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Purchasing Lead Time Reduction Case: ABB Oy, Drives

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<p>The main goal of this thesis was to create a guideline for the buyers of ABB Oy, Drives on facts why the purchasing lead time should be reduced. The study identified the advantages of purchasing lead time reduction for the supplier and the customer. The second goal was to identify the potential suppliers for purchasing lead time reduction and the actions to achieve the desired reductions. The third goal was consider the vendor managed inventory model as a solution to purchasing lead time reduction. A process proposal of vendor managed inventory in the case company's environment was created as well as a template of the agreement elements of vendor managed inventory.</p> <p>The main research method of this thesis was the case study research. The first goal of this thesis was achieved by conducting a comprehensive literature review on the subject. The second goal was reached by arranging a workshop with the buyers. The selected suppliers and actions of each category team were listed in an action plan. The action plan concluded also the target times and the resources needed to achieve the actions. The third goal was achieved by conducting a literature review on the vendor managed inventory and also by utilizing the vendor managed inventory processes currently in use in the case company.</p> <p>The execution of the purchasing lead time reduction workshop gave useful results. Suppliers that would give the biggest pay-off with minimum effort were identified by using the key performance indicator and the specific knowledge of the buyers. The most common actions that were identified in the workshop were related mainly to the finished goods buffer stocks and their location. The optimization of the order quantities were also identified as one common action to reduce the purchasing lead time. Mutual actions that would give benefits with all of the suppliers were also identified. The most important mutual action identified was to have the managers write an official letter to the suppliers where the managers would emphasize the importance of the purchasing lead time reduction. It was also identified that a great amount of help and mutual understanding from the sourcing department is needed to accomplish the actions. A process proposal of vendor managed inventory for the case company's environment was created by describing the main operational processes. The process proposal was created in a way which would serve the case company's production in the most efficient way. The vendor managed inventory agreement elements were listed in a template that could be used as a guideline or a check list when taking the model into use.</p>	
Keywords	supply chain management, purchasing, supplier, lead time reduction, vendor managed inventory

Tekijä Otsikko Sivumäärä Aika	Joanna Lalu Hankittavien materiaalien toimitusaikojen lyhentäminen, Case ABB Oy, Drives 55 sivua + 3 liitettä 11.2.2015
Tutkinto	Insinööri (AMK)
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<p>Insinööriyön tarkoituksena oli tutkia, miksi toimittajien toimitusaikojen tulisi lyhentää ja mitä hyötyä lyhentämisestä saadaan. Mahdollisia hyötyjä tarkasteltiin toimittajan ja asiakkaan näkökulmasta. Työn toisena tavoitteena oli tunnistaa potentiaaliset toimittajat, joiden kanssa voitaisiin lyhentää toimitusaikojen sekä tunnistaa tarvittavat toimenpiteet, joilla toimitusaikojen voidaan lyhentää. Kolmantena tavoitteena oli perehtyä varastointimalliin, jolla toimittajien toimitusaikaa voidaan lyhentää. Työssä tehtiin prosessiehdotus toimittajan hallinnoimasta varastomallista sekä luotiin mallipohja varastointimallin sopimuksen osioista.</p> <p>Insinööriyössä käytettiin tutkimusmenetelmänä tapaustutkimusta. Työn ensimmäinen tavoite saavutettiin tekemällä kattava katsaus aiheen lähdekirjallisuuteen. Työn toinen tavoite suoritettiin järjestämällä kohdeyrityksen ostajille työpaja. Työpajan tärkeimmät tavoitteet olivat toimittajien valinta ja toimenpiteiden kehittäminen. Työpajan tuloksena saatiin toimintalista, johon oli määritelty toimittajien ja toimenpiteiden lisäksi tavoiteaikataulu sekä tarvittavat resurssit toimenpiteiden suorittamiseksi. Työn kolmas tavoite saavutettiin tekemällä katsaus aiheen lähdekirjallisuuteen ja hyödyntämällä kohdeyrityksessä käytössä olevia prosesseja ja tietoja.</p> <p>Työpajan järjestäminen ostajille toi kohdeyritykselle hyödyllisiä tuloksia. Työpajassa valittiin ensin ne toimittajat, jotka toisivat suurimman hyödyn mahdollisimman pienellä panoksella. Toimittajien valinnassa käytettiin apuna toimittajien toimitusaikojen suorituskyvyn mittaria sekä ostajien syvällisempää tietämystä toimittajista. Yleisimmät valitut toimenpiteet liittyivät puskurivarastoihin ja niiden sijaintiin. Tilausmäärien optimointi havaittiin myös yhdeksi keinoksi lyhentää toimitusaikojen. Kaikista tärkein tunnistettu keino lyhentää toimitusaikojen oli lähettää kaikille kohdeyrityksen toimittajille virallinen kirje, jossa johtajat painottaisivat hankittavien materiaalien toimitusaikojen lyhentämisen tärkeyttä. Ostajat tunnistivat myös sen, että apua ja yhteisymmärrystä tarvitaan hankinnan puolelta, jotta tietyt toimenpiteet voitaisiin toteuttaa. Prosessiehdotus toimittajan hallinnoimasta varastosta tehtiin niin, että operatiiviset prosessit kuvattiin tavalla, joka olisi mahdollisimman tehokas kohdeyrityksen näkökulmasta. Toimittajan hallinnoiman varaston sopimuksen keskeisin sisältö listattiin taulukkoon, jota voidaan hyödyntää muistilistana tai yleisohjeena sopimuksen tekemisessä.</p>	
Avainsanat	toimitusketjun hallinta, osto, toimittaja, läpimeno ajan lyhentäminen, toimittajan hallinnoima varasto

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Abbreviations

SCM Supply Chain Management

KPI Key Performance Indicator

OTD On Time Delivery

MRP Material Requirement Planning

VMI Vendor Managed Inventory

EDI Electronic Data Interchange

ASCC Advanced Supply Chain Collaboration

ERP Enterprise Resource Planning

1 Introduction

Supply chains need to be developed and continuously improved and most importantly managed in the most effective and efficient way possible. Supply chains need to be managed to maximize customer value and achieve a sustainable competitive advantage. While supply chains have existed for a long time, many companies have only focused on what has been happening within their walls. Only few businesses have understood the whole chain of activities to deliver products to the end customer. (Handfield, 2011.)

Many of today's organizations are trying to achieve more effective lean supply chains by cutting away all the non-productive activities from their processes while improving performance. In this way organizations can reach their goals more effectively. One way to achieve effectiveness for the purchasing process is to reduce the lead time of materials purchased from suppliers. One big delusion of managers is that long lead times provide security and protection against uncertainties, when in fact it is just the other way round (Christopher 2011: 124). There are many ways to reduce lead time. This study will focus on the advantages that the supplier and the customer gain when reducing lead time and furthermore will give answers to why the purchasing lead time should be reduced.

1.1 Background

Last year ABB Oy, Drives had an organization change concerning the purchasing department. One common Drives Purchasing team was created, which now stands under the Drives Supply Chain Management (SCM) department. This change enables buyers to focus more on the suppliers' performance and its improvement.

One of the key objectives for the purchasing department is now to reduce the purchasing lead time with suppliers. This organizational change gives the opportunity to release time for buyers to become more involved with the matter. This study will give buyers a guideline to follow when negotiating with the suppliers to shorten the purchasing lead times.

1.2 Study Goals and Scope

The main objective of this bachelor's thesis is to give purchasers and suppliers a good and accurate overview of facts why the purchasing lead time should be reduced. The study aims to identify the benefits for the supplier and the purchasing company for reducing the lead times and at the same time achieving shorter supply chains. The study will be used among purchasers as a handbook in the purchasing lead time reduction negotiations with suppliers. This will help purchasers to justify why the lead times should be shorter and what the benefits of that would be.

This study also aims to identify the most potential suppliers for reducing the purchasing lead time and the ways to do that through the lead time key performance indicator. Most importantly the identification of the suppliers that give the benefits with a minimum input when reducing the purchasing lead time is the key objective of this study. The identification of the potential suppliers and the methods to reduce the purchasing lead time will be done through a workshop. The study will also consider one solution to reduce the purchasing lead time. A proposal of a vendor managed inventory process for current suppliers of the subscriber company will be made. The study will also consider the vendor managed inventory agreement and what should be decided on. The constraints that the subscriber company brings into this scene will be taken into consideration.

The subscriber company of this study is ABB Oy, Drives and the main benefits and results of this study are directed to the purchasing department. The subject of the study was chosen because it is a current interest of the buyers and is in need of immediate actions.

The structure of this study is concisely as follows: first the focus is on the literature review of the theories related to the supply chain, suppliers and purchasing lead time. Secondly the study focuses on the research question: What are the key factors and benefits of reducing the purchasing lead time and why is it essential? Thirdly the study focuses on identifying the potential suppliers for purchasing lead time reduction and what actions are needed to be done to achieve shorter purchasing lead times. Fourthly the proposal of the vendor managed inventory process and the content of the agreement are presented.

1.3 ABB Group

ABB is a global company that leads the power and automation technology businesses. ABB is the largest supplier of drives, power grids and industrial motors and in addition the largest provider of generators to the wind industry. The ABB solutions improve the efficiency, quality and productivity of the customers' processes. (About ABB, 2014.)

ABB's operations are divided into five divisions which all function globally. The operations are divided by industries and product categories. The first division to be briefly introduced is the Power Products. Power Products offer circuit breakers, switchgears, capacitors, instrument transformers, power distributions and traction transformers and also a complete range of medium voltage products. (About ABB, 2014.)

The Power Systems division offers turnkey solutions, renewable energy based power generation plants, transmission grids and distribution networks. The solutions provided by the Power Systems division play a key role in the optimization of electricity generation and are strongly involved in the evolution of more reliable, smarter and flexible grids. (About ABB, 2014.)

Discrete Automation and Motion division manufactures for example, motors, generators, drives, mechanical power transmission, PLC's, wind converters, solar inverters, voltage regulators and robotics. This division is the world's largest supplier of industrial electric motors and drives. The products are made to improve industrial productivity and energy efficiency. (About ABB, 2014.)

The fourth division is called Low Voltage Products. It offers low-voltage circuit breakers, switches, control products, wiring accessories, cable systems and enclosures. These products and solutions are suitable for many electrical applications from residential home automation to industrial buildings. (About ABB, 2014.)

Last but not least, the Process Automation division provides products, systems and services designed to optimize the productivity of industrial processes. These solutions include, for example, turnkey engineering, control systems, measurement products and electric propulsion for ships. Many of the customers of this divisions customers are from process industries, such as oil and gas, petrochemicals, mining, marine, pulp and paper and cement. (About ABB, 2014.)

1.4 ABB Oy, Drives

ABB Oy, Drives is located in Helsinki, Pitäjänmäki and is a part of the global ABB Group. ABB globally employs approximately 145 000 people and in Finland 5 400 people. In Finland ABB operates in more than 30 places and the biggest plant concentrators are located in Helsinki, Vaasa and Porvoo. ABB Oy, Drives is a part of the Discrete Automation and Motion division. The Drives department in Helsinki employs almost 1000 people. (ABB Lyhyesti, 2014)

The ABB Oy, Drives business unit is globally in charge of the sales and marketing of the drives together with research and development. ABB Oy, Drives provides a wide range of AC- and DC-drives. These are used among different industrial areas and applications. By adjusting a motor's speed of rotation with a drive, the energy consumption of the motor can be reduced up to 50 per cent. In 2012 ABB drives saved approximately 355 terawatt-hours, which can be compared to the annual electricity consumption of 85 million EU households. (ABB Lyhyesti, 2014)

The goal of ABB Oy, Drives is to create value to customers by adjusting customers' electrical machines in their processes and in that way helping customers to save time, materials, energy and natural resources. The business principles of ABB Oy, Drives are respect, responsibility and determination. (ABB Intranet, 2013)

2 Supply Chain Management

Supply chain management is a group of multi-leveled processes and operations that are all combined into one big network and is managed with all organizations that are included in a supply chain. As Sakki simply describes the supply chain: business consists of multiple individual functions which follow each other. In these functions a company's resources are slowly changed into a complete product or a service. In a supply chain the goods move in one direction from raw material suppliers to consumers but for this to happen, demand is needed. Demand and information move in the supply chain in the opposite directions. (Sakki 2009: 13-14.)

