A framework for implementing the VMI model in an MRO partnership

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Abstract

**Purpose** - The purpose of this paper is to investigate the feasibility of implementing the Vendor Managed Inventory (VMI) model in an MRO (maintenance, repair, and operations) partnership, and highlight its potential economic, environmental, and organizational benefits, as well as limitations.

**Approach** - First, a comprehensive literature review was conducted on fields relevant to VMI. Second, empirical data was gathered from a single exploratory case study with Momentum Industrial, and its customer Stora Enso. Semi-structured interviews were used to gather data from the case companies.

**Findings** - Results suggest that VMI results in benefits for the supply chain in general, such as reduced administration and inventory costs, improved service levels, reduced information distortion, and improved relationship among partners. For the particular case of VMI in an MRO partnership, improved service levels can be obtained by a reduced risk of production downtime for the customer. Moreover, the implementation of VMI has potential environmental benefits, such as reduced paper use, and higher transportation fill rate. Limitations of implementing VMI include the difficulty in system integration, and information sharing. Trust could be a potential issue that limits information sharing amongst supply chain partners. Moreover, the difference in organizational cultures and policies of partners should be taken into consideration.

**Limitations** - The study is limited to opinions from one MRO customer in the paper and packaging industry. Even though the questions asked to informants in Momentum and Stora Enso tackled benefits to MRO customers in general, a broader image could have been achieved by interviewing customers from different industries. Moreover, the case companies do not currently adopt VMI in their partnership, so the case study results are based on what they think would be the potential benefits and limitations of implementing VMI in an MRO partnership.

**Practical Implications** - This paper can serve as a guideline for logistics managers who are considering VMI in an MRO partnership specifically, as it provides them with the benefits and limitations associated with VMI. More generally, any company considering VMI can also benefit from the theoretical framework presented.

**Keywords** - Supply Chain Management, Sustainable Logistics, MRO (Maintenance, Repair, and Operations), Vendor Managed Inventory, Electronic Data Interchange
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We hope that our humble work has contributed in adding fruitful knowledge to our field of study.

Best regards,

Abdulrahman & Lina
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1. Introduction

Purchases made by businesses are classified by Kaplan and Sawhney (2000) into manufacturing inputs and operating inputs. Manufacturing inputs are materials that are parts of the end product such as raw materials. Operating inputs are not parts of the end product and they are usually referred to as MRO (Maintenance, Repair, and Operations) supplies, which for example can be maintenance parts that are added to production lines. MRO suppliers directly provide products, for instance, repair and maintenance parts to an organization (Kulkarni et al., 2011; Michaelides et al., 2003). Over the last years, MRO suppliers have developed from working with only one organization to being responsible for materials of several organizations. One of the MRO supplier's responsibilities is to provide cost benefits and maintain the quality for the organizations. Manufacturing organizations that want to focus on their core business functions are starting to work with MRO suppliers (Michaelides et al., 2003). MRO suppliers can also offer services such as delivery and consultancy along with their products.

Vendor managed inventory (VMI) is a collaborative commerce initiative that authorizes suppliers to manage the customer’s inventory of stock-keeping units (Yao et al., 2007). James et al. (1997, p. 2) describe VMI as an “approach to stock management, by attempting to optimize the overall operation of two separate nodes together, should deliver both increased effectiveness and efficiency within the supply chain”. It is a supply chain model that is used to integrate operations by using information technology techniques such as Electronic Data Interchange (EDI), which enables real time information sharing between suppliers and customers as an organizational benefit (Dong & Xu, 2002). Reduced inventory costs for the suppliers and improved service levels for the customers, such as higher fill rate and lower order cycle times, are potential economic benefits of adopting VMI (Yao et al., 2007).

Sanchez-Rodrigues et al. (2010) emphasize on the impact of supply chain uncertainty on environmental sustainability. Their findings indicate that the main factors that affect the uncertainty of transport operations are delays, variable demand/poor information, delivery constraints, and insufficient supply chain integration. Thus, enhanced information flow and supply chain integration as a result of VMI could lead to potential environmental benefits, since uncertainty has a negative effect on sustainability of transports (Sanchez-Rodrigues et al., 2010). For instance, the truckloads can be more utilized after implementing VMI according to Claassen et al. (2008), and Waller et al. (1999).

