4 different groups: supply and sales markets, production conditions, profitability and finance, and institutional factors. The environment also represents the many uncertainties that the management must accomplish to accommodate, and as changes emerge in the environment, the management should adjust their strategies accordingly. (Virolainen,1998) These factors and the emphasis of the different factors vary depending on the individual organization.

### 2.5.2 Identification and determination phase

The identification and determination phase consist of multiple steps in which the organization identifies the desired value chain position, analyse the supply markets, identifies the strategic decision-making hierarchy of the organization, and lastly, identifies the organizational structure to carry out the strategic development. (Virolainen, 1998)

Value chain position refers to the mission and the strategic objective of the organization within a market. For example, one organization can carry out every process that is required to turn raw materials into delivered end products internally, where as another organization can operate as a subcontractor for a subcontractor. According to Lamming & Cox (1995) organizations should ask themselves during this process whether they are satisfied with the current position, should they to increase it, or to change the value chain position completely. Such factors need to be identified and considered as the strategy development process proceeds.

By analysing the supply market, the organization can assess and identify the available external resources. Factors such as the quality, quantity, risk, technology, etcetera, need to be addressed. Also, the power of the organization within the supply market needs to be identified. For example, the amount of available potential suppliers will have a direct impact on the strategic options available for the purchasing organization.

For the developed purchasing strategy to be successful, the purchasing managers need to identify the decision-making hierarchy of the organization. Hesping et al (2015) propose that there are five levels of strategy development in purchasing. At the highest level is the firm strategy that controls all functional strategies, such as the manufacturing, marketing and purchasing strategies. Further, these functional strategies, for example, the purchasing strategy will control supplier category strategies, that control tactical sourcing levers, which ultimately control the individual supplier strategies. The underlying notification is that the purchasing managers cannot establish successful individual supplier strategies unless it is ultimately supported by the overall firm strategy.

Last step is to identify the organizational structures, so that the strategy development can be facilitated. Organizational structures affect notably how activities are carried out within the purchasing department, but also between purchasing and other functional areas. Organizational structure also affects for example how authority is delegated, responsibilities, and communication patters between functions.

### 2.5.3 Integration phase

As the fundamental purpose of purchasing is to provide the organization operations with a constant and reliable flow of materials and services, the purchasing strategy and other functional strategies must be consistent with another, most notably with the production strategy. The basic elements of the manufacturing strategy - cost, quality, dependability and flexibility – are optimized to support and satisfy the organization competitive strategy (Buffa, 1985). There are undoubtedly also other elements that need to be considered when developing manufacturing and purchasing strategies, but these four basic elements are often critical ones. Purchasing strategy should be integrated to support the production strategies, simply put, if the production strategy emphasized quality and flexibility over the price of the product, the purchasing strategy should also be built on such premises. Purchasing is often viewed as the link between external suppliers' capabilities and the internal requirements of the organization competitive and production strategies. Watts et al., (1995) have proposed a framework in Figure 8 for integrating the purchasing strategy with the manufacturing strategy, so that they act together to support the overall competitive strategy.

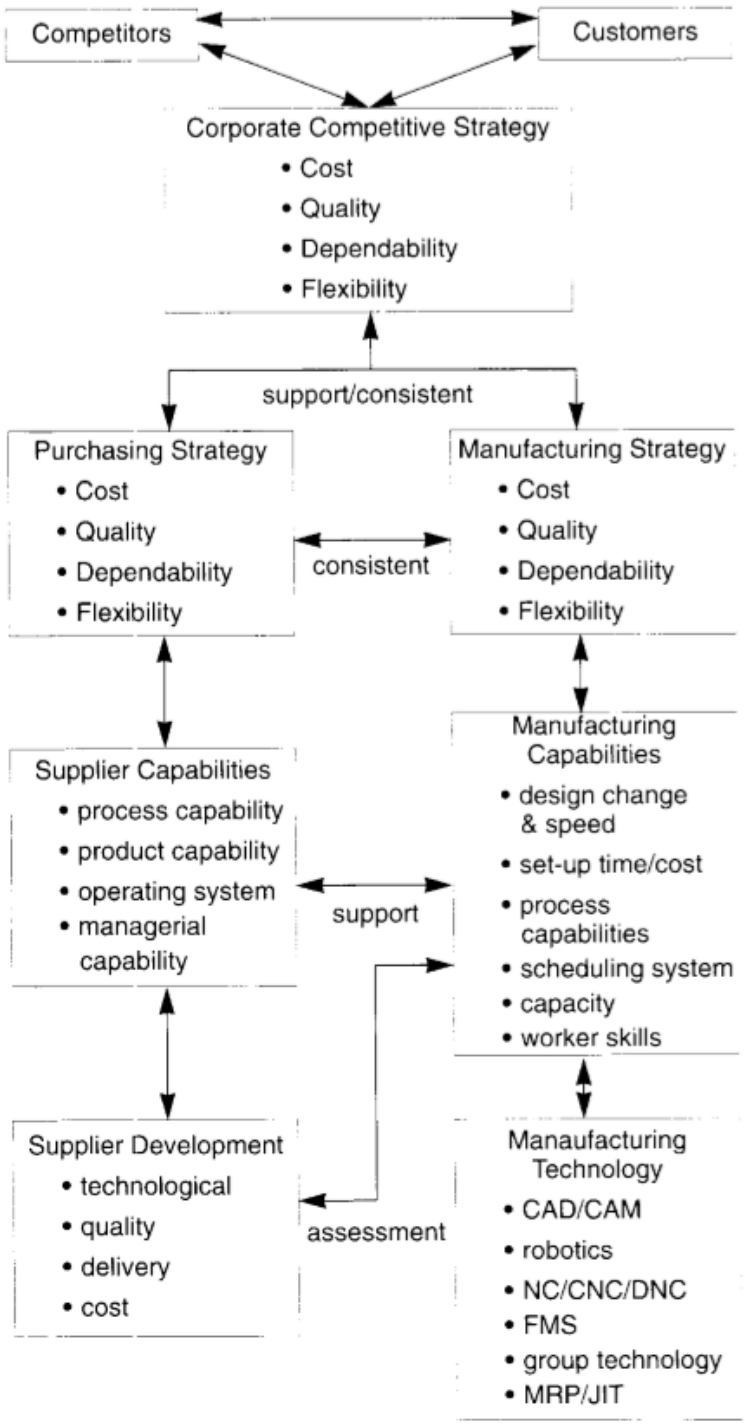


**Figure 8.** Linking the purchasing strategy. Adopted from Watts et al., (1995).

### 2.5.4 Decision making phase

As there are many strategic choices available, the organization must be able to choose the purchasing strategies and tactics that suit and support competitive strategy and other functional