Materials do not move in the supply chain without any information impulses and this is why supply chain management equally consists of goods, information and cash flow. Sakki describes the supply chain management (SCM) process like this: the starting point is when a customer places an order and from there the information starts to flow through the chain to suppliers. Once the information has reached the suppliers, the materials will flow to the opposite direction and end up to the customer. The SCM is summarized as controlling and implementation of the goods movement, cash flow and information flow. (Sakki 2009: 21.)

No company works in isolation and in every supply chain each company acts as a customer when buying materials from its own suppliers and then it acts as a supplier for its customers when delivering products to them. The outcome is that most products move through many organizations as they travel between the original raw material supplier and the final customer. Every product has its own unique supply chain and it describes the total journey of materials as they move. The plainest version of a supply chain is where a single product moves through several companies where each of them gives value to the product. (Waters 2009: 8-9.)

The ultimate goal of SCM is to grow the service level for the end-customers. To reach this goal there are many objectives to achieve. One major goal is to reduce risks and uncertainty in the supply chain and the actions done to achieve these goals have a positive on inventory levels, processes and cycle times. (Leenders et al. 2002: 330.)

2.1 Overview of Purchasing

Bloomberg et al. defines purchasing as follows: to fulfill a company's demand, materials must be received to make goods for sales, production equipment and operations. The process of receiving supplies is a complex chain of different tasks. Purchasing and supply management is one of the basic common functions of all organizations and therefore one of the biggest challenges is to make sure that purchasing and supply management resources are used effectively (Bloomberg et al. 2002: 11; Leenders et al. 2002: 39.)

Purchasing and supply chain management are more and more recognized by companies' top managements as key business drivers. Nowadays most companies use at least half of their sales turnover to purchase materials and services. It has been recognized that to achieve a short-term financial position and long-term competitiveness, efficient and constructive relationships with suppliers are needed. The concepts of purchasing, procurement, materials management and supply chain management can contain different actions throughout different organizations. The content in these concepts depends on the stage of the company's development, the operating industry and the competitive position. Nonetheless the essence of all these concepts is purchasing. (Van Weele 2005: 4; Leenders et al. 2002: 11.)

To achieving effectiveness and efficiency in purchasing it is essential to develop successful relationships with suppliers. Many professional purchasing managers think that developing strong supplier relationships is the key to create and sustain a competitive advantage in today's global marketplace. Strong relationships are very important with the buyer and the supplier for successful purchasing. (Coyle et al. 2003: 118-119.) Purchasing contains a group of actions and when they are fulfilled, the outcome will be that the company receives materials or services needed in the production or sales. The purchased materials are an essential part of the supply chain operations which normally form the biggest costs for the company. (Sakki 2009: 18.)

The goal in the relationship between the purchaser and the supplier is to create an alliance between them with trust. To accomplish the job the purchaser has to have an ability to create a connection with the supplier, to transfer information, to control the situation and to use given feedback effectively. Purchasing is as important as sales in the company. Rarely there are sales without purchasing, and increasingly the best result comes from purchasing right. It is also essential for purchasing to continuously try to

reach lower inventory levels and improve inventory turnover. At the same time purchasers need to focus on reducing order lines and improving the service level. To achieve profitable purchasing it is important to understand the entire business of the company. The purchaser needs to understand what the main goals of the business are and why. (Rauhala 2011: 12-15.)

There are three types of purchases. It should be taken into consideration that the effort put into purchasing needs to match with the value of the materials needed. High-cost materials usually need more time and effort from the purchasers than low-cost materials. The first category is non-critical materials. These are the type of materials with low profits and a small risk to purchase. The purchasing of non-critical materials do not require more than a simple procedure. The second category is the bottleneck materials. The characteristics of these materials are low profits but a larger risk to purchase. In this type of a situation long-term agreements with alternative suppliers are needed. In this way possible problems will be avoided. The last type is strategic materials, which have a high profit. Usually in cases like this long-lasting relationships with the suppliers are essential. It would be desirable to develop a partnership with the suppliers. (Waters 2009: 326.)

2.2 Purchasing Process

Depending on what types of materials are purchased and whether they are purchased from a new supplier or an existing one, the purchasing process varies. The process is also affected by the supplier's way of manufacturing the products, whether manufactured to stock or plan, or made to the customer's order. In the process there are also persistent activities done even though the process might otherwise vary. (Jonsson, 2008: 343.)

The basis of purchasing is the expected future material requirements. The material requirements planning system generates the planned orders or order proposals. These order proposals, in other words purchase requisitions, can also be created manually by the organization. A purchase requisition is a request to the purchasing department to create a purchase order according to the supplier. (Jonsson, 2008: 344.)

As Jonsson (2008) states, procurement is the activity of selecting a supplier and making the purchase agreement, which are both included in the purchasing process. Purchasing may be done from a new supplier or from a supplier that the company has purchased

from before. Using approved suppliers usually means stable product quality and delivery accuracy. If the purchase is directed to an approved supplier, there will be no need to go through the heavy request for information (RFI), request for quotation (RFQ) and the request for proposal (RFP) processes. A purchase requisition can be directly transformed into a purchase order. (Jonsson 2008: 345.)

A purchase order defines the materials purchased, the quantity and delivery time, the price of the material and delivery conditions. A purchase order is a document that gives the supplier the input to deliver. After sending out the purchase order the supplier needs to confirm the delivery and the supplier has to do this within a certain time limit. An order confirmation means that the supplier has received the order and accepted the delivery time, quantities and prices. Sometimes the supplier has to make changes to the confirmation. For example the delivery time might have been extended because of some delivery challenges. (Jonsson, 2008: 346.)

Delivery monitoring is also part of the purchasing process to assure that the materials arrive on time. This means that checking needs to be done so that deliveries take place at agreed times. Not always can buyer nor the supplier affect the reason why materials arrive later than asked. The delivery delays might be caused by the freight forwarder or some other human mistake done during the transportation process. A late delivery might cause disruption or stops in the production, unsatisfied customers and loss of sales. On the other hand a delivery made too early may cause unnecessarily tied up capital, more redundant storage space and disturbances to normal material flow. (Jonsson 2008: 346-347.)

Sometimes the supplier might send the buyer a delivery notification. The supplier notifies their customer that the delivery is on the way. The delivery notification sent by the supplier is also called the advanced shipment notice. The purpose of this notification is to prepare the goods reception and quality control and also pass the information about packaging and loading to make the identification and reception control easier. Receiving and inspecting the delivery is a process called delivery reception. This is the process that contains receiving the goods and checking that the delivery is complete and correct materials have been received. Inspection of deliveries always costs money and takes time so it is essential for the supplier to deliver correctly. An ideal situation would be that all suppliers were so reliable that no inspection would be done. Once delivery checking and

inspections are done, the goods will be moved into stock or directly to the place of consumption. (Jonsson, 2008: 347.)

Last in the purchasing process is invoice handling. After the supplier has delivered the goods, they will send an invoice for the materials. The invoice is sent straight to finance and administration where the invoice will be matched with the purchase order. If the matching is not possible, the invoice will be sent to the purchaser for further checking and approval. The purchaser will then investigate why the invoice does not match with the purchase order, and once the differences are cleared, the invoice will be sent back to the finance and administration department for them to handle, and finally the invoice will be paid according to the agreed payment terms. (Van Weele 2005: 225.)

2.3 Goals of Purchasing

Purchasers work in an environment that includes a long list of objectives to achieve. The main goals will be covered in this section. The most important goal is to confirm an uninterrupted flow of purchased goods to the operating company. All the materials must arrive on time in the right quantity and condition. The next goal is to minimize inventory investment and losses since typically the inventory carrying costs are between 20 and 30 per cent of the value of the product. The third goal is to maintain sufficient quality of the materials because it will reflect straight on the quality of the company's final product. The purchaser must also find or develop the suppliers since a quality supplier can solve many of the problems in purchasing and help in achieving better results. Standardizing the materials purchased can reduce inventory, carrying costs and prices, so this is also one of the goals of purchasing. Also the cost of the required materials plays a role in the purchasing goals. The materials should be purchased at the lowest price possible without having an effect on the materials quality, quantity and delivery requirements. (Bloomberg et al. 2002: 13-14)

Improving the company's competitive position is also included in the purchasing objectives. Purchasers can help to achieve better competitiveness by ensuring that the right materials are purchased at the lowest possible price. The development of supplier relationships is also a key matter which will guarantee a continuous flow of materials. Also communication is important in purchasing when it comes to communicating with other departments in the company. Purchasing affects almost every aspect of the company's

operations, so that is why effective communication between departments is essential. The last purchasing goal is to accomplish the purchasing goals with a low level of administrative costs like all other departments and activities. (Bloomberg et al. 2002: 14.)

2.4 Purchasing Roles in the Supply Chain

Supply chain management is a term for the way the company manages all of its material processes and optimizes the material flows throughout the whole supply chain. To achieve an uninterrupted flow of materials, cooperation between purchasing, logistics and materials planning is essential. (Van Weele 2005: 226.)

The cost structure of the manufacturing companies show the importance of purchasing. Generally the largest costs in companies are made up of purchased materials and services. The efficiency of the purchasing process affects the success of the business in various ways. It is also important to understand that operative purchasing has a big impact on the company's return on invested capital. (Van Weele 2005: 16; Rauhala 2011: 134.)

All the companies receive their money from customers and it is clear that the customers are important to a company's business. It is not irrelevant from the company's future point of view where the money that is received from sales is used since about 50 to 80 percent of the sales revenue is used to purchase new materials. Purchasing is playing a key role in a company's profitability and profit. This needs to be noticed by the management. A proficient purchaser understands that it is not necessary to keep inventory for assurance. Inventories are kept only for real sales and consumption because a company's resources are its capital and it is important that it is used productively. (Rauhala 2011: 24.)

An organization's strategic success can be improved by purchasing, which is done by identifying and developing new and existing suppliers. Also by letting the supplier into the organization's new product development process can help to reduce the development times. By getting to the markets quickly with new ideas and innovations can help to strengthen the organization's market position. (Grant et al. 2006: 100.)

Mostly all of an organization's other departments depend on purchasing functions for information or support, and relying on this fact purchasing brings value to other functions as well. Purchasing department should be included early in the decision-making process that affects the purchasing. When purchasing is well informed about new decisions early enough, it will allow the purchasing department to give better support to other departments in need of support in the organization. (Grant et al. 2006: 101.)

3 Purchasing Lead Time Reduction with Suppliers

3.1 Suppliers' Role in the Supply Chain Management and Partnership

As in most organizations the supplier and the purchaser do much of their business with each other. They rely on each other and have an inducement to continue working with each other and form a long-lasting relationship. However for a supplier to last as a long-term partner, they need to have enough qualifying features to work with the purchasing company. (Waters, 2009: 314.)

The importance of finding the right suppliers with enthusiasm to work together with the buying organization is essential. It has been said that a poor supplier will cause more problems than poor materials. There is no point of purchasing a well-designed product from a supplier who in the end cannot actually deliver it. Organizations need suppliers that are able to meet the agreed standards. Purchasing needs to recognize suppliers who can guarantee high quality, accurate deliveries, acceptable prices, capacity to supply the materials and all other requirements. Also factors such as specialized deliveries, good location, and ability to deal with inconsistent demands may be important to some companies. It has been said that even small improvements in the relationship with suppliers might have a huge impact on the company's return on the net asset, which leads to the fact that the most important concern of the purchasing manager should be the development of supplier relationships. (Waters, 2009: 311; Van Weele, 2005: 18.)

In the last few years companies have spent money and time on developing better supplier relationships. Before achieving a well-working partnership, companies must make improvements in logistics, quality and product development. Improvements in logistics means that suppliers are given a transparent view of the upcoming material and supply needs. In this way suppliers have a good understanding of the future requirements which will result in high service level and lower logistic costs for both the supplier and the buyer company. On the quality side, mutual agreements made early on quality requirements lead to decreased quality costs and possibly to zero defect deliveries. Last but not least, by giving the supplier a glance on future product developments and processes will reduce the time to get the new products or features to the markets and also the start-up costs may be lower. The achievement of effective supplier relationships and management is one of the key factors of a successful business strategy. Companies that have

tied the purchasing and supply strategies to the company policies have gained enormous savings and improvements in operational processes. These can be achieved by devoting and effective supplier management. (Van Weele 2005: 158-166)

The partnership with the supplier is more than a customer relationship. The partnership is built on mutual trust, honesty and cooperation, which aims to add value to both the purchaser's and the supplier's company. The purchaser's big goal is to achieve long-term commitment to cooperation with the suppliers. To develop an effective relationship with the suppliers depends on the ability of the purchaser to create working relationships. To make the partnerships last it is essential to grow the transparency between the operating parties. Transparency means that early demand information is shared between each other. Also the possibility for each other to see the inventory levels and the delivery possibilities is a key factor in transparency. Profound partnerships with the suppliers reduce the need for inventories and the risks of losing the supplier and also the quantity of suppliers. (Rauhala 2011: 17, 98-99; Leenders et al. 2002: 317.)