Previous research discussed what VMI can bring to both the suppliers and the customers in general (Disney & Towill, 2003; James et al., 1997). However, the benefits of VMI vary in different supply chains and depend on product demand (Kaipia et al., 2002). VMI has been implemented in various businesses including mass retail industries, telecommunications, and even hospitals (Dong & Xu, 2002). The area of VMI was addressed in various previous researches. For instance, Dong and Xu (2002) conduct a quantitative study to explore the effects of VMI on supply chain relationships, where they focus on inventory systems, purchase prices, and purchase quantities. James et al. (1997) conduct twenty case studies to understand the operation, benefits, limitations, and contextual nature of VMI from the managers’ point of view. Five of the case studies were performed with suppliers while fifteen were performed with customers. Claassen et al. (2008) conduct a research that aims to compare theory and practice on performance outcomes of VMI and identify enablers of successful VMI implementation. Disney and
Towill (2003) conducted a simulation study to investigate how VMI can affect the bullwhip effect on supply chains. Vigtil (2007) performs a study that aims to find what information is critical for a successful implementation of VMI. Kaipia et al. (2002) conduct case studies on VMI between a grocery manufacturer and a sales company, a consumer paper manufacturer and a wholesaler, and in a hygiene products supply chain. Yet, there seems to be lack of literature on the benefits and limitations of VMI in an MRO partnership. Allocating the replenishment decision to the vendor may result in a significant benefit especially in the case of low-value items like MRO supplies (Lysons & Gillingham 2003, cited in Sarpola 2007).

The purpose of the research is to investigate the feasibility of implementing a VMI model between an MRO supplier and its customers. The paper will highlight the potential economic, environmental, and organizational benefits, drawbacks, and limitations of the VMI model. The following are research questions that the authors aim to answer:

**RQ1**: What are the economic, environmental, and organizational benefits of adopting a VMI model between an MRO supplier and its customers?

**RQ2**: What are the drawbacks and limitations of implementing a VMI model between an MRO supplier and its customers?

To approach the research questions, a thorough literature review on VMI, MRO, supply chain management (SCM), and sustainable logistics will be conducted first. After that, a case study with Momentum Industrial, an MRO supplier, and one of its customers will be carried out. The case study will enable the researchers to compare the literature findings on the feasibility of using the VMI model to empirical data gathered from the case companies. Semi-structured interviews will be used to collect data for the case study.

This research will present a framework for implementing the VMI model in an MRO partnership. The framework includes the potential benefits that could be achieved by adopting VMI, and the limitations associated with it. There are knowledge motives, practical motives, and sustainable motives to this study. Practical motives include guidelines for Momentum Industrial and its customers to refer to if they decide to adopt the VMI model. Additionally, the research can generally serve supply chain/logistics managers in MRO supply industries and customers of MRO products and services. Knowledge motives include fulfilling a gap in the literature mentioned earlier, regarding VMI in MRO partnerships. Moreover, the paper will add to the pool of knowledge on MRO, SCM, sustainable logistics, vendor managed inventory, and electronic data interchange. Sustainable motives will relate to the potential environmental benefits that can be accompanied with the VMI model.

In the next chapter, the details of the method followed by the researchers, the validity, generalizability, and reliability will be discussed. Additionally, the case companies will be introduced. After that, a comprehensive literature review will be presented. In the Results chapter, empirical findings from the case study with Momentum Industrial AB and its customers will be presented. Results will be discussed and compared to the literature in the Analysis and Discussion chapter. In the last chapter, a conclusion of the findings, limitations of the paper, and further research will be presented.
2. Methodology

This chapter will describe the method applied to approach the research questions and fulfill the research gap. A description of the involved case companies will also be presented. Moreover, the validity, reliability, and generalizability of the research will be discussed. Finally, ethical and societal aspects of the research will be tackled in this chapter.