strategies the best way possible. When it comes to purchasing strategy, the biggest decision often can be viewed to be the make-or-buy decision, as it will have a great impact on the organization structure and its processes. Whether the organization should product products or parts of the product internally or externally is ultimately decided by multiple factors, which are ultimately organization dependent. Make-or-buy decision is a multicriteria decision making process that includes both qualitive and quantitative factors that need to be addressed holistically to obtain the best achievable outcome. For example, factors that favour manufacturing the product internally include low production costs, desire to integrate operations, direct control over production and product quality, secrecy in new product design, unreliable or uncapable suppliers, control over lead time and inventories, too small production quantities to attract suppliers, using excess plant capacity to eliminate idling, or political and social reasons (unions, tariffs, etcetera). Vice versa, factors that favour producing the product or part externally include the lack of expertise within the organization, lower total costs, supplier specialized know-how, small volume requirements, insufficient production facilities, desire to use multi-sourcing, brand preference, or the fact that the product is not essential for the organization strategy. (Burt et al., 2003; Wisner et al., 2005) When calculating costs for different strategic options it is important to include all the costs that will be generated. For example, purchasing a product externally includes costs such as the price of the product, transportation costs and inspection costs, but also the costs generated by the purchasing function and the follow-up costs caused by quality defects, service, dismantling, etcetera. To improve the cost calculation process concepts such as the Total Cost of Ownership can be applied (Ellram, 1995). Further, some academics suggest that the make-or-buy decisions should be based on the core competences of the organization (Quinn & Hilmer 1994). Such method allows organizations to focus on their true core competences by outsourcing all the non-critical processes. As the benefits of such method are well documented, it seems that the best way to support the make-or-buy decision making process is to combine multiple approaches. Like Arnold (2000) state, the transaction costs economics and the core competencies approach complement each other, as the operative cost and the strategic long-term aspects of those approaches are brought together.

As the initial make-or-buy decision is made, the next phase consists of choosing the most suitable sourcing approach from a category of options (Virolainen, 1995). The three main categories include insourcing, internal outsourcing, and external outsourcing. Insourcing means that the organization will make the product internally and use internal hierarchy to lead

the process. Within internal outsourcing the organization will establish independent profit units instead of hierarchical departments. This is to increase efficiency by making the market element relevant within the organization (Kruger and Homp, 1997). Internal outsourcing also includes joint ventures (common service companies) and direct capital investments, that are conducted to integrate the horizontal cooperation of independent organization. External outsourcing includes everything between deep relationships suppliers and cooperation to using competitive bidding and spot-markets. For example, if formal coworking includes relationship specific investments, it still is classified as external outsourcing, but if the buying organization owns even a tiny portion of the supplier, it is classified as internal outsourcing. The organization needs to be aware of the multiple choices available to them. Which option the organization chooses will depend on the information gathering and analysis conducted earlier. The options category is displayed in Figure 9. (Arnolds, 2000)

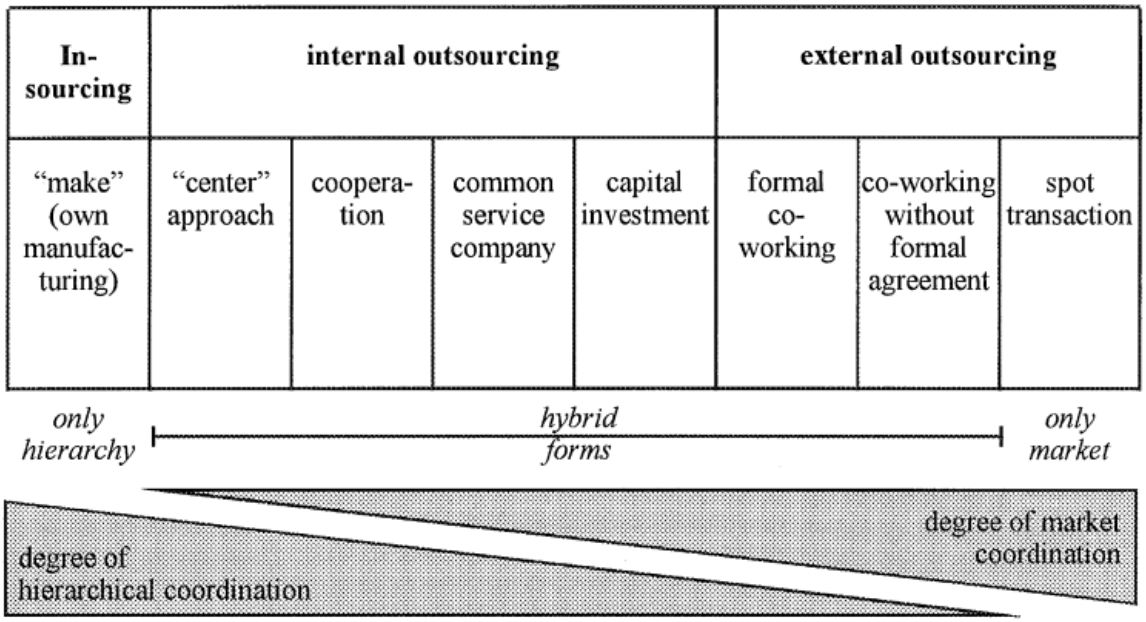


**Figure 9**. Alternatives of outsourcing. Adopted from Arnolds (2000).

### 2.5.5 Implementation and measurement phase

After the purchasing strategy has been developed, the final phase is to implement the strategy to the organization. As the finest strategy is ultimately useless without implementation, special

attention should be given during this phase. In general, purchasing strategy implementation to be successful, the top management should be concerned with topics such as appropriate resource allocation, individual objective setting, communication, training and motivation with the organization (Virolainen, 1995). Also, the essentiality of the middle management during implementation should be emphasized, as they play a crucial role in strategy implementation (Guth & Macmillan, 1986), and measurements should be established so that the effects of the strategies can be assessed. Beer & Einstad (2000) have listed six 'strategy implementation killers' that are: (1) Top down and leissez-faire ("let-them-do") senior management style, (2) Unclear strategy and conflicting priorities, (3) Poor vertical communication, (4) Poor coordination across functions, businesses and boarders, and finally, the most commonly identified factor, (5) An ineffective senior management team. It could be argued that successful strategy implementation requires well developed integrated strategies that are communicated clearly and openly throughout the organization. As successful strategy development requires inputs from all organizational hierarchy levels, the information should also flow freely upwards. It seems that the role and capabilities of top management, and the nature of information flow and communication within the organization are essential preconditions for successful purchasing strategy development and implementation. Beer & Einstad (2000) state: "*Successful implementation needs more than a leader; it requires teamwork from a leadership group that, through dialogue and collaboration, stays connected to the knowledge embedded in lower levels*" – which in return enables the organization to further develop sharper strategies, as more information is available.

## 3. Case Scania Suomi Oy

Within this section of the research the case company and its core business processes are presented and analysed. Firstly, the basic information regarding the case company is presented. Next, the overall picture of core processes is drafted. Note that even though almost every vehicle will be manufactured according to a specific customer order, resulting in different workshop activities and the usage of multiple specialized suppliers, some general supply chain paths of new vehicle sales can be identified. After visualizing core processes, problematic factors within the core processes are bring forth, and affecting factors discussed. Lastly, there will be practical propositions of how the order-to-delivery process could be enhanced. As the case study moves onwards, the same processes and the identified problems are presented more

in depth. Before moving on to the actual empirical section, the research methodology and the material are discussed shortly.