There is no one ideal type of partnership that could be implemented in all situations even though all partnerships share some common characteristics. Researches show that there are three types of partnerships. The first type is that both companies recognize each other as partners and they coordinate activities and planning on some level. This type of partnership usually aims for short-term relationships and includes normally only one functional area. Type two partnership is determined by the fact that the involved organizations have improved their coordination of activities into integration of activities. This type of partnership is expected to be a long-lasting one with multiple functional areas involved. The last type of partnership is on a well-advanced level and the organizations have a critical integration between each other. In this type of partnership both partners see each other as an extension of their own company. These partnerships normally last for a long time since both parties are dependent on each other. (Grant et al. 2006: 118.)

As part of supply chain management it is essential to achieve continuous improvements in the organization's processes. The key to make continuous improvements to give better value to customers is to work closely with the key suppliers and help them to develop their quality and make deliveries more reliable and faster, urging the suppliers to achieve lower product or service costs. (Leenders et al. 2002: 29)

3.2 Purchasing Lead Time

Many businesses have been focusing on improving performance through cost reduction and quality improvements and have also succeeded in these obvious opportunities. This has led companies to the new battleground of lead time reduction to search for competitive advantage. The purchasing lead time covers the time from the order release point to the point when materials are received to the buyer's stock or the materials are shipped. Briefly said it means that organizations need to respond to customers' needs on time. By tradition people usually think that low cost and high quality cannot go together, or low cost and fast delivery or fast delivery and high quality, believing that compromise needs to be done. It needs to be recognized that costs will not need to increase when lead times are reduced. It can be possible to reduce both costs and lead times by reducing for example unnecessary transportation or inventory. (Harrison et al. 2014: 178-179)

The goal in many companies in the supply chain is to reduce lead times of the purchased materials. It must be taken into consideration that how much one lead time day costs for the company and what the effects are on the company's operating profit after one day reduction of the lead time. The reduction of lead times should be viewed together with other functions and parties involved in the supply chain. A company's profitability will improve fundamentally by making the whole logistics chain to work well and effectively. (Rauhala 2011: 93.)

It is obvious that companies that can react to customers' needs accurately are more likely to attract more orders than those who cannot give the same responsiveness. Nowadays customers in all markets are increasingly time-sensitive, which directly reflects to their purchasing behavior. It is not rare for customers anymore to choose short lead times before low price. While prices are still important in the choice of a supplier, a huge dominance has also the cost of time. The cost of time is an additional cost that is built up while the customer is waiting for the delivery. If a company is looking to achieve competitive advantage by improving its responsiveness to customer needs, it will be essential for the company to get the same respond from its suppliers. (Baily et al. 2008: 186-187; Christopher 2011: 121.)

The purchasing lead time consist of:

- Placing a purchase order
- Order entry and processing
- Supplier manufacturing/warehouse work lead time
- Transportation length
- Order received
- Different waiting periods between processes.

Each one of these steps consume time and because of inefficient processes, bottlenecks and demand fluctuations. Each of these activities takes a different time to be completed. (Sakki 2009: 120; Christopher 2011: 125.)

By reducing lead times of the purchased materials the need for physical inventory space decreases, which will automatically lead to the fact that there will be less materials and components to handle. In this way the number of current assets will decrease in the company and also the amount of waste will get smaller. Reducing lead times will make the operations flow faster and effective and in this way the follow-up and supervision will become more efficient. Also the reduction will make the operations control and the systems more straightforward. An effective logistic process will reduce the company's overhead costs and grow the diligence, which will cause fewer delivery errors. (Rauhala 2011: 93.)

When demand is fluctuating lead time and its control becomes an important issue. Shorter lead times will allow the order to be made based on the updated demand forecast. Furthermore, shorter lead times will improve the customer service level, increase competitive advantage and reduce the safety stocks and also stock-outs will become rarer. The lead time usually consists of many factors and in all the practical situations the lead time can be reduced and also controlled. The benefits of controlling the lead time are proven by the Japanese experience of Just-In-Time production, and as a consequence it is necessary and beneficial to reduce the lead time. However it has been

argued that the lead time accounts for at least half of the logistics success. (Jha et al. 2008: 6876; De Treville et al. 2014: 338; Harrison et al. 2014: 177.)

Most organizations focus on responding to customer needs as fast as possible, so through this concept the lead time has become a widely used performance improvement indicator. The lead time can be measured in many ways, for example as the manufacturing lead time and the customer lead time. In this study, the customer lead time means the same as the purchasing lead time. The customer lead time is viewed from the supplier point of view and is defined as the time between receiving the order and shipping or delivering the finished products to the customer. Companies may use many different ways to reduce the lead time but for example to reduce the customer lead time, implementing lean or JIT practices or IT integration have been found to be effective ways. Usually when reducing the lead time, it will impact the operations management practices. (Ward et al. 2006: 177-196; Singh et al. 2013: 38.)

There are plenty of tensions that indicate for shorter lead times and lead to time sensitive markets. The most important factors are that many of today's companies prefer to reduce their own inventory levels, which will affect the lead times, which need to be shorter in order to achieve lower inventories. The next tension is that product life cycles become shorter all the time, which then leads to the fact that the time for developing new products, to launch them and to meet the market demands is getting shorter. Third tension to reduce lead times is that unstable markets makes it dangerous to rely on the forecasts. It has been noted that many organizations have the same problem with inaccurate forecasts. To cope with these inaccurate forecasts many companies rather build up safety stocks to provide protection against these forecast errors. However it is more desirable to reduce lead times to cope with the forecast errors than to build up safety stocks. (Christopher 2011: 124.)

Most organizations face the problem of the lead-time gap, which means that the time to purchase, make and deliver the products to the customer is longer than the time the customer is willing to wait for the delivery. The figure 1 describes the lead-time gap where the customer's order cycle is the time the customer is willing to wait for the delivery. Usually in many organizations the only way to close this gap is by carrying inventory. Even though the demand is forecasted, which is never accurate, most companies still build inventories to meet the demand ahead. (Christopher 2011: 84.)

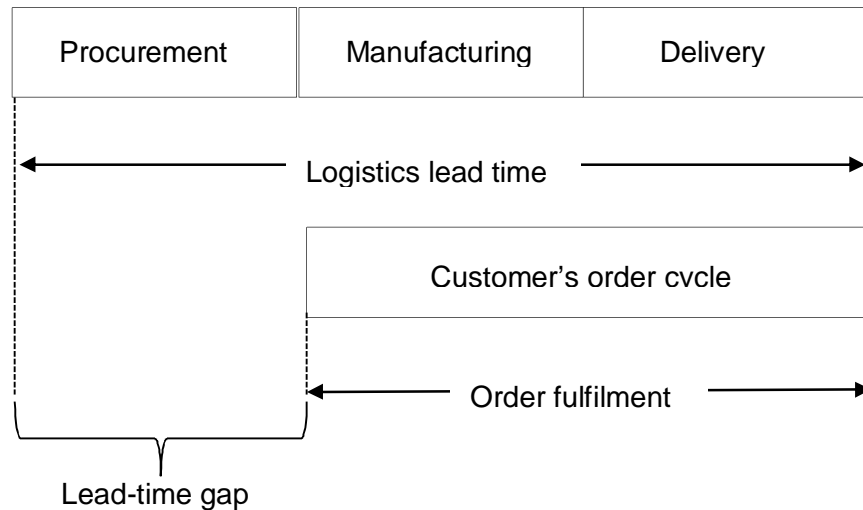


Figure 1. The Lead-Time Gap (Copied from Christopher 2011: 84).

Improving the forecast accuracy is a tempting goal that is hard to achieve and expensive if money is set on improving forecast techniques. Much more efficient is to reduce the lead time, which will result in inventory reduction, for example by improving the visibility of the demand will reduce the lead time. (Christopher 2011: 85.)

3.2.1 Advantages of Lead Time Reduction

From a customer point of view the supplier should take into consideration the reduction of the customer lead times as customers continuously insist on shorter delivery times for ordered products. For the suppliers it is essential to sustain customer relationships and that is accomplished through meeting the customers' needs and keeping a good service level.

Lead time can be a very useful and effective competitive weapon against the organizations' competitors. Customers are becoming less patient on waiting for the delivery of their order. No matter what the deliverable product is, the ability to deliver it sooner than the competitors is essential for achieving successful sales. As said, time is money in all environments, but especially in a logistical pipeline time it becomes more and more important. It is increasingly important to deliver with speed in today's highly competitive environment so lead time reductions should be taken very seriously since long lead times mean a slow response to customer requirements. (Singh et al. 2013: 37; Christopher 2011: 121.)

For the supplying company the external benefits of reducing the lead time are lower overall cycle time and the providence of faster services together with improving the competitive advantage on the markets. These benefits are crucial for improving responsiveness to the customer and unstable markets. (Harrison et al. 2014: 177.)

The internal benefits of reducing lead time of the purchased materials for the supplier are that cash-to-cash cycles become shorter which releases working capital improving liquidity and reduces asset intensity of the supply chain. Also by speeding up turnover times for work in progress and inventory lowers the supply chain inventories. These benefits are very useful when a company is implementing lean strategies or waste elimination approaches. (Harrison et al. 2014: 178.)

The first benefits of reducing lead time are shown usually as shorter cycle times and faster inventory turns. After this usually overhead costs are reduced due to disappearance of delays and breakdowns from the system. So reduced lead times will result in both cost reduction and time reduction. (Harrison et al. 2014: 180.)

3.2.2 Lead Time Reduction in the Suppliers' Environment

Customers' needs can be met in many ways of lead time reduction and therefore add more value, and without a doubt any supplier wants to be the best in the customer's eyes. From the purchasing point of view the following overview of ways to meet the customers' needs by using time is for suppliers to use. Suppliers can increase the responsiveness of the customers' needs by decreasing time used on customer queries, estimates and complaints, which will increase the customers' loyalty and willingness to work together with the supplier. Once short lead times and respond times are achieved and offered it will be hard for the customer or the buyer to accept any longer lead times. (Harrison et al. 2014: 181.)

By managing the increased product variety, customers' needs can be met through shorter lead times in processes. Shorter lead times in product development, manufacturing and the whole supply chain help the suppliers to deliver a variety of products without any cost increment. From the customers' point of view this will increase the range of products available. Also increased product innovation will help the supplier to meet the customers' needs. By shortening the lead time in product development, innovations can

be brought to the markets more quickly and with the maximum effect. If a company innovates new products faster than its competitors, increased competitive advantage will be most likely achieved. Once shorter lead times are achieved in the product development it will be clear that the consequence is that new products will be brought to the markets faster. The fact that new products will be brought to the markets faster will provide a number of advantages. For example the sales life of the product is more comprehensive and a higher price can be charged and in addition new customers can be won. (Harrison et al. 2014: 182.)

It has been said that there are only two types of forecasts in the industry, the wrong ones and the fortunate ones. Without saying it is clear that the further the company tries to forecast it is unlikely for the forecast to be accurate or correct. Relying on long-term forecast is not very secure, so reducing the risk of going in the wrong direction is to reduce the production lead times, which will shorten the period when the demand is uncertain. When forecasting is done over a shorter period, it will become more reliable. (Harrison et al. 2014: 182-183.)

In the literature P-time is used to determine how long it takes for a product to go through the supplier's pipeline. It starts from the moment a new order is released and ends when the order is fulfilled and received by the customer. Therefore D-time is the time that the customer is willing to wait to have their demand fulfilled. The D-time is measured from the point when the buyer from the customers' company realizes the need and ends when the goods are received by the customer. These times should be measured for each separate product group since all of them have different internal processes. (Harrison et al. 2014: 187-189.)