2.1 Research approach

The inductive and deductive approaches are the two main Western research approaches that can potentially result in the creation of new knowledge (Spens & Kovács, 2006). The inductive way of research is a theory development process that starts with observations of certain happenings and then making generalizations about the observed phenomenon. The deductive approach, on the other hand, is a theory testing process that starts by forming a theoretical basis and generalization then testing its validity during specific instances. A third approach that is less known than the former two is the abductive approach. The abductive approach follows the logic of finding the causes or explanations of the studied effect (Spens & Kovács, 2006). The three different approaches can be shown in Figure 1 below (cf. Spens & Kovács, 2006):

![Figure 1: The deductive, inductive, and abductive research approaches](image)

Deductive positivism is usually described as the primary research approach in logistics research (Spens & Kovács, 2006). Deductive research starts by exploring theory, then drawing logical conclusions in the form of general hypotheses, and lastly, testing the formed hypotheses empirically. In other words, deductive reasoning can be defined as a theory testing process that starts by building general theory, and testing whether this theory is valid for specific cases. New knowledge is created after the corroboration or falsification of the tested hypotheses (Spens & Kovács, 2006).

Spens and Kovács (2006) state that many different data collection and analysis techniques are used in logistics research, both of which are qualitative and quantitative. They go on to say that quantitative methods are usually linked with quantifiable data and numerical data analysis. In contrast, qualitative methods involve the collection of non-numerical
data. However, they conclude that it is the data analysis method, not the data collection method, that decides whether a research should be considered qualitative or quantitative.

This research is considered qualitative, as both the data collection and data analysis methods are qualitative. Moreover, the adopted research approach is deductive. After spotting a research gap and generating research questions, the researchers performed a comprehensive literature review on the following topics: Supply Chain Management, Sustainable Logistics, MRO (Maintenance, Repair, and Operations), Vendor Managed Inventory, and Electronic Data Interchange. Based on the literature review, a theoretical framework was constructed to highlight the benefits and drawbacks of implementing VMI. Since the authors believe that there is a research gap on the applicability of the VMI model in an MRO partnership, the literature review is limited to VMI benefits and drawbacks in general, as no previous research tackling this area was found. This research aims at investigating why MRO suppliers should consider or disregard VMI models, so a case study is suitable to complement the research methodology according to Yin (1994).

The researchers conducted an exploratory single case study in order to compare theory to practice and investigate the potential of adopting VMI for MRO suppliers in Sweden. The case study was performed with Momentum Industrial and its customer, Stora Enso. Face-to-face and telephone interviews were conducted with informants from the case companies to collect primary data. Secondary data for the case study was collected from websites of involved companies. After performing the interviews, the data was analyzed and compared to the theoretical framework. The end result is a refined framework that merges indications from theory and findings from practice. The research approach can be illustrated in Figure 2:

![Figure 2: Research approach](image)

Qualitative researches are concerned with subjective assessment of attitudes, opinions, and behavior (Kothari, 2004). Attride-Stirling (2001) argues that when doing a qualitative research, it is essential to analyze the collected data all the way from project starts with ideas to the interviews, and analysis. Furthermore, it is also important that the value of the possible results lies in doing a good methodological work and research process. Biggam (2015) states that qualitative research is linked to in-depth studies, and involves exploratory studies that should be carried out in the subject’s normal environment. Moreover, the author implies that qualitative research involves the term phenomenology.

Primary data is data that is gathered by the authors themselves, such as responses from interviews. Secondary data, on the other hand, is data or information that has already been collected by somebody else or for other purposes, such as literature findings (Andersen...
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Altabba, A. & Karlsson, L & Schwencke, 2013). For this thesis, secondary data was gathered from books, articles and case companies’ websites, whereas the primary data are answers from the interviews with respondents from the case companies.

The case study method, according to Kothari (2004), is a very common form of qualitative analysis. It encompasses a careful and comprehensive observation of a social unit, be that unit a person, a family, an organization, a cultural group or even the entire community (Kothari, 2004). Since a case study method was used, the philosophy followed by the researchers can be described as phenomenological, one that has high respect for the uniqueness of human experience (Hycner, 1985). Merriam (2009, p. 40) describes a case study as “an in-depth description and analysis of a bounded system”, while Yin (2008, p. 18) defines a case study as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when boundaries between phenomenon and context are not clearly evident”. Yin (1994) lists typical criticism against the case study method and how it can be compensated for. Lack of symmetric handling of data can be neglected by systematic reporting of all evidence. Having no basis for scientific generalization is a point against case studies, but Yin (1994) stated that the purpose is to generalize to theoretical propositions, unlike statistical researches which generalize to populations as a whole. Long durations consumed by case studies are a downside, but the time limits depend on investigators, so that is not an objective critic.