## 3.1 Research material and methodology

This thesis is conducted as a qualitative single case study. As a research method, the case study provides good tools for investigating how and why questions, but also methods for new theory development, testing and refinement. Case studies can lead into new creative insights and theories as the researchers are not constrained by inflexible research models when they are exposed to complex managerial problems. In many occasions, drawing conclusions that are generalisable from a limited number of case studies can be challenging to accomplish. (Voss et al., 2002)

The material for the case study section of this research is mainly collected through interviewing the case company personnel. The positions of the interviewees within the company range from vehicle salesperson to project manager, and from regional director to members of the executive board. Also, some of the material is captured from meetings and casual conversations with the employees. None of the interviews were recorded on tape, although extensive notes were taken. Not recording the conversations enabled the interviewees talk freely about the possible problems that they might have experienced concerning the research questions. The interviews took place in Scania Suomi headquarters in Helsinki during the summer 2017. The interviews were held in the office of the interviewee or in a negotiation room, so that there were no interruptions. The interviews were semi structured, allowing the interviewees to express themselves better without losing the focus of the interview. Some of the personnel were interviewed more than once as the researcher gained a better understanding of the overall situation and was able to formulate more accurate questions. In addition to the materials gained through interviews and conversations, data from case company intranet was collected. For example, excel sheets, reports and interorganizational presentations were used to formulate the process descriptions. All in all, the researcher spent multiple months at the case company, so that the processes could be mapped, and all the affecting factors would be taken into consideration

## 3.2 The case company

The case company, Scania Suomi Oy, is a Finnish commercial vehicle company that sells heavy trucks and buses, specialized engines, and offers maintenance and financial services. The annual turnover is around 250 million euros, and the company employs approximately 550 people in 26 different service and sales points located around Finland.

Scania Suomi Oy is fully owned by the Swedish truck and bus manufacturer Scania CV AB, that has a turnover of around 10 billion euros and employs over 45 000 people in 100 countries. As of 2014, Scania CV AB has been fully owned by the Volkswagen group.

Scania is one of the oldest commercial vehicle brands as it began operating in 1891 in Södertälje, Sweden, where the company HQ and main production site are still located. The Finnish subsidiary, Scania Suomi Oy, began operating in 1949 when the first Swedish commercial vehicles were imported to Finland. Scania Suomi Oy was the leader of the Finnish heavy truck market in 2017 with a market share of 34,1% and 968 delivered trucks.

New vehicle sales business model in the case company is mostly based on the design of the vehicle and coordinating the contractual relationships between supply chain members. Even though the case company carries out some manufacturing processes relating to the sales of new vehicles, most of the added value will be derived from combining and coordinating the purchasing activities. The truck cabin, powertrain and chassis are ordered from the parent company factory located in Södertälje Sweden, and the superstructure of the vehicle, paintwork, additional equipment, etcetera, are purchased locally in Finland. The product portfolio of case company is vast, as almost any type of superstructure can be built on the various platforms that the case company provide. The end products are used for example in retail, forestry, construction, manufacturing, courier, petroleum, chemicals, agriculture, mining industries, airports, and by public institutions, such as fire departments and militaries. The sales of new vehicles generate around 70% of the total revenue, whereas the post-sale services make up the remaining 30% of the total revenue. Post-sale services include for example vehicle maintenance and repair, spare parts sales, remote access services to the on-board-computer, and the Ecolution-program, in which drivers are trained, and vehicles are optimized according to the transported goods and predefined routes. Since Scania is one of the most expensive brands on the market, post-sale services are very important to the case company business

model. The strategic objective is to offer superior service in terms of coverage of the service network, spare part inventories, service quality, service point open hours, roadside assistance, etcetera, so that the vehicle uptime of the customer can be maximized.

**Picture 1.** Scania tractor-trailer equipped with timber transport superstructure.

### 3.2.1 The Finnish road transport market

Road transport is the most common transportation type in Finland, as more than 90% of the goods were transported on rubber wheels (Pöllänen et al., 2007). Road transportation industry is one of the biggest employing industries in Finland, employing more than 150 000 people, including around 70 000 truck drivers. According to the Finnish Transport Agency there are around 10 200 companies registered in Finland as “road transportation of goods”, with a combined turnover of 5,7 billion euros, amounting to an average of 560 000 euros per company. This means that the average size of a Finnish transport company (i.e. the customer) is quite small; more than 50% of the 10 000 companies employ only 1 person, and 30% employ 2 or 3 person. The Finnish transport industry is networked in its nature, as many of the smaller companies work as subcontractors for big transportation service providers and forwarding agencies, such as Posti Group or DB Schenker. These large service providers also have some

vehicles of their own, but most of the vehicles are owned and operated by the smaller subcontractors. (Rajamäki, 2014)

The competition in the Finnish heavy commercial vehicle market is mainly divided between three different brands; Scania, Volvo and Mercedes-Benz. Scania and Volvo have been competing for the market leadership for the past 10 years, as they both have markets shares varying between 30-40%. Mercedes-Benz typically achieves market share between 15-18%. There are also other brands on the market, such as MAN, DAF, Sisu, Renault and Iveco, but none have achieved market shares of over 5% in years. All other brands use a supply chain structure similar to case company, in which the vehicle is produced abroad by a parent company and the superstructure is bought locally from specialized superstructure suppliers. Sisu is the only company that assembles the vehicles and superstructures themselves, providing customers 'ready-built' vehicles for different segments that limit the product customizability considerably. Taken into consideration their market share and historical financial performance, this has not proven to be a successful strategy, suggesting that the customers of the commercial vehicle industry appreciate the diverse vehicle customization options that the other type of supply chains structure offers.

The annual truck sales reflect the general economic situation; 5211 commercial vehicles registered in 2008, but only 3174 in 2009 following the economic downturn (Trafi, 2017). The correlation between economic situation and new truck sales is because around 55% of the total transports are carried out for industrial needs and around 15% for construction industry needs (ALT, 2014). The commercial vehicle industry can be described to be cyclical. This cyclical nature of commercial vehicle industry increases the need for long-term planning if the companies are to remain profitable also during the economic downturns.

## 3.3 Core processes

The core processes of the case company can be divided into three sequential steps. These include the (1) Sales Process, (2) Order to Delivery Process, and (3) Service Delivery Process.

The sales process is best described as back-and-forth loop of discussion between the customer, vehicle salesman and the external bodybuilder. The initial meeting between the customer and

the Scania Suomi salesperson aim to outline what the customer needs. The technical specifications of the vehicle will depend on the intended use of the vehicle. Multiple vehicle specifications, such as the engine power, number of axles, cabin type, frame type, etcetera, will be chosen according to the planned cargo type, cargo weight and the drive terrain. In addition, the customer can use their knowledge of their specific driving routes to optimize the vehicles further. The equipment possibilities are almost endless, the customer can choose to install extra lights, doors, tool boxes, power tools, cranes, separable forklifts, automatic snow chain systems, pumps, winches, etcetera. In general, as the amount equipment increases, so does the lead time. As most of the customers already own a commercial vehicle, it is often used as a baseline for the new vehicle design. After the salesperson and the customer has agreed on a preliminary vehicle design, the salesperson will contact 2-4 bodybuilders to receive quotations. As the quotations are received, the salesperson will mediate the best offers to the customer and they will overview them together. In many cases, at this point some changes are required by the customer, and updated quotations are requested from the bodybuilders. Once every party is in an agreement, and the customer fulfils the financial requirements, the sales order is signed. At this point the final price of the product is defined, and the delivery date estimates are given to the customer. The sales process is finalized as the customer signs the sales order, and the Order to Delivery (O2D) process will begin.