There are several different ways to reduce the P-time, in other words the supplier's lead time. The first way is to give the supplier better and detailed demand information earlier and speed up the access to the demand data. In this way the supplier can react to the demand more quickly and that way satisfy the customers' needs, also keeping in mind that time-based thinking in product development gains competitive advantage among other suppliers. So from the customers' point of view suppliers should be taken along to the product development processes to ensure quick response to deliver the new products. Process improvement from both customers' and suppliers' sides is also useful in reducing lead times or in this case P-time. Processes need to be engineered so that all the unnecessary steps are eliminated and the wasted time is also removed from the

remaining steps. Focusing on the issues that add value to the customer is the key. (Harrison et al. 2014: 200-201.)

There is a six-stage process to reduce lead time in the suppliers' environment: control, simplify, compress, integrate, coordinate and automate. The first one is to control the performance and improve the process capability. Lead time depends on the balance of the load and capacity in the processes. If the load is bigger than the capacity, naturally the lead time will get longer. Optimizing the throughput is a way to reduce lead time. Also by simplifying the process is a way to reduce lead time. If many different products share the same process, it will quickly get very complex, which will then lead to bottlenecks in the processes. (Harrison et al. 2014: 202.)

By eliminating the wasteful steps from processes will compress the lead time. This can be done by straightening the flow of each product and reducing the batch sizes to improve the flow and at the same time the queueing time will be reduced. One way to reduce lead time is also to integrate different activities together. Integration of the activities can be done by improving the speed and accuracy of information. For example demand information, process information and product information. Coordinated activities help also to reduce the lead time. Coordinating activities means that they are done in parallel or in the best order from the value adding point view. By doing activities at the same time instead of one after another will reduce lead time. The last approach is to automate the processes. This must be done once all the waste is removed from them. Since it is never wise to automate wasteful processes. The goal is to improve reliability and capability in the processes as well as speed. (Harrison et al. 2014: 202-203.)

3.2.3 Vendor Managed Inventory for Reducing Purchasing Lead Time

This section will cover at the basics of the vendor managed inventory model and its advantages once implemented. It has been identified that implementing the inventory model will reduce the purchasing lead time. The time from customer order delivery time will be shorter when the supplier manages the inventory.

VMI is an abbreviation for vendor managed inventory which is an example of a value added inbound logistics process being outsourced. This means that the supplier is in charge of managing the customer's inventories with the provided demand information

from the customer. Giving better demand information will eliminate a step from the information chain and therefore provides transparency towards the supplier. In this way the supplier can manage their own production effectively according to the demand information provided. This will lead to lower inventory levels and logistic costs. The early availability of demand information will allow the supplier to be anticipatory which will then result in reduced lead times. (Zammori et al. 2009: 165-166; Claassen et al. 2008: 407.)

The concept of VMI contains the fact that the decision responsibility is moved to the supplier. The supplier manages the inventory levels and decides when to supplement the inventory on behalf of the customer. The suppliers make these decisions and get an opportunity to choose the shipment frequency and the delivery quantities that makes the suppliers responsible for keeping the agreed quantities stored. Sometimes the customers transfer even the financial responsibility of the inventory to the supplier. On the other hand, the customer must share sensitive and on time data with the supplier to achieve good functionality of VMI. The information that is needed by the supplier to manage the customer's inventory are inventory levels, expected demand, promotional activities and product related costs. The availability of accurate information is the core of this process and is essential for VMI to be successful. (Zammori et al. 2009: 166-167; Claassen et al. 2008: 407; Waller et al. 1999: 183.)

Since the demand fluctuation is a major problem in most supply chains, many suppliers are attracted to the VMI process because it reduces the demand uncertainty. Often suppliers are forced to keep a finished goods inventory or maintain excess capacity which are both very expensive ways to assure a proper customer service level. VMI is a solution to reduce the bullwhip effect which is caused by uncertain demand in forecast-driven supply chains interrupting the smoothness of the supply chain processes. VMI also reduces the need of keeping buffers of inventory and capacity. (Waller et al. 1999: 184.)

Benefits of Vendor Managed Inventory

The benefits of VMI are generally built from cost reductions, improvement on service and better transparency in the supply chain. The main benefits of VMI are introduced in table 1. The most important advantage of the VMI for the supplier is that they are able to plan their production exactly according to the customer demand and also the fact that a long-

term trustworthy relationship with the customer is created and therefore sales are secured for the supplier. The key to achieve these benefits, is to release accurate demand information to the supplier in charge. (Claassen et al. 2008: 407.)

Table 1. Main advantages of VMI (Zammori et al. 2009: 167).

Supplier Benefits	Customer Benefits	Shared Benefits
Bullwhip effect reduction	Stock-out reduction	Reduction of data entry errors
Lower reliance to forecast	Financial cost reduction	Improved speed of the process
Reduction of order modification	Purchasing process simplification	Stock level reduction
Production planning simplification	Increase of sales	Improved service level

It has been discovered that the information sharing in VMI gives huge benefits in the supply chain costs area and reduction of the bullwhip effect leading to better performance. VMI gives a competitive advantage to the customer since it provides higher product availability, service level and lower inventory monitoring and ordering costs. (Sari 2007: 529-533.)

Risks and Disadvantages of Vendor Managed Inventory

The relationship between the customer and the supplier might lead to a situation where the whole inventory management burden is intentionally off-loaded to the supplier causing both increased administration and inventory costs. This will have a negative impact on cash flow and liquidity.

There are risks and disadvantages for both the supplier and customer. The supplier might suffer from increased inventory and inventory management burden, reduced cash

flow and grown assets, increased administration and also costs of capability and development. On the other hand the customer will suffer of increased dependence on the supplier which is counted as a risk. Also the revelation of sensitive information can be a risk for the customer, especially in a situation where the same supplier works with the customers' key competitors. All the above mentioned disadvantages might occur if the VMI system is not prepared and planned carefully enough and might build up to damaged supply chain competitiveness. (Hines et al. 2000: 352.)

Agreement for Vendor Managed Inventory

A flexible agreement between the supplier and the customer has been recognized to be an important start for the VMI partnership. The agreement needs to be written in a flexible way, so modifications during partnership are possible since it is impossible to forecast the future. Once all the conditions are agreed on and stated in the agreement, both parties will know what to expect from the relationships. (Zammori et al. 2009: 168.)

When taking vendor managed inventory into use there are several aspects that need to be agreed on so that both parties know what to expect from the partnership. The parties need to agree on all the conditions which will be respected during the relationship. The structure of a general agreement of VMI is described in figure 3 below. Also connections between annexes and chapters are presented.

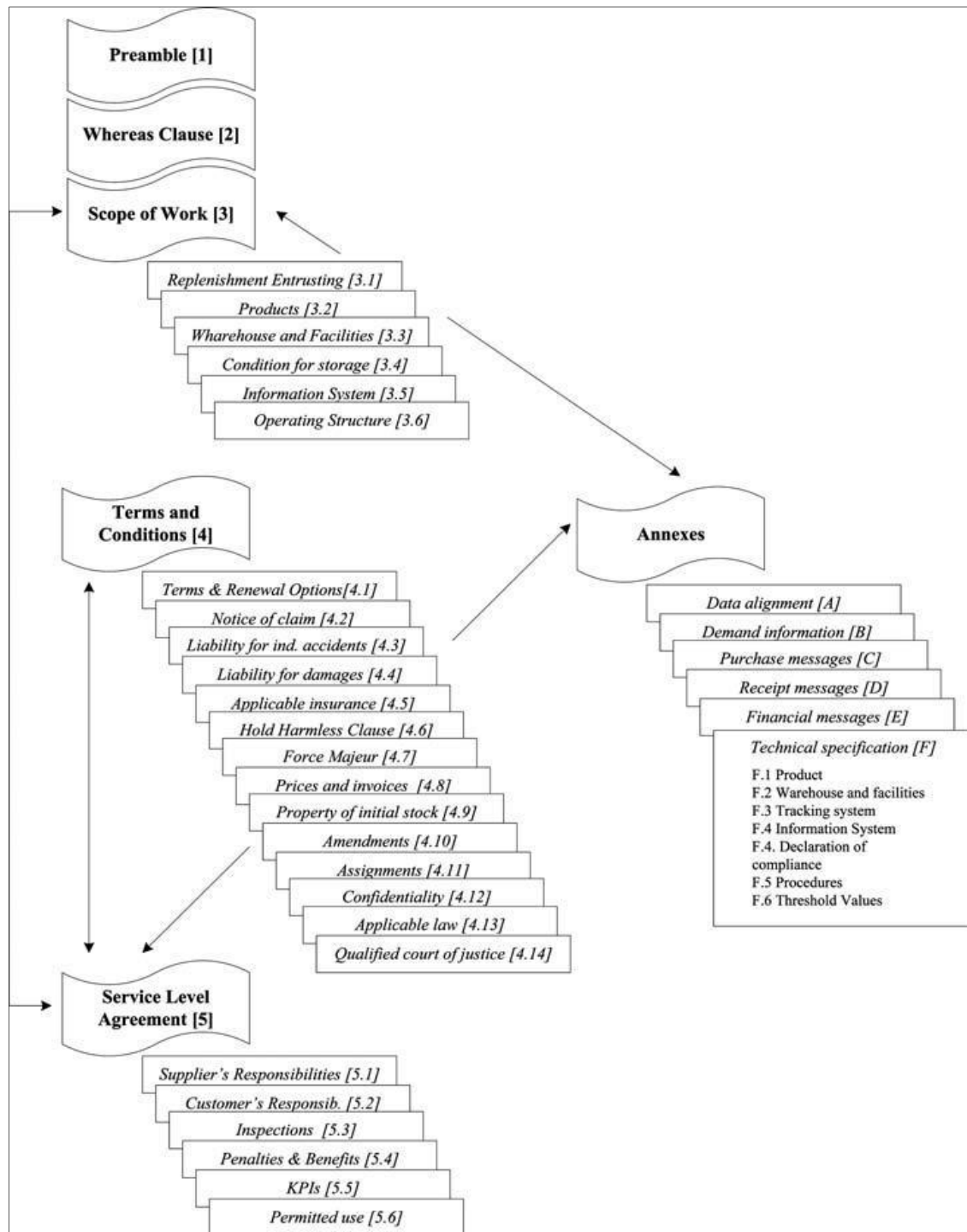


Figure 2. The General Structure of the VMI agreement (Copied from Zammori et al. 2009: 169).

In the preamble the customer and the supplier explain their purpose to enter the relationship and all general information of both companies are presented, such as company names, head offices, tax codes and other meaningful information for the agreement. In the whereas clause the overall structure is described and emphasis is on the willingness

of both parties to apply a partnership with trust and mutual support. On the other hand the scope of the work section lights up the expected behavior from both sides referring to the annexes of technical details. To avoid different interpretations or misunderstandings, all the responsibilities and tasks are clearly specified, as to whose responsibility they belong to, including the parts on information sharing released by the customer and the service level performed by the supplier. In common situations the supplier's duties end when the goods are delivered to customer facilities. The partnership scope is generally as follows:

- The supplier has full responsibility to generate purchase orders and to supplement the customer's inventory.
- The customer is responsible for maintaining the warehouse property and inventory operating management.
- The supplier owns the replenishment and production policies fully.
- Both parties agree on sharing sensitive information in the interest of the VMI.
- The supplier is willing and ready to meet the agreed level of performance. (Zammori et al. 2009: 170, 181.)

These facts listed above are the core of a successful VMI partnership. In the scope of the work section also the physical location of the warehouse is decided and normally the customer is responsible for the warehouse maintenance costs. The responsibility for the condition of the storage is divided between the customer and the supplier. The customer has the responsibility to make sure the goods are stored in an appropriate location and that the goods are kept separate from materials that are not included in the same process. Also in this section of the agreement both parties agree on sharing all the information that is needed to support the VMI. Both parties are also willing to adjust their information systems to work together. (Zammori et al. 2009: 170, 181.)

The terms and conditions section cover the legal issues of the agreement. The first part determines the terms of the relationship and presents the options of termination and also the adequate causes. It is good to include a fair method to modify the agreement since condition and requirement changes may occur. The service level agreement describes

in detail the causes of dissolution of the agreement and also possible renewal options are presented. The second part of the terms and conditions section defines the responsibilities of both parties if an industrial accident happens, stored items are damaged or stolen or in the case of an unexplainable loss of stored items. It is also agreed which party is responsible for the materials from their delivery to their consumption. Also all the applied insurances and a chapter of dealing with the data confidentiality are included in this section. An important part of this section is the financial aspect which includes for example the price of the items, terms of payment, startup costs and penalties. (Zammori et al. 2009: 170, 182.)

The service level agreement section is a typical section in any logistics agreement. Here the supplier and the customer commit themselves to maintaining a certain level of performance agreed beforehand. The service level expected by both parties is defined in this section and includes a set of key performance indicators to measure and evaluate the achieved level of performance. In common situations of VMI the supplier and customer responsibilities are carefully determined. As mentioned earlier the supplier is in charge of the inventory replenishment and assures to keep the stock inside the agreed minimum and maximum levels. The supplier is also responsible for standardizing the shapes and dimensions of the pallets and packages. On the one hand the supplier has the right to make decisions about reorder points, lot sizes and shipment frequency. Generally the supplier is obligated to send an acknowledgement of the order and wait for an approval to ship and once the shipment is made, the supplier will send an advanced shipping notice so that the customer knows what to expect. On the other hand the customer is responsible for rehabilitating the storage to meet the needs of VMI. The customer is also responsible to embracing the facility maintenance, operating and purchasing costs and is responsible for the operative management of the warehouse. It is also essential to give the supplier full visibility of inventory levels and provide sales and demand data. (Zammori et al. 2009: 171, 183.)

The annexes section defines in detail the technical topics which are briefly covered in the body of the agreement. The technical features and specifications are presented in detail and are determined case by case. The demand information shared should be described focusing on content, format, and communication standard, frequency and dispatch responsibilities. The demand messages possibly sent are generally the stock level, stock withdrawal, planned promotions, production schedule and incoming orders. Also the message that will trigger a purchase order is defined. Possible messages could be a

purchase order proposal and purchase order approval. Receipt and consumption messages should also be sent. Also a notification of receipt should be sent to the supplier as a consumption report. (Zammori et al. 2009: 185.)

The technical specification defines all the technical parameters that are needed to implement the VMI successfully. The technical specification should include:

- product characteristics
- plant and facilities
- equipment
- information systems
- data type
- operating practices. (Zammori et al. 2009: 171.)

The product characteristics should include the item description, technical drawings, materials, weight, potential hazards, place of use and the place of storage. Also some specific information should be included such as transportation lead time, minimum and maximum stock levels, pallet type and dimensions, number of items per pallet and weight and dimensions of the complete package. The elements of plants and facilities are also detailed, such as warehouse layout, shelf types, loading capacity, security systems, forklifts available and the number of storage locations reserved for VMI. Detailed elements of information systems should be agreed on and defined. The elements of hardware and software, communication standards and interface, integration of information systems and ongoing synchronizations should be adopted. The technical specification is definitely the most important part of the annexes and must be carefully defined. (Zammori et al. 2009: 185-186.)

4 Study Methods

This chapter will present at the research method used in this study and the reason of the selected method. The table 2 displays the research methods to use in different kind of studies.

Table 2. Relevant Situations for Different Research Methods (Copied from Yin. 2014: 9).

METHOD	Form of Research Question	Requires Control of Behavioral Events?	Focuses on Contemporary Events?
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival Analysis	Who, what, where, how many, how much?	No	Yes/no
History	How, why?	No	No
Case Study	How, why?	no	yes

Table 2 is helpful for deciding which research method to use. The form of the research question mainly indicates the method to be used, and also facts such as the study focuses on existing events or whether it requires the control of behavioral events. (Yin. 2014: 9.)

4.1 Case Study Design

A case study design was chosen to be used in this study, since the study focuses on one process in a specific environment. A case study typically investigates only one of the following: an event, a process, a person, a group of people or an object. A case study is a specific and fundamental description of a selected phenomenon. The starting point is to gather diverse information of the selected case and present it thoroughly. A case study usually views a complicated long-term phenomenon, so it easily answers to questions how and why. The goal of a case study is to increase the understanding of the selected case. A case study can also try to describe or explain a certain case. (Laine et al. 2007: 9-10, 31.)

Qualitative and quantitative information can be combined in a case study. It is essential that the case study contains only one case or a small group of cases. The target of a case study is not determined in the beginning such as in a statistical study. The case study path begins with a thorough literature review and the posing of the research question or objective. It is essential to understand the strengths and limitations of case study research. In figure 3 the linear but a repetitive process of conducting a case study is illustrated. (Laine et al. 2007: 11.)

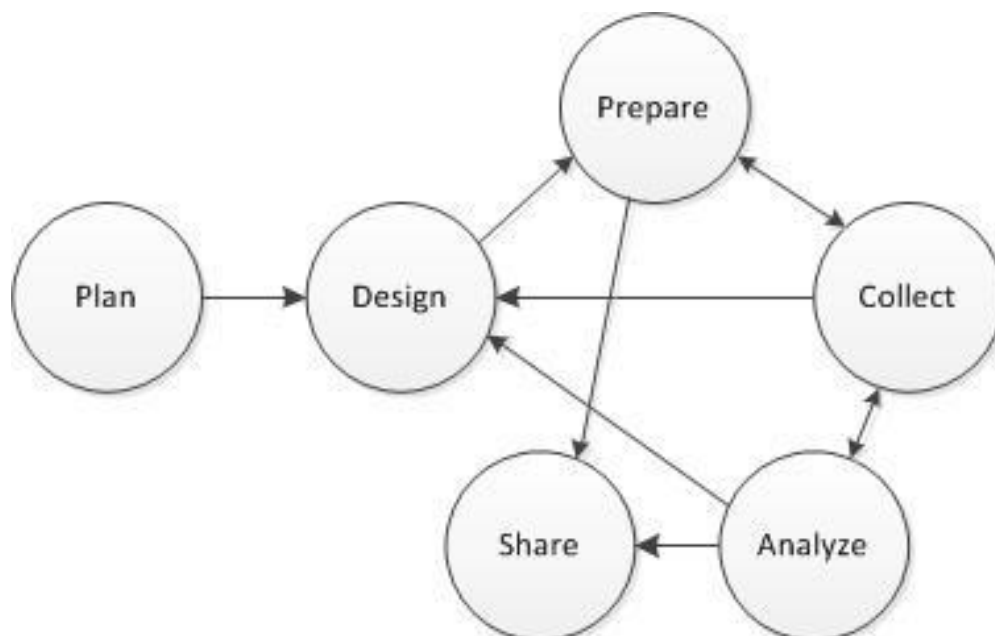


Figure 3. The Case Study Process (Copied from Yin. 2014: 1).

The path of doing case study research starts with a thorough literature review and by determining carefully the research questions and objectives. It is also important that the research procedures are planned formally and distinctly. (Yin. 2014: 2.)

The main features of a case study are that the data is collected in natural situations and the one who conducts the study collects the data. Usually the data is gathered by interviews, observations or different kind of written documents. The study is normally descriptive and it is not changed into numerical form. A case study aims to form a hypothesis instead of testing one. A case study is flexible and continually formed and focuses on the present, but usually to understand the present, it requires a look into the past is. (Soininen. 1995: 82.)

4.2 Data Collection Method

The way to approach purchasing lead time reduction with the buyers is done by organizing workshops to focus on this case. The goal is to apply GE's Work-Out process to these workshops. The plan is to find solutions and development ideas that cause the biggest pay-off with a minimum effort in a way that the solutions will be easy to implement.

According to the GE's work-out process frontline everyday workers have a great number of ideas for improving the performance of the company but no authority. Managers have the authority but have no time to evaluate and approve the improvement ideas. This was the bottom line for the created work-out by GE. The concept of the work-out is based on the fact that the employees that work closest to the job know it best and have the best ideas to improve and develop it. A small group of employees and managers are gathered to share development ideas and suggestions and together they are presented to the leaders. After the ideas are presented, the leaders will have to make the decisions on the spot whether to carry them out or not. (Ulrich et al. 2002: 4-8, 23.)

The key of the Work-Out process is to bring employees together to develop rapid and long-lasting improvements in processes. It is a simple structured and systematic process improvement tool. There are three steps in this process. The first is to design and prepare the work-out and then to conduct the event and after that implementing the decisions. The design phase is used to agree on key issues that need to be solved, then identifying the participants of the Work-Out and introducing the goals and expectations of the process. (Ulrich et al. 2002: 85-88.)

The next step is to execute the Work-Out event. The event pulls together people from different levels and areas of the company such as senior managers, operating frontline employees and employees from personnel management. The event consists usually of five sessions as follows:

- Work-out introduction, brief of goals and agenda
- Small-group idea generation, each team handles a different aspect of the problem and list up ideas to achieve the ultimate goal
- Whole-group idea assessment, the teams ideas are presented to the rest of the event participants
- Small-group recommendation development, time to develop an action plan for implementing the ideas
- Final-decision session, development recommendations are presented to the managers and sponsors and decisions are made on the spot.

This above description of the work-out event ensures that the maximum amount of quality ideas are brought up and that the action list will deliver fast results. (Ulrich et al. 2002: 89-94.)

The final step of the GE's work-out is to implement the brought up development ideas on the action list. The process of implementing the Work-Out ideas starts with letting everyone necessary to know about what was decided to implement. The implementation is

done by the project owners and teams usually within 12 weeks. Reviewing and estimating the impact of the recommended actions is part of the implementing process and last the closure work session is held. (Ulrich et al. 2002: 95-96.)

In practice this was done so that one workshop session was arranged in Estonia, since half of the purchasing team was located in Estonia. The workshop took place in January 2015. This session lasted for one whole day to get the maximum benefits of the arranged event. The schedule, baseline data and goals of the workshop were distributed to the buyers in advance, so that efficient preparations were assured. The results of the workshop were listed on a template found in appendix 2.

5 Purchasing Lead Time Reduction with ABB Oy, Drives Suppliers

This section is going to present the current status of the purchasing lead time reduction in ABB Oy, Drives and its goals. The workshop plan and execution are also presented. Most importantly the results of the workshop are brought out.

5.1 Current Status and Goals

In the purchasing department of the case company there was no special attention given to purchasing lead time reduction until the autumn of 2014. A lead time key performance indicator was created by one of the buyers to measure the time it takes from placing the order to the supplier to receiving the order. The key performance indicator (KPI) means that the performance of a process is measured. The process cannot be improved if it is not measured. Otherwise it would remain unknown whether improvement has been achieved or not. The measurement has been going on for only a few months and it is planned to be continued and made global among other local business units of ABB Drives.

Through this Lead Time KPI it is now possible to follow, measure and analyze the development of the purchasing lead times. The KPI consists of many factors such as purchase order placement date, planned delivery date, the actual received date and net value of the ordered products. The planned and the actual purchasing lead times are compared to each other. This comparison shows whether the supplier reaches the goals of the set and agreed lead times. The value of the purchasing lead time KPI is calculated as follows:

Planned Lead Time KPI

$$= \frac{\sum ((\text{Planned delivery date} - \text{Order placement date}) * \text{Net value})}{\sum \text{Net value}}$$

$$\text{Actual Lead Time KPI} = \frac{\sum ((\text{Actual received date} - \text{Order placement date}) * \text{Net value})}{\sum \text{Net value}}$$

As shown in the above formula, in the planned lead time KPI formula the planned delivery date is the date that the buyer sets on the purchase order when the goods are wanted

to the warehouse. The order placement date is the date when the purchase order is made and released to the supplier. The net value in the formula is the whole purchase order line value. The only difference in the formula of the actual lead time KPI is that the planned delivery date is not taken into account while the actual reception date of the purchase order line is. In this way the comparison of the actual and planned lead time is possible.

By analyzing the current status of the purchasing lead time, it was discovered that on average almost every month the suppliers have not been able to deliver as planned and this affects also the on-time delivery KPI. When purchasing lead times are reduced, at the same time the on-time delivery KPI is increased if the suppliers can meet the agreed lead times. When the planned lead time is much lower than the actual lead time, it can be seen that the on time delivery KPI is affected. As can be seen from figure 4, there were only a few months when the actual lead time was lower than the planned lead time.