When simplified, the O2D process includes some 20 sequential phases conducted by multiple actors. Although almost every salesman has their own way of conducting this process, a general pattern can be recognized. The common pattern is best described in a process chart, after which individual phases are discussed further. Note that the process chart is dependent on the vehicle in question, and in many cases some phases might be unnecessary, or that they are conducted in a different order. The different phases are displayed below in Figure 10.

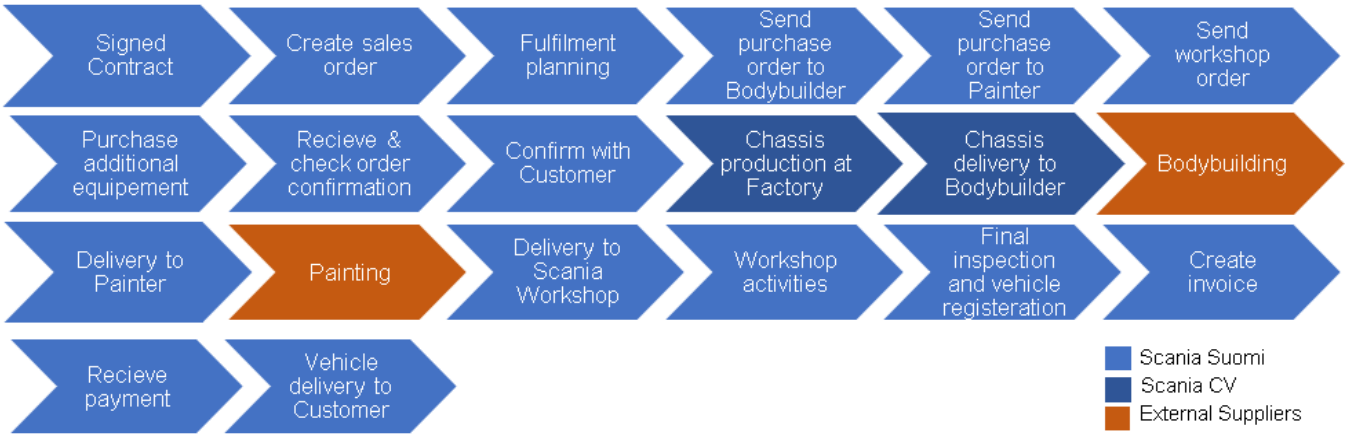


**Figure 10.** Order to Delivery process.

After the contract has been signed by the customer, the salesman creates a sales order in the worldwide ERP system. This application will be used to choose everything that the parent company factory will produce, meaning that the salesperson will choose the chassis, powertrain, cabin, interior options, etcetera, for the vehicle-to-be within this program. As the vehicle is created within the program, the sales person will dictate a desired delivery date for the vehicle chassis based on the estimated availability of production slots at the bodybuilder, or the desired delivery date of the customer. Once the Factory receives the new vehicle order information via the ERP system, the factory will give out on a preliminary delivery date, which will depend on the overall que situation and the vehicle model. Based on the received preliminary delivery date, the salesperson will start to fulfil the vehicle production schedule in terms of bodybuilding, additional paintwork and/or taping, vehicle transport, and to order all additional equipment for the vehicle, such as bull bars, CB-radios, extra running lights, work lights, etcetera. As the preliminary delivery date is approaching, the factory will send out a confirmed delivery date that will be used as the final chassis delivery date. This date will be used to lock in previously arranged bodybuilding slots. As the Factory delivers the chassis to the bodybuilder based on the confirmed delivery date, the bodybuilding can begin. After bodybuilding, most of the trucks are either painted or taped, so that the names of the company and the coalition can be seen. After the visual upgrades, the semi-finished truck is transported to the case company workshop where the sales took place. In the workshop all electrical, hydraulic and pneumatic work will be finished, alongside the final equipment installations. Next, the needed documents are gathered, the truck is registered, and the final inspection is conducted. Before the delivery, the salesperson must be sure that the customer has paid the

agreed amount, after which the finished vehicle is handed over to the customer. Currently the whole O2D delivery process takes between 150 to 250 days, depending on the complexity of the vehicle. Lastly, before moving on to the Service Delivery Process, a detailed flow map of the O2D process is presented, according to Scania CV in Figure 11. Note that the sales order administration is often conducted by the sales representatives.