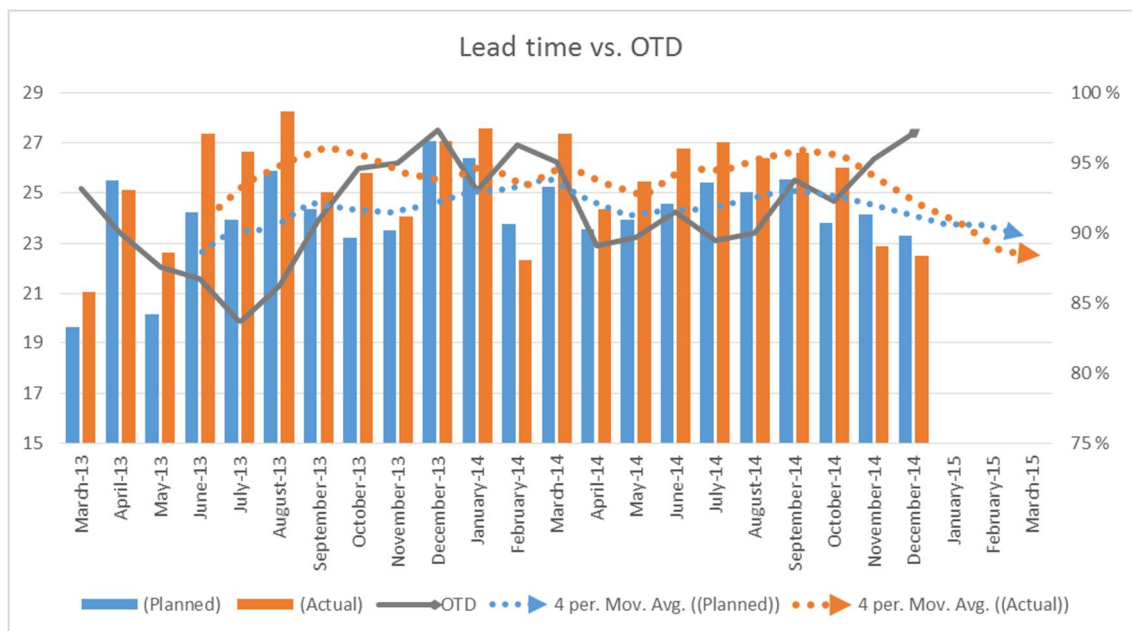


Figure 4 Lead Time vs. OTD

The lead time KPI showed that the top 25 suppliers with the longest lead times were mostly located in Asia. The same suppliers were continuously ranked on the top 25 list with the longest lead times. Also a connection between the types of materials was noticed. Many suppliers that supply expensive electronic components with long production lead time such as box builds, circuit and control boards were at the top of the list. Also

expensive component suppliers which supply chokes, capacitors and IGBT modules were on the top 25 list. Materials like this usually have long manufacturing times.

The reliability of this lead time KPI was also taken into consideration. The actual received dates may not be correct due to human errors or waiting times in the goods reception or due to a faulty goods reception. Also if prices of the order lines are not correct, they must be corrected manually once the invoice is received. This means that the goods reception must be canceled in the system and renewed after the price change. This kind of mistakes might lead to a fault with the reception date, since the correction must be done manually. Partial deliveries also cause confusion in the reception dates, since half of the purchase order lines might be received on time but the other half are received late.

Purchasing Lead Time Reduction Workshop

To achieve and plan the actions for reducing purchasing lead time it was planned to arrange a workshop for all buyers. The reduction of the purchasing lead time was set as one of the main actions of the purchasing plan for 2015.

The most important goal of the workshops was to produce an action list. This action list included the following factors: the selected supplier, the actions planned to reduce the lead time, the target set for the new lead time and the resources needed for the actions and also time goals were set for the actions. Also the resources needed to accomplish the set actions of lead time reduction, whether a project or other resources were needed or if the reduction can be done by the buyer itself, were mapped. The time schedule was also set separately for each supplier and each action. The time schedule was set realistically since this matter of purchasing lead time reductions was new for the purchasing team.

The suppliers were selected by analyzing the lead time KPI. The selection was also based on the information of the suppliers' potentials. Each buyer had specified information of their own suppliers and it was used when selecting the potential suppliers for the purchasing lead time reduction. All the buyers were gathered together and set into the commodity teams. The goal was to identify the suppliers from the commodities that would give the most benefit by minimum input of reducing the purchasing lead time.

Naturally, the value of the total purchased order lines are directly affecting the inventory value of the case company. The shorter the lead time, the lower the inventory value. So the suppliers that bring the most value to the stock and at the same time have long lead times should have their purchasing lead times reduced. In this way the greatest benefit would be achieved.

The numeric goal of reducing the actual purchasing lead time was set per supplier. Each buyer who would start the work with reducing purchasing lead times set the goal for each supplier separately. The key was to get the planned lead time lower and at the same time assure that suppliers could meet the new lead times so that the OTD would not be effected. The actual lead time KPI in quarter four varied from 5.15 to 0.20 in the top 25 suppliers with the longest lead time. These numbers calculated in the KPI were ratios. When comparing these lead times with the on-time delivery KPI, the lead times of all suppliers were summed. The actual summed ratio of the lead time KPI was 24.0 when the planned KPI ratio was 23.8. These KPI figures are ratios to compare suppliers. As table 3 below shows at least since measuring of the lead time KPI was started, the suppliers had never met the quarterly planned lead time on an average. From table 3 it can be also seen that in 2013 the planned lead times have been lower compared to 2014 except in quarter four.

Table 3. Planned vs Actual Lead Time Compared to OTD

Quarter	Planned	Actual	OTD
Q2.2013	23,23	24,88	89 %
Q3.2013	24,70	26,64	87 %
Q4.2013	24,32	25,54	96 %
Q1.2014	25,18	25,90	95 %
Q2.2014	24,01	25,53	91 %
Q3.2014	25,33	26,68	92 %
Q4.2014	23,77	23,98	95 %

A concerning fact was that when the planned lead time was lower in 2013, the overall OTD was also lower. This means that the suppliers were not able to meet the set targets of the lead times. In quarter four quite significant improvements in lead times were accomplished. On average suppliers were able to meet the goals of the lead times quite well and at the same time the on-time delivery indicator was improved.

5.2 Workshop Execution

The workshop for reducing the purchasing lead time was held on 26 January in Estonia, in the Drives factory area. Since half of the purchasing is located in Estonia and half in Finland it was decided to hold the workshop in Estonia. Almost all buyers were able to participate in the workshop, which was in favor of decent results. The participants are listed in the references. In the below list is presented the more detailed time schedule of the workshop. The opening and the closing of the workshop are not included in the actual work list of the workshop. This list shows the time line of the workshop which was followed.

- Each buyer selected and wrote down their own potential suppliers. Time given for this action was 15 minutes.
- Suppliers chosen by the buyers were presented to their own team. Time for this action was 10 minutes.
- Suppliers with most potential to deliver biggest pay-off with a minimum effort were selected together with the team. Time given for this action was 20 minutes.
- Idea generation, what kind of actions were needed to reduce the lead time. Time to complete this action was 30 minutes.
- Lunch break for one hour.
- Idea generation and selection of actions to reduce the lead time. Time given for this action was one hour.
- Coffee break for 15 minutes.

- Action plans were created, target lead times and time goals were set. Needed resources were identified. Time to complete this action was one hour.
- Each team presented their action plan. Time given for each presentation was 10 minutes.

The workshop started with an introduction given by the purchasing manager and the supply chain manager. They emphasized the importance of this workshop and the reduction of the lead times. After the workshop opening, a brief introduction on how the execution would be done was given. The workshop started so that each buyer selected and listed the potential suppliers from their own scale. The planned time for this selection was 15 minutes. The next step was to present the selected suppliers for the team. This action was given 10 minutes. In the execution of the workshop these two steps were mixed by the teams. It was preferred to have an open discussion about the potential suppliers for the lead time reduction.

Ideas about how to reduce the lead time were also discussed among the teams during the morning. After the lunch the actions were selected and verified. Also the conducting of the action plans was started. The actions were listed on the action plan template and the current and target lead times were written down. Also the resources needed for the actions were identified and the target time to achieve the actions was set.

After all the teams had finished their action plans, the plans were presented to the whole purchasing team. The purpose to present the action plans to the team first was to get comments and ideas from each other. Good discussions about the actions and resources followed and new ideas were presented. Finally the action plans were presented to the supply chain manager.

5.3 Workshop Results

The workshop execution gave good results and ideas about how to reduce the purchasing lead time with the suppliers. The actions to reduce the purchasing lead time were mainly focused on the top 25 suppliers of the lead time KPI.

The electrical team identified the need for checking the validity of the data in the ERP (Enterprise Resource Planning) system especially for the new items. The data identified for checking were also chosen. The delivery times and confirmation times together with the planning calendar values were identified for checking. The validity of the ERP system data is crucial since all the data is collected from there to the lead time KPI. This ensures the validity and reliability of the KPI.

Altogether 11 electrical suppliers were chosen for the lead time reduction. The most common action identified was to update the buffer agreement and to agree the delivery time from the buffer stocks. Optimal order quantity harmonization was also identified as one of the actions for several suppliers. To transfer the buffer stocks closer to Finland with a few of the suppliers was identified as one action to reduce lead time. This would shorten the shipping distance which would lead to shorter purchasing lead times. The sharing of more detailed forecast information and stock level information with one of the suppliers had already led to shorter lead times. It would allow the supplier to plan their production more efficiently which would help them to meet their customer's demands on time. One action that had been identified before was to reduce the variety of the products with a certain supplier. This was listed in the electrical team's action list. To complete this action the help of the product engineering is needed. The benefit of this product variety reduction would be much shorter lead times since it will release the working capacity at the supplier's site. The electrical team decided to set the time goals for the action in their next team meeting because of lack of time.

The mechanics team identified six suppliers for the purchasing lead time reduction. The most common action to reduce the lead time was to buy capacity for the supplier. For two of the suppliers more capacity is needed to manufacture the application engineered parts. These parts that are application engineered are customer specific and take time to produce due to the lack of capacity at the supplier's site. The request to have shorter lead times for the application engineered parts came straight from production. One of the suppliers also needs extra capacity to manufacture the cabinets. These actions would reduce the lead time since the supplier would get more capacity to work with and meet the customer's requirements. Also the need for second sources for the materials were identified as one action with two suppliers. Building up buffer stocks for heat sinks would drop the lead time significantly from 42 days to 7 days. Most of the actions listed in the mechanics team's action list require the help of sourcing and a few of the actions

also need help from the product engineering. The target times for these actions were set along the current year.

The electronics team identified suppliers that have long purchasing lead time and manufacture expensive components for the production of the case company. Many of the identified suppliers had the same kind of actions listed in the action list for 2015. A common action for all the suppliers was identified by the electronics team. A formal letter from the managers about the importance of the purchasing lead time reduction should be sent to the suppliers of ABB Oy, Drives. This would help with the purchasing lead time reduction actions to be taken seriously enough and it would require the help of the management team. Another common action noticed was to change the suppliers so that European supplier serve the Helsinki Drives factory and the Chinese suppliers would serve the Beijing Drives factory. In this way ABB Drives would have second sources if needed but mainly the purchasing would be done from European suppliers. This would reduce the purchasing lead time for a number of materials. Calculation should be done to make sure the efficiency of the change. Most probably the item price would grow but significant savings in the transportation costs and time would be made.

The electronics team chose three Chinese suppliers for purchasing lead time reduction. A common action plan was created for all of these three suppliers. All of these suppliers have a finished goods buffer stock for the case company which includes materials that have the largest consumption in the drive production. First of all the buyers need to choose the materials with high consumption with an existing finished goods buffer stock for the lead time reduction. The materials need to be stable without continuous changes to the product structure and they need to have a reliable demand forecast. Currently these materials have a two week purchasing lead time from the buffer stock. The goal is to reduce the purchasing lead time to one week. To achieve this goal the electrical team decided to widen the minimum and maximum levels of the stored items in the finished goods buffer stock. This would give the suppliers flexibility for their own production and storing. The next action was to optimize the order quantities of these chosen products. This would affect ABB Oy, Drives' inventory value and turnover since the order quantities could be reduced due to shorter purchasing lead times. Also one Finnish supplier was chosen for the purchasing lead time reduction. Actions to reduce their purchasing lead times was to harmonize the lead time between materials that have a finished goods buffer or materials with critical components or no buffer stock at all.

All of the three suppliers that were chosen for the purchasing lead time reduction from the electrical category face a problem in transportation times. Currently most of the materials that are purchased from Chinese suppliers are shipped by sea freight which takes about six to eight weeks. This makes it difficult to get any significant improvements on the purchasing lead time since it is so much more expensive to ship the materials by air freight. Calculations should be done to reveal whether it is more expensive to ship those materials by air freight or does it cause more costs to have such a long purchasing lead time.