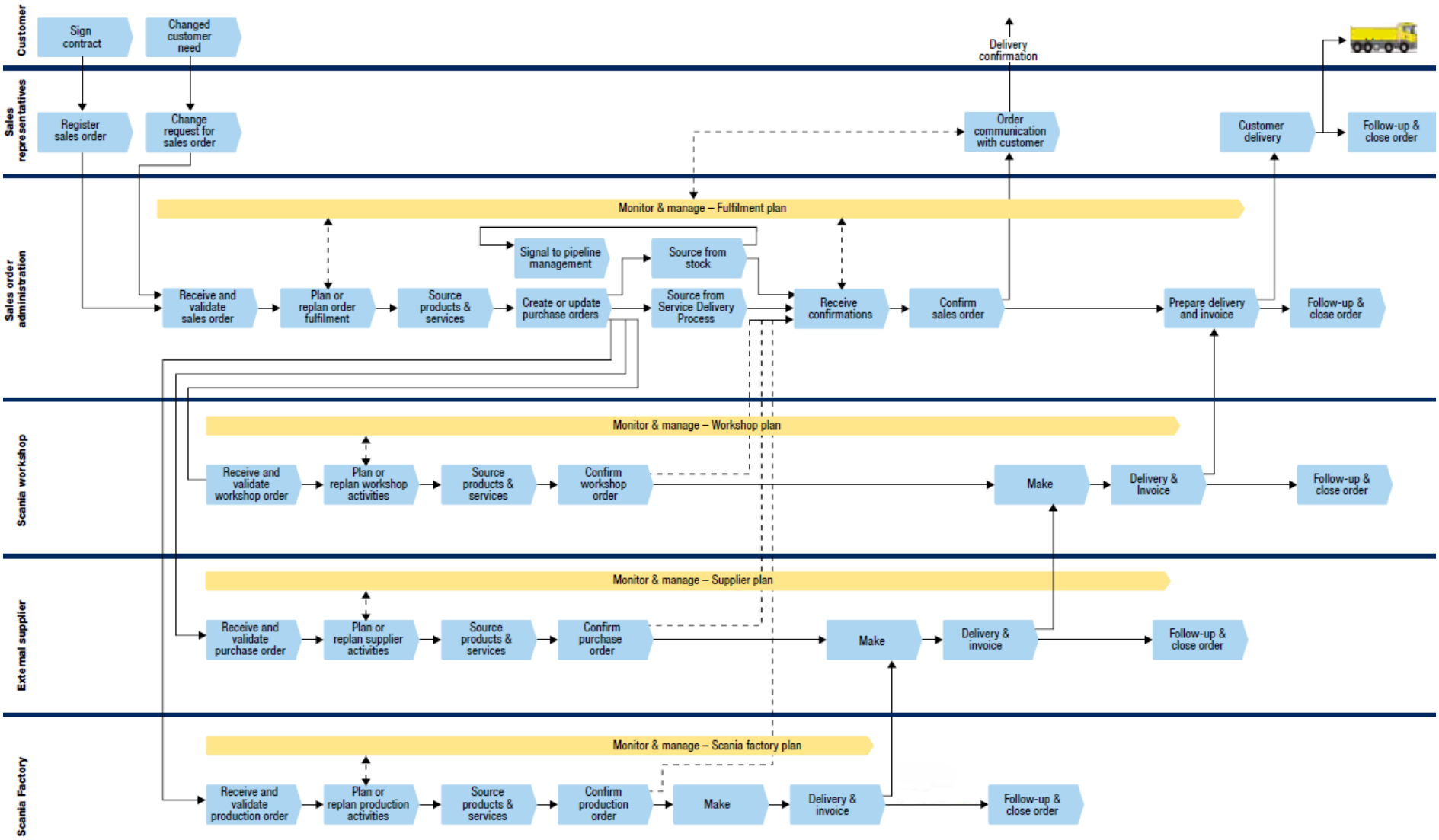


**Figure 11.** Order to Delivery process flow map.

As the O2D process is ending, the Service Delivery Process is about to start. Most of the vehicles will be sold with some sort of service attached to the actual vehicle. For example, the case company offers various adjustable maintenance and repair contracts. When the vehicle is under a repair or maintenance contract, the budgeting of the customer is made easier as the customer doesn't have to deal with sudden repair costs. In addition to the popular maintenance and repair contracts, most of the customers opt for financing services. Further, the case company offers driver training, vehicle optimization and remote access services to the vehicle. With the help of services named above, the customer can decrease fuel consumption, and to optimize the operations of the fleet in real time. The Service Delivery process is essential for many customers, especially when the average size of the customer company is relatively small. For example, if the customer opts for a financing and maintenance and repair contract, all the vehicle relating expenses will be based on a fixed monthly fee, excluding fuel and insurance costs. From the customer point-of-view, successful bids on the transport contracts need to be low enough to be competitive, but high enough to be profitable, and knowing the costs helps this process considerably.

Before the identified problems are presented, a simplified figure is displayed to represent the case company core processes in a manner, that describes the area of responsibility for each producing party and the flow of the processes.

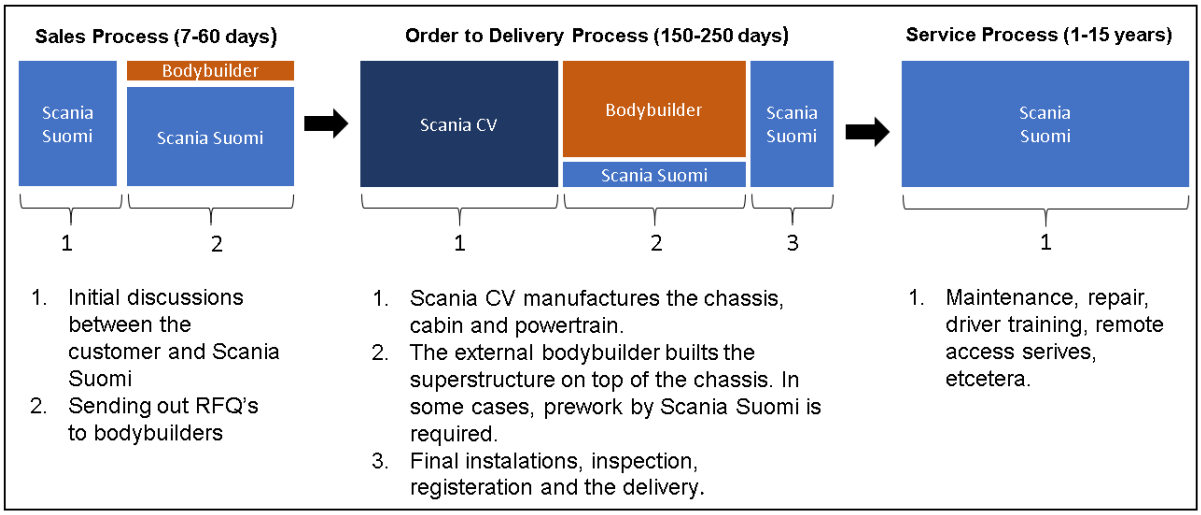


**Figure 12**. Case company core processes.

## 3.4 Identifying problems

Based on the interviews and the material derived from the intranet, multiple problematic factors can be identified within the core processes that ultimately affect the total lead time.

To begin with, many interviewees noted that the Scania CV Factory could develop their production line so that more customization could be conducted at the factory. Approximately 1/3 of the vehicles are transported from the factory to Scania Suomi workshop instead of the bodybuilder, as parts of the vehicle must be moved around so that the superstructure will fit the chassis, or the vehicle is fitted with extra axles. For example, parts like air pressure tanks or the AdBlue tank is in the wrong place and must be refitted. Also switches for work lights, control for the tipper, etcetera, must be fitted into the dashboard at the workshops. In addition to the extra work caused by the dismantling, the quality can be decreased as the chassis is rustproofed and painted at the factory. Any drilling and welding conducted after that can affect the overall quality of the vehicle chassis. This problem will be named as the “Factory problem”.

The first information related problem is that currently the ERP system doesn’t collect any data about the bodybuilders or the superstructures of the vehicles. This means that the delivery performance of the supplier and the lifetime quality of their products are estimated on subjective basis, instead of service history and actual delivery data. Although most of the salesmen are very familiar with the bodybuilders, statistical analysis often provides the most accurate results. This problem will be named as the “Data problem”.

The other problem regarding the information within the O2D process is related to its control and decentralization. The problem itself consists of multiple smaller problems, but since they all share the same solution, they are merged together. Firstly, at the current moment the information transfer is hard work. For example, when budgeting or reporting the monthly sales, the finance department must go around the salesforce and ask them when their vehicles will be delivered and invoiced. Or when the vehicles are coming back to the workshops from the bodybuilders, the tracking is done manually on a large whiteboard. Every attached paper represents a specific vehicle, and they include the bill of materials needed for the final installations. As a result, the salesforce must walk down to the workshop to move the “vehicle” on the board, and to print a new paper every time a change occurs in the

equipment required by the customer. Secondly, much of the O2D process information is transferred between actors in a verbal manner. There are benefits to this type of communication, but it also jeopardizes the process for human errors. In addition, Scania Suomi has signed frame contracts with some of the bodybuilders, and such contracts include a condition about late delivery penalties, but to prove the late delivery is difficult if the delivery dates are discussed over the phone. Thirdly, there is no centralized or unified way of controlling the O2D process and information related to it. Much of the salesmen work time is spent on managing the O2D process and keeping all the stakeholders updated on the progress. This problem is named the "Control Problem"

The forth problem can be identified as lack trust between the supply chain members. This is due to the fact that as the processes required to manufacture a vehicle vary considerably, so does the production lead times. As a result, production lead times are sometimes difficult to estimate correctly, and small delivery delays do happen. The risk of delays is countered by establishing temporary inventories between the processes. There were no data available to analyse the problem in depth, but according to the interviews, the supply chain members typically protect their own production schedules by adding multiple days to the estimated delivery date. Given the number of parties involved, this mistrust towards delivery dates between the supply chain members is likely to increase the total lead time significantly. This problem is will be named as the "Trust problem".

Based on the identified problems, a common factor can be discovered, that is there doesn't appear to be strategic focus towards the O2D process management. At the current moment no one doesn't seem to be looking at the process as a whole, but the personnel are focusing on their specific responsibilities. As a result, different dealerships will organize their processes differently, but more importantly, the possible improvements gained through systematic supply management are lost. According to Scania CV internal material, the sales organization is responsible for appointing preferred suppliers, securing capacity, and agreeing on price and lead time. In other words, the Sales organization is responsible for supply management, but according to the salesmen, the communication with the suppliers remains solely on transactional level, and that there are no strategic objectives regarding supply chain management. There is no shortage of suppliers in any superstructure purchase category, and competitive bidding is used for every vehicle. The framework contracts mentioned earlier were developed by the former purchasing manager many years ago, and they have not been revised since then. The current purchasing manager is mostly concerned with MRO-purchases (Maintenance, Repair, Operating), and doesn't have the required time to take on any additional projects. This problem will be named as the "Management problem".

## 3.5 Analysing problems

From the case company point-of-view, the first problem is located at the Scania CV factory production lines. As the production line is purposely built to serve large markets instead of niche markets like Finland, the customization level available is not ideal for the case company, as they require abnormalities like reinforced double frames, specialized placement of hydraulic and pneumatic tanks, and additional dashboard switches and fuses. The things are further complicated by the launch of the new range that is being produced side-by-side with the current range of vehicles. As a result, the factory production line is facing difficult times; the average delivery time for vehicle chassis is around 8 weeks, but currently it is somewhere around 20 weeks. In addition, the information systems sometimes don't work accordingly. For example, technical 3D-drawings are missing for some vehicles and must be sent manually. Although these issues have been noticed by the management and are mostly momentary, they have a considerable impact on Scania Suomi core business processes. For example, the customization available at the factory level has a great impact on the production flow, as the chassis are transported around workshops, in which some preliminary and final electric, hydraulic and pneumatic work will be conducted. In addition, additional axle installations which are common in Finland, are centralized to one specific workshop, meaning that the chassis can travel a great length before they reach the yard of the bodybuilder. If the factory was able to allow a greater degree of customization, almost all the vehicles could be transported straight from the factory to the bodybuilder. Given that the factory line is built to serve multiple large markets instead of one relatively small one, a customization workshop could be set up right next to the factory production line. This way the production line wouldn't be impacted, and the vehicle customization could be conducted in a centralized manner. The customization workshop overheads could be controlled if the workshop would serve multiple markets that have similar traits as Finland, such as Norway and Sweden. In addition to the production flow improvements, when operations and purchases are being centralized, the economies of scale and specialization would likely start to have an effect.

The Data problem deals with the lack of bodybuilder delivery performance and quality related information. As a result, the statistical ranking of suppliers is made impossible. The sales department appoints preferred suppliers, but it is done on a subjective basis, because no statistical data is collected. The sales department uses competitive bidding for most vehicle superstructures from bodybuilders that they have personally ranked as "good enough", but since there is no data about the delivery performance and overall quality, every factor isn't taken into account. For example, the

workshop service history records usually don't include any information about the superstructure manufacturer. If the superstructure and trailer workshop service data could be sorted and searched based on the name of the supplier, the case company would be able rank the suppliers more precisely in terms of quality. Such knowledge could be further used for example to rank the suppliers, help the customers make better superstructure related purchasing decisions, or to share the accumulated information with the suppliers to help them to develop their products. In any event, the possession of such supplier related data would only be beneficial. The case company should estimate how difficult such modifications to the ERP system would be, and then reassess the potential risks and costs against the notable benefits.

The Control problem causes a lot of work that doesn't produce any additional value. For example, a significant amount of the salesmen worktime is spent on keeping the stakeholders updated. In addition, much of the Order-to-Delivery related information is exchanged verbally, and much of the information is stored in a decentralized manner. As a result, the risk of human error is increased, and the success and progress of the Order-to-Delivery process is dependent on the individual salesman. The whole process could be moved into an electronic format, which would be linked to the ERP system. This sort of project portfolio management system could be beneficial if it was developed properly. First of all, the sales department would have a proper control tool, as currently the salesmen use mainly to-do lists, calendar and the human memory to control the O2D process. Secondly, it would eliminate the need to communicate the sales department invoicing forecast, to move the papers on the whiteboard etcetera, since the people that actually need the information could simply go receive it themselves. 3D drawings, Bill-of-Materials, etcetera, could be easily distributed within this channel to all necessary parties. Thirdly, the system could be used to gather information about the supplier delivery performance as the O2D process progress would be updated actively in a unified manner, and it could be a valuable input for the supplier ranking and development process. Lastly, back office support could be used to update the O2D process progress, so that the salesmen could focus on the actual sales process and bring in more revenue. The parent company is developing such software, but as of 2015 the project was suspended. Although there are rumours that the project is being restarted, it will probably take some years before they are able to launch it worldwide. The case company must either wait and hope that all the necessary features will be built in by the parent company, or they can start to develop their own.

The fourth problem is named the trust problem, because the delivery date estimates are not trusted between the supply chain members. As the production processes vary depending on the individual

vehicle, accurate delivery dates are sometimes difficult to estimate. To ease the situation, there are inventory days scheduled into the beginning of production to act as a buffer against late deliveries between the different Order-to-Delivery processes. Establishing buffer inventories will help the individual parties to run and schedule their production but can increase the total lead time considerably. Project management IT systems could be extended to cover the whole supply chain. As of now, such system is only used for factory deliveries. In the parent company web portal, the external suppliers can access the factory database to see the status of the vehicle, the delivery dates, technical drawings, etcetera. This will help the bodybuilders schedule their production based on easily accessible real time data and notify automatically if any sudden changes occur. Development of such software would include costs, and these costs should be estimated against the potential benefits. Establishing such information transfer capabilities with every bodybuilder would likely be unprofitable, but it is an option that should be examined further.

Lastly, If the case company is to improve their order to delivery lead times, they should start to manage their supply chain actively. Since the delivery performance of the case company is dependent on the delivery performance of the bodybuilders, relationships should be established so that the processes could be optimized between the supply chain members. In addition to external supply chain management, there are factors that can be improved within the internal processes of the case company, such as the division of labour together with information collection and transfer. In order to mitigate problems and improve processes the case company should provide top management support alongside with decent resources, such as personnel and a budget for the potential software development.

| Problem | Description | Affecting factors |
|---|---|---|
| Factory problem | Too few customization options at the Scania CV Factory increase Scania Suomi lead times, external spending and may decrease quality. | 1. Scania CV factories are optimized to serve the largest markets.<br>2. Production line modification can increase risks that outweigh the potential benefits.<br>3. The factory is already occupied with challenges that the range of the new vehicles has caused for the production line. |
| Data problem | The ERP system doesn't collect any data related to the bodybuilders or their products. Statistical ranking of suppliers is impossible. | 1. Making changes to the ERP system can include significant risks and costs.<br>2. Scania Suomi doesn't seem to recognize value in such data. |
| Control problem | Order-to-Delivery related information transfer requires a significant amount of work, verbal contracts, information decentralization. | 1. The traditional way of working and organizing acitvities works.<br>2. Developing or adopting new software is expensive and time-consuming.<br>3. Change resistance. |
| Management problem | External suppliers control some of the key processes and have a substantial impact on the end product, yet the relationships remains mostly on a transactional level. | 1. Requires additional resources and personnel.<br>2. Relationships are dyadic and evolve over time. |