It was identified among the buyers and managers that a great amount of help from the sourcing department is needed. For a long time the most important factor of purchased materials has been the item price. The sourcing department chooses the suppliers and negotiates the item prices. It has now been noticed that sourcing needs to take into account the other overhead expenses that are for example caused by transportation mode, the shipping distance, lead time and material order quantity. In today's business environment time has become more and more important and this is why the lead time of an item is highly important. The purchasing department needs the sourcing department to focus also on the purchasing lead time reduction so that both teams have similar goals.

The most important outcome of the workshop was the efficient and useful action lists for the current year. The workshop was a great way to start the reductions of the purchasing lead time. It is important to have an actual action list with goals and target times. This forces the buyers to complete the actions that were agreed on. Follow-up meetings should be organized to ensure the completion of the actions.

Further development ideas for the workshop would be that the sourcing team could participate in a workshop also. In practice it would mean that at least one person from each sourcing team would join the purchasing category teams. It would be preferable that the whole sourcing department could participate in the workshop. This would be a great opportunity to share ideas and achieve a common understanding of the purchasing lead time reduction at the same time.

6 Vendor Managed Inventory in ABB Oy, Drives Environment

This chapter introduces a proposal of a vendor managed inventory process for the case company's suppliers. The background and the current status and after that the actual proposal of how the vendor managed inventory would work in the specific environment are presented. Also the elements and issues to be covered by the agreement are presented.

6.1 Background and Current Status

As the purchasing lead times should be reduced by the buyers the reduction of lead times is one of the main jobs of purchasing department nowadays. The reduction can be done through implementing vendor managed inventory with a selected supplier. Vendor managed inventory means that the inventory of the products is totally managed by the supplier. This means that the buyer will not place any purchase orders but instead the supplier is responsible for managing the customers' inventory.

Only a couple of suppliers in the case company's environment have the vendor managed inventory process in use and it is used among small items such as screws, nuts, stickers and manuals. The model of this VMI process used with these small items is modified so that the supplier itself goes to the factory and checks the inventory levels and if needed fills the storage places.

The case company's' environment is built up so that it would support the vendor managed inventory model in some cases. This means that the materials that are wanted in the VMI need to be single sourced or at least it makes it much easier to implement. A major part of the purchased materials are multi sourced. This means that a product has two different suppliers which both deliver the material in allocation. In the case company's environment only few materials are single sourced. The VMI model should be implemented with these single sourced materials. For buyers to reduce the purchasing lead times, vendor managed inventory is one of the solutions, since this process requires that the suppliers' inventories are closer to the ABB Oy, Drives factory.

6.2 Vendor Managed Inventory Process Proposal for Suppliers

For VMI to work between the customer and the supplier, more exact information about demand forecast, inventory levels and actual demand is needed to be shared. Without this information the supplier is not able to fully satisfy the case company's needs. The decisions on what information and how frequently it needs to be shared must be made first. In this case environment the information could be shared through an internet based system called Advanced Supply Chain Collaboration (ASCC). The suppliers have access to this internet based program already to see the forecast and made complaints. This ASCC system already has the requirements to share this kind of information. Also electronic data interchange (EDI) could be used to send the information needed straight to the supplier's system. This requires that the supplier's system needs to be able to receive this kind of information.

The most ideal situation and set up of the VMI process would be that the supplier would move their finished goods inventory closer to the customer. In this case the inventory would be located either at the external warehouse 1 in Vantaa or the external warehouse 2 in Espoo or even nearby in another location. In both places the customer has own warehouse facilities from where the daily deliveries are made to the factory. The supplier would have to acquire their own storage space from one of the warehouses so that the same day deliveries would be possible.

Two kind of proposals of the VMI process flow are introduced next. First the supplier would receive a purchase order that is created by the system automatically. One suggestion would be, that a scheduling agreement is taken into use with the supplier. By taking this into use, it means that the purchase requisitions created by the MRP run are taken out of use and schedule lines are created automatically by the MRP run of the system instead. The schedule lines correspond to the purchase requisitions including the same information as quantity, prices and delivery time information. The only difference is that the schedule lines are like delivery requests and the supplier can invoice according to the schedule lines. This practice is not so compatible with the VMI since the order would be generated in the customer's system first. This would leave the step of the buyer placing the purchase order out, but does not fully support the real idea of the VMI where the supplier decides when to supplement the stock.

The other option, closer to a real VMI relationship would be that ABB Oy, Drives provides electronically the inventory levels and demand forecast information to suppliers system most likely by electronic data interchange (EDI). After the message of the information is received to the suppliers' system, it will automatically generates purchase orders. The supplier would deliver according to these purchase orders placed by the system. After the purchase order is placed, an acknowledgement should be sent to ABB Oy, Drives. From the order acknowledgement a purchase order should be generated in the ABB's system automatically so that it would enable proper invoicing.

Once the order is generated and sent to the suppliers' warehouse or production, it would be picked or manufactured and sent to the customers' factory. In practice, this would be done so that the suppliers' warehouse workers would move the order to the customers' side of the warehouse where the nominated carrier would pick them up and transport them to the factory among other stock transport orders. This is possible only if the supplier agrees to move their finished goods inventory to the same locations as the customers' inventory.

Figure 4 describes a possible process flow for the vendor managed inventory, assuming that the suppliers stock would be placed near the customer and proper connection between suppliers' and customers' systems would be possible. The information movement needed to create an order are shown as dotted lines. A bigger picture can be found from appendix 3.

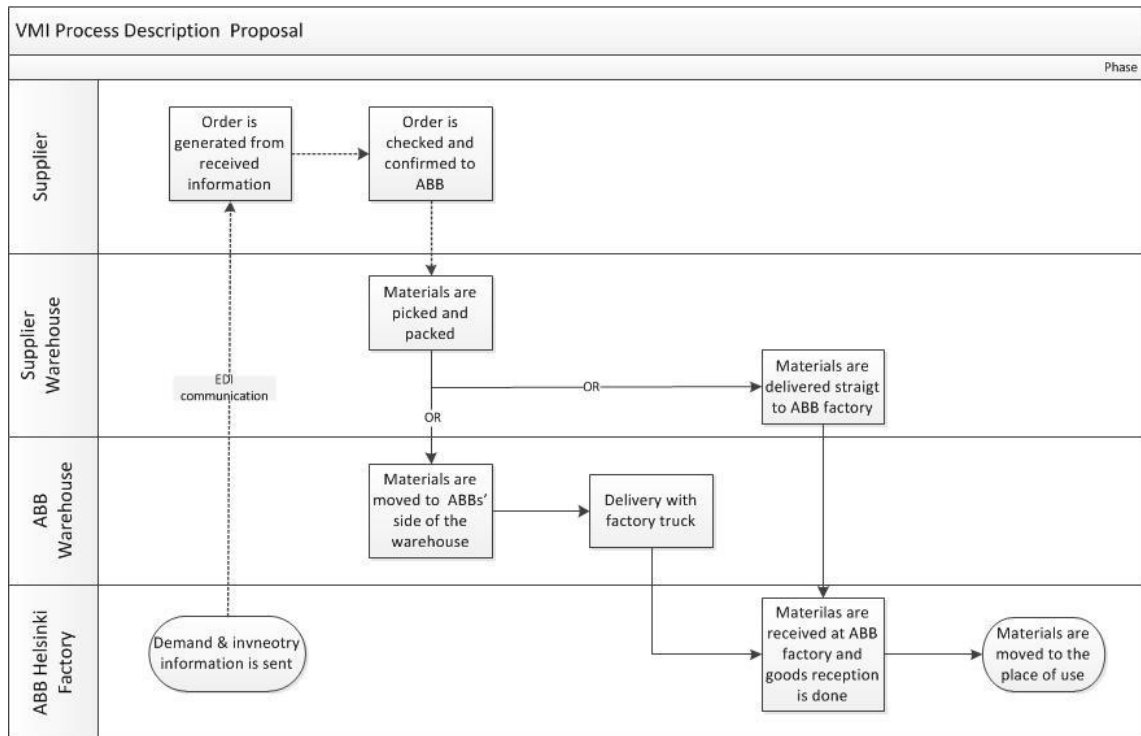


Figure 5. VMI Process Description Proposal

The proposal of the VMI process in figure 4 does not take into account the information sharing in detail. Only the operational processes are described and what information puts the physical materials on move. All other detailed information about stock levels, data connections, responsibilities and conditions are defined in the mutual agreement.

This proposal of VMI process starts from the customer, in this case the ABB Oy, Drives Helsinki factory. The customer is in charge of sending a correct on-time demand and inventory information to the supplier most likely via EDI. The most ideal situation would be that once the demand and inventory information is received in the suppliers system, it would automatically generate the orders. Once orders have been generated, they would be checked by the suppliers' sales assistant.

If the orders are fine they are confirmed and the order confirmation is sent to the ABB's system. Once this information is received, the system generates a purchase order automatically based on the order confirmation sent from the supplier. Now proper invoicing is possible since the customer has a purchase order to match with the invoice.

After the order is checked it is picked and packed and sent either straight to customer's factory or through the customer's warehouse. If the supplier's warehouse is near or at the same location as the customer's warehouse, then it makes sense to just move the ordered products to the customer's side of the warehouse form where daily transportations are made to the factory.

The process ends when the materials are received to the customer's factory and the good reception is done and the materials are moved to the place of use. This process proposal requires that the supplier's warehouse would be near to the customer and proper connection between systems would be possible.

6.3 Vendor Managed Inventory Agreement

When planning to take the VMI into use, it is essential to agree on certain conditions with the supplier. Once an agreement is made it is clear for the both parties what is expected of the relationship. To success in the implementation of the VMI and assure functionality, different conditions and ground rules must be set.

The basic elements on the vendor managed inventory agreement are common and can be implemented with all suppliers qualified for VMI. All supplier specific matters are decided and agreed on separately when planning to take VMI in to use. The outcome of this VMI study section is a check list of elements needed to be agreed on when negotiating with the supplier about taking the VMI concept into use.

Table 4. Elements of the VMI Agreement

Elements of the VMI Agreement	ABB's Requirements & Possibilities	Supplier's Requirements & Possibilities
Scope of work: standards and relationship expectations		
Basic terms and conditions: damages, insurance, prices, invoices		
Service level: supplier and customer responsibilities and KPIs		
Stock ownership and location,	Supplier should have the stock nearby ABB factory/warehouse	
Premises, warehouse and handling facilities		
Replenishment methodology		Supplier's responsibility
Materials included in VMI	Big consumption and value, single sourced materials	
Minimum and maximum inventory levels to be maintained	ABB's risk policy of buffer stocks	
Packing and storage procedures, transportation		
Methodology to share information, system integration	EDI, ACSS	
Content, format and frequency of information shared		
Claim process	Current process, modified if needed	

Table 3 shows the key elements that need to be agreed on with the supplier. This table works as a check list and a template when negotiating the agreement with the supplier. Also the case company's requirements and possibilities are taken in to account as well as suppliers'. This helps to create an agreement that satisfies both parties and both know what to expect from the relationship.

The accurate information sharing methods are not taken into account in table 3, since the methods used in the VMI relationship depend on the supplier's systems and the type of information can be received and how. The purpose of this table is to be used with any supplier that wants to implement the VMI process with ABB Oy, Drives.

7 Results

This chapter is going to present the answers to the research questions of this study and how the results were achieved. Secondly the further development ideas are also presented.

The aim of this study was to identify why the purchasing lead time should be reduced and what the benefits of that would be. The benefits of reducing the purchasing lead time were investigated from ABB Oy, Drives' perspective and from the supplier's point of view. The second target of this study was to recognize the potential suppliers for purchasing lead time reduction and what actions were needed to reduce the purchasing lead time through a workshop. Thirdly the study focused on one selected way, the vendor management inventory, to reduce the purchasing lead time. The goal was to make a process proposal of the vendor managed inventory in the case company's environment and consider the elements of the VMI agreement.

The first goal of this study was achieved by making a comprehensive literature review of the subject. The review showed that the most important reason for ABB Oy, Drives to reduce the purchasing lead times is to decrease the inventory value and speed up the inventory turnover, in this way the need for safety stock reduces and stock-outs and over stocking becomes rarer. It is more desirable to reduce the purchasing lead time than to build up safety stocks to protect the on-time deliveries. Another important reason to reduce the purchasing lead time is that it allows the purchase order to be placed based on the updated demand forecast. This automatically, then, reduces the bullwhip effect. Thirdly it is important to reduce the purchasing lead time because it improves the performance of the company. Since customers are nowadays more and more time-sensitive it is important to react to the market changes quickly. One of the ways to shorten the supply chain is to reduce the purchasing lead time, which will lead to better reactivity.