**Figure 13**. Problem description and affecting factors.

## 3.6 Contemplating additional ideas

Some academics suggest that postponement could improve the total lead time significantly, meaning that semi-finished products would be modified according to the individual customer order. This may be true in many situations, but it wouldn't fit the case company business model. The reason is simple; there are at least hundreds of choices for the vehicle setup from the factory. For example, for the 949 vehicles sold last year around 450 different vehicle setups were used, and even if case company could order some chassis in advance and eliminate the 8-20-week lead time, that is frowned upon by parent company as they don't want any additional inventories to be established along the supply chain. In addition, the superstructure customizability is reportedly very important for many the customers, so that modifying semi-finished superstructures wouldn't be viable due to the manufacturing methods. The case company has recently offered ready-built vehicles in some of the simplest segments, but they haven't been commercially successful due to the wide spectrum of customer requirements. Further, this type of production strategy would increase the capital requirements as the case company would have capital tied down to the vehicle throughout the manufacturing process, but also the time it is required to sell the vehicle. Since the customers appreciate the vast design options available, and the case company wants to keep the tied down capital to the minimum, postponement or ready-built

vehicles doesn't seem to be the answer. Lastly, increasing modularization is unlikely to shorten the order lead time considerably since much of the production is already based on modules. The parts that are not modularized are manufactured according to the specific order to enable the great amount customization options. In other words, increasing modularity further would likely decrease the amount of design choices available for the customer.

Developing strategical cooperation with a limited number of bodybuilders could provide significant benefits. Simplistically, to complete projects faster, the speed of each sequential processes can be increased, or the sequential processes can be conducted simultaneously. The trouble with the first option is that it often follows the curve of diminishing returns; there is a limit to how fast a person can weld, drill, etcetera. Alternatively, to examine the latter possibility, an extensive knowledge about all the sequential processes is required, because it would likely require process modifications at both ends. Such information is hard to come by without trustworthy and strategical relationships with the suppliers. In other words, strategic cooperation with the suppliers seems to be a precursor to process development after a certain point. For example, if the superstructure could be built on a subframe or a jig, the superstructure could be simply lifted on the chassis as it arrives from the factory, but as stated, it is likely to require process modifications at both ends. Further, in addition to conducting processes simultaneously and increasing supply chain performance, strategical cooperation could provide competitive advantage. As the super structure is an integral part of the vehicle, it should be considered as such. For example, the Delft University of Technology in Netherlands host a platform which aims to decrease road transport fuel consumption by 20% by increasing aerodynamics of the superstructure and trailer. The parent company invested around billion euros to lower the fuel consumption of the new vehicle range with 5%, whereas fuel consumption can be decreased 10% at highway speeds with roof deflector and trailer side wings. The case company could gain significant competitive advantage over their main competitors by providing more fuel-efficient products to their customers. Theoretically, with the new vehicle range and the aerodynamic superstructures, the case company would be able to produce vehicles that use 10-15% less fuel than their competitors. Such savings in fuel costs equals to around 3-5% at the customer bottom line, as on average fuel costs make up around 30% of total costs for the case company customers.

One solution that hasn't been examined properly, is at the heart of every strategic purchasing decision: the make-or-buy decision. Until recently the case company used to outsource all bodybuilding, but in 2014 the case company won the public tendering of some 200 trucks to be sold to the Finnish Defence Forces. As a result, the case company started installing superstructures in their Jyväskylä workshop.

The remaining trucks will be delivered during this year, but at the end of this year there will be an industrial building suitable for installing superstructures. It can be used as a maintenance facility also, but the case company should actively think about assembling or manufacturing the superstructures instead of outsourcing, at least in some segments. For example, much of the container-handling equipment or timber truck superstructure could be purchased from suppliers and installed in a case company workshop / bodybuilding site. If the case company would install the superstructures themselves, it would include many significant benefits such as increasing the control over the order to delivery process to decrease lead time, increased turnover and profits. Especially as the superstructure makes up on average some 15-40% of the total costs. It could be easier to optimize production, develop the products, cut costs by eliminating duplicate work throughout the supply chain, etcetera, if the bodybuilding would be conducted internally. In addition, the bodybuilders don't seem possess any information that the case company couldn't possibly gain, because many superstructures are not technologically that advanced, in a sense they just have to be built. Undoubtedly there is a learning curve, but when compared with the average size of the bodybuilders that the case company uses actively, the turnover can be 10-100 times greater than the external bodybuilder. This great power imbalance enables the case company to access information through acquisitions, or to develop a flexible and efficient state of art production line themselves. Further, as the case company market share is over one third of the overall markets, there would be a lot of manufacturing work available, if the superstructures would be steered into the case company bodybuilding workshop. According to a salesman, although few customers require a certain bodybuilder for their vehicle, most customers don't care about the bodybuilder company name, but focus on the design, the quality and the price. This means that guiding customers towards Scania superstructures could perhaps be accomplished, especially as most of the customers already do think highly of the brand. Moving from "buy" to "make" strategy has been already being proven successful by the bus segment; in 2014 parent company bought Lahden Autokori, an unprofitable company that used to specialize in bus superstructures. Three years after the acquisition, the parent company had turned the newly founded company profitable and established total control over all processes.

Finally, the case company could gain valuable lead time related information quickly and cheaply, if they were to conduct root cause analysis on some of the already delivered vehicles. Within the inventory report, even after the demonstration-vehicles used in marketing were sorted out, one can see multiple vehicles that has spent inexpiable periods of time before being invoiced, that increase the total average of inventory days notably. Such delayed cases shouldn't be forgotten, they should be opportunities for learning. For example, the sales department could organize a training day in

which some of the cases would be analyses, so that similar situations could possibly by avoided in the future.

4. Developing an action plan

In this chapter, an action plan is developed based on the finding of the case study. The intent of the proposed action plan is to increase supply chain orientation and to begin implementing supply chain management at the case company. The underlying notion for increasing supply chain orientation and implementing supply chain management at the case company is due that most of the revenue is generated by coordinating the new vehicle sales process, yet it receives little to none strategic attention. The situation further complicated as the case company heavily relies on the delivery performance of the suppliers, as external purchases form a significant proportion of the final product. Next, the findings of the case study are reflected against the theoretical background, and an action plan in developed and proposed to decrease lead times and improve supply chain performance at the case company.

To enable supply chain management implementation at the case company, top management commitment has been identified as one of the most important antecedents for successful supply chain management implementation (Lambert et al., 1998; Rodgers et al. 1993; Mackness 1991). As the implementation of supply chain management would require changes for example in the working routines and the information systems, appropriate resources should be allocated to support the implementation process. In addition, the management should communicate the need for improvement throughout the company to decrease possible confusion or false impressions amongst the personnel. Effective communication by the management has been identified as a major factor in various implementation processes (Aladwani, 2001; Fui-Hoon Nah et al, 2001).

Proposition 1: Top management commitment. Communicate the need for improvement throughout the organization and dedicate appropriate resources.

After the top management has committed to supply chain management implementation, a cross-functional and -regional team should be established to discuss the various processes that the supply chain management implementation will affect. The team should include personnel for example from sales, IT, purchasing, finance, marketing and technical support, so that all the necessary and valuable opinions and insights will be considered. Establishing a cross departmental team could also ease the

internal integration of processes, as currently a departmental mindset prevails. As the implementation of supply chain management requires the integration of processes from sourcing to delivery (Cooper et al. 1997), it is essential that every relevant department is represented (Chen et al., 2009). Internal integration of processes is the foundation of external process integration (Stevens, 1989).

Proposition 2: Establish a cross-functional team to increase internal integration and to begin implementing supply chain management.

The newly appointed team should conduct a spend analysis of the superstructure purchases and attempt to divide the superstructures into individual segments. As the case company offers a wide range of different types of vehicles for different types of customers, segmentation would ease the successful strategy development. Research suggests that developing a single strategy for the whole purchasing function is far from optimal, rather a spectrum of different strategies and tactics are developed for different suppliers and purchases (Nollet et al. 2005; Hesping & Spiele, 2015). For example, it is likely that the customers purchasing criterion for multiple light courier trucks is different than when a municipality purchases a new fire truck, etcetera, and that the case company should consider such factors while developing supply strategy. In some superstructure segments using competitive bidding with approved suppliers can be a viable solution, or for complex superstructures a partnership type of relationship between the case company and the bodybuilder may help to deliver the most value to the end customer. Further, as different types of vehicles require different manufacturing processes, the segments are likely to provide different kind of development opportunities. Some segments can offer the possibility of conducting manufacturing processes concurrently, to centralize manufacturing processes, or to offer a business case for superstructure insourcing.

Proposition 3: Segment and analyse the purchased superstructures.

Once the segments have been outlined and analysed, the case company can move forward to develop strategies for the segments. The best outcome is likely achieved through applying lean philosophy and methods in conjunction with supply chain management. Supply chain management will enable the case company to have a better influence on the activities of external suppliers, and applying lean philosophy and methods will help to increase the overall supply chain performance by identifying and eliminating non-value adding activities within the order-to-delivery process. There are many decisions to be made, such as the make-or-buy decision (Probert, 1996), supplier selection (Chen et

al., 2006) and segmentation (Svensson, 2004), which business processes and information flows should be integrated with the preferred suppliers (Lambert & Cooper, 2000), and so forth. Also, performance indicators should be agreed upon and data collection methods established. The developed supply strategies should be integrated to the business strategy, so that there are no inconsistencies. Like the business strategy, the developed supply strategies should be scrutinised and reanalysed over time to ensure the relevance and the functionality of the strategies, as changes emerge in the business environment.

Proposition 4: Develop strategies for individual segments while applying lean philosophy. Define KPI's and establish data collection methods.

Finally, the case company should start to implement and carry out the developed strategies and tactics. Segments that seem to provide the biggest benefits, compared to the changes and resources required, should be prioritised. Strategy implementation phase is said to be the most important one, since without implementation even the best strategies are useless. Generically speaking, researchers have noted many problematic factors during strategy implementation phase, including weak role of the senior management, lack of communication and commitment, misunderstanding the strategy, lack of coordination and/or sharing of personal responsibilities, unalignment to corporate systems and resources, and the lack of time dedicated to strategy implementation due to the daily routines (Beer & Eisenstat, 2000; Aaltonen & Ikavalko, 2000). Research findings suggest that the problems of successful strategy implementation can be mitigated by establishing two-way communication channels within the organization, allowing the personnel to present comments and questions about the new strategy (Alexander, 1985; Aaltonen & Ikavalko, 2000). Also, the role of middle managers is highlighted during implementation, as they are largely responsible for communicating the strategic changes and desired state to the personnel. As the strategies are being implemented, the rate of development should be measured actively with the KPI's and communicated throughout the organization.

Proposition 5: Start implementing the developed strategies and tactics. Measure development actively and establish a culture of constant improvement.

# 5. Results

The purpose of this research was multifold; to develop a coherent theoretical background for reducing total lead times in an engineer-to-order type of production approach, bring forth information about the peculiarities of the Finnish commercial vehicle industry, and to provide the case company with practical suggestions of how they could reduce lead times and improve processes. To fulfil these objectives, a case study was conducted.

To begin the research, an extensive literature study was carried out. The developed theoretical background included theories and managerial philosophies that were identified by the academia to be the most suitable for situations similar to the research questions. Special attention was paid during the development of the theoretical background, so that it would take into consideration the features and the characteristics of the case company and its business environment. As it turned out, the case company manufacturing method and the business environment influenced the direct applicability of many existing theories and tactics, mostly because of the case company production strategy can be classified as engineer-to-order due to the customer requirements, but also because the strategy of the parent company. In response, the theoretical background combined observations and methods from multiple theories, such as supply chain management and lean manufacturing, so that the several factors influencing the research questions could be addressed in a comprehensive manner. The developed theoretical background provided frameworks that could be reflected against the case company processes, so the research questions could be properly analysed and responded to. The theoretical background provided considerable support for the case research, as many of the problems identified within the case company were discussed within the academia. As the coverage of the research questions was vast, the tools provided by the frameworks, such as the Value Stream Mapping, were not be used to their full extent during the case study. This was done partly because there wasn’t the required type of data available, and partly because multiple problematic factors could be identified using more simplistic methods, mainly through interviews.

As there were multiple similarities identified between the theoretical background and the findings of the case study, the correlation suggested that the best possible answers for the research questions could be constructed by adjusting best practices from existing theories to suit the specific situation of the case company. The action plan that was proposed for the case company made use of this notion.

Although individual problems, such as the factory problem, could be addressed separately, it seems likely that the biggest benefits can be gained through systematic supply chain management while applying lean philosophy. Currently, relationships between the case company and its superstructure suppliers can be described as transactional, meaning that the superstructures are not managed in a strategical and integrated manner, even though they are an integral and costly part of the vehicle. To decrease lead times that are dependent on external suppliers, relationships should be established with selected prominent suppliers so that processes can be optimized in detail throughout the supply chain. Such supply chain optimization could also provide more favourable conditions for joint quality control and product development. Establishing deeper relationships with prominent suppliers should be achievable as the case company controls 1/3 of the total markets, and therefore holds considerable purchasing and negotiating power. That said, the dominant position of the case company could provide a business case for manufacturing some of the superstructures internally instead of outsourcing them, especially as the 'make-strategy' has been already proven successful in some segments. However, before any relationships can be established or lead times reduced, the top management must commit to supply chain management implementation and dedicate appropriate resources towards it. There is a vast spectrum of factors that need to be considered, and much of the related information is scattered around the case company. The personnel obtaining such information should be brought together with the sole intent of improving the order-to-delivery process so that the multiple affecting factors can be assessed as preciously as possible. Different vehicle segments and suppliers should be analysed, so the most suitable strategies and tactics could be developed for each individual segment. More accurate and efficient data collection, distribution and analysis methods should be agreed upon and established, so that the future development can be measured, and the impact of the strategies analysed. As more relevant information becomes available, the case company can improve their strategic decision-making capabilities further.

Since the study was conducted as a qualitative single case study, the generalizability of the research findings is decreased. However, as the case company controls 1/3 of the market, and as some 95% of the competiton have a similar supply chain structure, it can be expected that competitors within the industry are facing similar challenges compared to the case company. As this cannot be verified within the study, it provides an interesting future research subject; what are the general characteristic of the Finnish commercial vehicle industry supply chain, and how they could be improved? Researching the commercial vehicle industry further could be beneficial, as the industry has a distinct impact on the many other industries. The proposition is highlighted in countries that have long transport distances and a lot of heavy industries, such as Finland

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