The demand in the case company is fluctuating and forecasting of the demand is challenging. Reducing the purchasing lead time will make it easier to handle the inaccurate forecast. The case company also tries to reduce their own customer lead time, which means that suppliers should be able to deliver faster also. For ABB Oy, Drives to accomplish their own targets without building bigger safety stocks, it is essential to reduce the purchasing lead time also.

From the suppliers' perspective it is essential to sustain their current customer relationships, which will be accomplished by meeting the customer's needs. Now that ABB Oy, Drives is demanding shorter purchasing lead times, the suppliers should take action. Shorter lead times can be a useful weapon in the competitive markets. This should be noticed by the suppliers.

The most important reason for the supplier to reduce the purchasing lead time is to satisfy the customers' needs and improve their responsiveness. Secondly the advantages of reducing the purchasing lead time are lower cycle time, improved competitive advantage, cash-to-cash cycles becoming shorter, which releases working capital, and the inventory turnover becoming faster. For the supplier the ability to deliver the materials faster and sooner than the competitor is important for achieving successful sales. The same reasons and benefits of reducing purchasing lead time applies to suppliers and customers.

The second goal of this study was to identify potential suppliers for the purchasing lead time reduction and the actions needed to reduce it. The main idea was to identify the supplier that could give the biggest pay-off with a minimum effort. To accomplish this identification, the knowledge of the buyers and the KPI of purchasing lead time were used. The actual identification of the suppliers and the actions were done in the workshop which was held together with the whole purchasing team. The most important output of the workshop was the action plans for the year 2015 of each category team.

The workshop gave expected results on reducing the purchasing lead time. The suppliers and the actions were selected so that they would deliver significant advantages compared to the effort. Altogether there were 22 suppliers identified for the purchasing lead time reduction with various actions. Some of the actions were achievable with the resources of the buyer, but some of the actions required the help of the sourcing department, product engineering and the management.

There were a couple of common actions identified that could be implemented to reduce the lead time of several suppliers. First of all a formal letter from the supply chain management should be distributed to the suppliers. This letter should emphasize the importance of the purchasing lead time reduction and recommend the suppliers to take action. The second action was to check and update the data in the ERP system. Since all the data into the lead time KPI is collected from the ERP system, the data there should

be on time and corrected if needed. Third action was to replace the Chinese suppliers by European suppliers. This would reduce the purchasing lead time significantly since the geographical distance would not be long. This action will need calculations to see, whether it is beneficial cashwise.

The third goal of this study was to make a process proposal for vendor managed inventory in ABB Oy, Drives' environment and also consider the elements of a vendor managed inventory agreement. This section of the study was done by conducting a literature review of vendor managed inventory and the agreement of the model. Also current VMI processes used in the case company's environment were used as a reference to create a common process proposal of vendor managed inventory. The actual creation of the process proposal was done by the Microsoft Visio program. The common elements of the vendor managed inventory agreement were presented in a table where the ABB Oy, Drives' requirement and possibilities were listed. This table can be used as a template and a guide line when negotiating with the supplier on the agreement.

The process proposal was made so that the operational actions and processes were described while taking into account the place of action and action content. The actions were not described in too many details since all the suppliers' environments are different depending on, for example, the materials that are delivered and the physical place of the supplier's warehouse or factory. The process description was made to be used as a guideline when planning to take the vendor managed inventory into use. One important part of the vendor managed inventory is the information flow. Accurate and sensitive information about the actual demand, forecast and stock levels need to be shared with the supplier in order to achieve the advantages of the vendor managed inventory. Without this information the supplier will not be able to meet the case company's needs appropriately. The ways to share this kind of information were also discussed in the study. There are different ways to share information but the way taken into use depends on the supplier ERP system and, whether the system is capable to receive certain type of information.

The other part of the third goal was the vendor managed inventory agreement. The element of the agreement were chosen based on the studied literature and current agreements between ABB Oy, Drives and the supplier. The agreement should be made as detailed as possible. In this way conflicts and misunderstanding can be avoided.

The first part to agree on is the standards and the relationship expectations. Both parties then know what to expect of the partnership. Basic terms and conditions for example on damages, insurance, prices and invoices should be agreed on next. Then the responsibilities of the supplier and the customer will be decided on and also the KPIs to be followed will be chosen. The location and ownership of the stock should be chosen and agreed on. For ABB Oy, Drives the best scenario would be that the stock is located nearby the factory or the external warehouses. After that the premises, warehouse and handling facilities should be decided on together. The replenishment methodology of the customer's stock should be the supplier's responsibility and the methodology needs to be recorded on the agreement. Also the claim process is listed in the agreement and how it would work during the relationship.

Materials to be included in the VMI should be chosen by the customer and the supplier. It is preferred to include materials that have big consumption to the VMI. Also, single-sourced materials are easier to implement to the VMI. The minimum and maximum levels of inventory to be maintained need to be agreed on and the case company's risk policy of the buffer stocks need to be taken into account. The packing and storage procedures and the transportation methods must be agreed on together with the supplier. Most importantly the ways to share the needed information and what kind of system integrations can be made must be investigated and agreed on. The content, format and frequency of the information that will be shared must be selected and enrolled in the agreement. This is the main part of the vendor managed inventory that needs to be carefully planned and implemented.

8 Conclusion and Recommendations for Further Development

In conclusion this study gave good and qualified reasons to reduce the purchasing lead time. The arguments brought forward in this study are useful when negotiating on shorter purchasing lead times with the suppliers. The buyers of ABB Oy, Drives can use this study as a guideline when negotiating with the suppliers. It makes it easier to negotiate on purchasing lead time reduction once accurate and concrete arguments in favor are provided.

The purchasing lead time reduction workshop was an effective way to start the actions to reduce the lead times with the potential suppliers. The workshop forced the buyers to

concentrate on the given tasks and develop effective ways to reduce the purchasing lead time. The action plans that were created in the workshop assure that the chosen actions for purchasing lead time reduction are completed.

The process proposal of vendor managed inventory is a good applicable process for ABB Oy, Drives. The process must be modified for each supplier separately and it works as a guideline for the vendor managed inventory process. The template of the agreement elements of vendor managed inventory is a good outline for the mutual agreement and the template can work also as a check list. The process proposal and the template of the agreement elements can be very useful for the buyers if setting up the vendor managed inventory model.

This chapter briefly introduces some further development ideas that arose while this study was conducted. First of all a presentation could be prepared that would include all the main advantages and reasons why the purchasing lead time should be reduced. A presentation that would be easy to share with the suppliers, and it could contribute to the negotiations of purchasing lead time reduction.

Secondly calculations of how much one lead time day would cost for ABB Oy, Drives should be made. In this way the effect of the purchasing lead time could be understood even better. Accurate calculation of the cost of one lead time day would help to compare whether it is more efficient to purchase materials from a supplier that is close or from Asia. When purchasing from Asian suppliers, the transportation costs might rise on a high level and it would take time to ship the goods from there to Finland. The calculations should take all the factors into account including the cost of one lead time day.

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Appendix 1: Workshop participants

Workshop Participants	
26.1.2015	
Name	Role
Kimmo Lampinen	Purchasing Manager FI
Piret Krutob	Purchasing Manager EE
Jane-Li Zhang	SCM Manager
Risto Retsja	Buyer
Outi Liukonen	Buyer
Pasi Tuomi	Lead Buyer
Tuija Ålander	Development Specialist
Toomas Lepiku	Buyer
Oliver Liiv	Buyer
Enely Schneider	Buyer
Tuula Koskela	Lead Buyer
Kadri Tamme	ERP Specialist
Taavi Lond	Buyer
Tarmo Tamm	Buyer
Getter Kalev	Trainee
Mart Poldma	Buyer
Mikko Lahti	Lead Buyer

Appendix 2: Purchasing Lead Time Reduction Workshop Template

Purchasing Lead Time Reduction Workshop

Team: _____ Date: _____

Participants:

Name	Role

Purchasing Lead Time Reduction Workshop

1. Baseline data – the 25 suppliers with highest LT – Team Electronics Q4

Ranking	Row Labels	Received Value	PO line	Received Quantity	Average of PLANNED LT	Weighted Ave. Of PLANNED LT	Average of ACTUAL LT	Weighted Ave. Of ACTUAL LT	DIFFERENCE (Planned-Actual)	Sum of Net value*LT per Poline	Sum of Net value*LT per Poline	KPI PLANNED	KPI ACTUAL
1	Supplier 1	Censored	843	118 777	32	24	55	40	-16	Censored	Censored	3,04	5,14
2	Supplier 2	Censored	245	32 805	51	46	52	48	-2	Censored	Censored	1,48	1,56
4	Supplier 4	Censored	251	1 603	25	24	20	20	4	Censored	Censored	1,25	1,03
11	Supplier 11	Censored	726	127 692	11	11	11	11	-1	Censored	Censored	0,54	0,58
12	Supplier 12	Censored	113	10 255	56	52	51	47	5	Censored	Censored	0,52	0,47
14	Supplier 14	Censored	91	9 190	43	44	39	39	5	Censored	Censored	0,44	0,39
18	Supplier 18	Censored	87	15 280	23	21	21	20	0	Censored	Censored	0,26	0,26

Purchasing Lead Time Reduction Workshop

1. Baseline data – the 25 suppliers with highest LT - Team Electrical Q4

Ranking	Row Labels	Received Value	PO line	Received Quantity	Average of PLANNED LT	Weighted Ave. Of PLANNED LT	Average of ACTUAL LT	Weighted Ave. Of ACTUAL LT	DIFFERENCE (Planned-Actual)	Sum of Net value*LT per Poline	Sum of Net value*LT per Poline	KPI PLANNED	KPI ACTUAL
3	Supplier 3	Censored	242	41 336	26	24	24	21	3	Censored	Censored	1,33	1,19
8	Supplier 8	Censored	115	173 869	30	29	30	26	2	Censored	Censored	0,89	0,81
10	Supplier 10	Censored	1 233	12 847	11	16	9	13	2	Censored	Censored	0,88	0,76
13	Supplier 13	Censored	70	9 437	20	82	12	39	43	Censored	Censored	0,85	0,40
15	Supplier 15	Censored	208	1 107	26	29	25	28	2	Censored	Censored	0,33	0,31
17	Supplier 17	Censored	236	94 159	42	81	28	39	12	Censored	Censored	0,35	0,27
21	Supplier 21	Censored	895	20 411	22	24	16	19	5	Censored	Censored	0,29	0,24
22	Supplier 22	Censored	62	43 410	36	21	27	14	7	Censored	Censored	0,32	0,22
23	Supplier 23	Censored	157	17 902	16	16	14	14	2	Censored	Censored	0,25	0,21

Purchasing Lead Time Reduction Workshop

1. Baseline data – the 25 suppliers with highest LT – Team Mechanics Q4

Ranking	Row Labels	Received Value	PO line	Received Quantity	Average of PLANNED LT	Weighted Ave. Of PLANNED LT	Average of ACTUAL LT	Weighted Ave. Of ACTUAL LT	DIFFERENCE (Planned-Actual)	Sum of Net value*LT per Poline	Sum of Net value*LT per Poline	KPI PLANNED	KPI ACTUAL
5	Supplier 5	Censored	276	372	25	24	29	28	-4	Censored	Censored	0,76	0,90
6	Supplier 6	Censored	597	67 419	55	69	47	52	17	Censored	Censored	1,17	0,88
7	Supplier 7	Censored	22	40	76	80	67	71	9	Censored	Censored	0,99	0,88
9	Supplier 9	Censored	4 459	234 102	11	16	9	17	-1	Censored	Censored	0,74	0,77
16	Supplier 16	Censored	2 465	226 067	10	10	9	9	2	Censored	Censored	0,35	0,30
19	Supplier 19	Censored	31	288	60	60	59	60	0	Censored	Censored	0,26	0,26
20	Supplier 20	Censored	1 615	224 271	14	15	10	11	4	Censored	Censored	0,33	0,25
24	Supplier 24	Censored	403	49 477	17	17	14	15	2	Censored	Censored	0,24	0,21
25	Supplier 25	Censored	381	19 434	16	18	13	15	3	Censored	Censored	0,24	0,20

Appendix 3: Vendor Managed Inventory Process Description Proposal