A single case study involves focusing on and understanding one unique case; this would allow the researchers to discover and develop a single case, while observing the effects of different elements (Baxter & Jack, 2008). Yin (2013) implies that a single case study could add a significant contribution to knowledge by extending the theory. However, a single case study can decrease the generalizability of a research, since the information collected is from one case only (Yin, 2011).

2.1.1 Secondary data collection

One of the most vital parts in a thesis is reviewing the literature and exploring previous theoretical findings. It provides the authors with important information about the research, such as research methods and theoretical standpoints. It also helps with the limitation and identification of the research problem (Walliman, 2011).

Fink (2014) states that databases can be used to find relevant articles; these databases could be found through schools’ libraries, which provide free access to different databases. To find relevant literature that can help with fulfilling the purpose and answering the research questions of this thesis, the University of Gävle’s electronic library has been used as a source for accessing relevant search engines, such as Google Scholar and Web of Science. Google Scholar is the search engine that has been used most when searching for scientific articles, which is recommended by Walters (2007), and Andersen and Schwencke (2013). Furthermore, Walters (2007) explains that Google Scholar is a valuable place to search for articles due to its comprehensive coverage. The keywords that were mainly used in the search for scientific articles were: Supply Chain Management, MRO (Maintenance, Repair, and Operations), Vendor Managed Inventory, Electronic Data Interchange, and Sustainable Logistics. Walliman (2011) recommends that relevant literature should be reviewed in a systematic and meticulous way; this can be through reading the literature and checking if it can be connected to the research problem. Using a systematic approach when searching for and writing about literature is also time-saving. For instance, keeping track of the details of each piece of literature could
save valuable time during the finalization of the thesis, especially when it comes to writing the reference list; there will be no need to remember and retrace the references and details (Walliman, 2011). The researchers’ approach has been to search for articles, write down the titles of articles, read those that seem most relevant to the subject, and then use them in building the theoretical framework. This approach is also recommended by Andersen and Schwencke (2013).

After building the theoretical framework, a theoretical model was created that summarizes the different benefits of VMI in general, and categorizes them according to their beneficiaries. The theoretical model’s purpose is to highlight the general benefits that are frequently mentioned in previous researches. The general benefits of VMI will provide a good indication of VMI benefits in an MRO partnership.

2.1.2 Primary data collection and analysis

In total, five interviews were carried out with three interviewees. From Momentum Industrial, the sales managers, Jimmy Haaranen, and logistics manager, Dennis Nordli, were interviewed. Anders Malmborg, a purchasing manager in Stora Enso, was interviewed as his organization is a customer of Momentum Industrial. The choice of customer was made with the help of Momentum Industrial. Two initial interviews with Momentum were performed to understand how the logistics processes work in an MRO relationship and explore research opportunities within the field. After deciding on the purpose and research questions and building the theoretical framework, individual in-depth interviews were performed with the three interviewees. One of the in-depth interviews was conducted in Swedish, based on a request from the interviewee, the logistics manager of Momentum. The interview was conducted by one of the authors who later on translated the answers to English, so the interview could be transcribed by both authors. The interviews log can be shown in Table 1 below:

<table>
<thead>
<tr>
<th>Interview</th>
<th>Interviewee</th>
<th>Position</th>
<th>Case Company</th>
<th>Date</th>
<th>Duration</th>
<th>Type</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jimmy Haaranen</td>
<td>Sales Manager</td>
<td>Momentum Industrial</td>
<td>1/3/2016</td>
<td>90 mins</td>
<td>Face-to-face</td>
<td>English</td>
</tr>
<tr>
<td>2</td>
<td>Dennis Nordli</td>
<td>Logistics Manager</td>
<td>Momentum Industrial</td>
<td>2/3/2016</td>
<td>30 mins</td>
<td>Telephone</td>
<td>English</td>
</tr>
<tr>
<td>3</td>
<td>Jimmy Haaranen</td>
<td>Sales Manager</td>
<td>Momentum Industrial</td>
<td>22/4/2016</td>
<td>100 mins</td>
<td>Face-to-face</td>
<td>English</td>
</tr>
<tr>
<td>4</td>
<td>Anders Malmborg</td>
<td>Purchasing Manager</td>
<td>Stora Enso</td>
<td>28/4/2016</td>
<td>35 mins</td>
<td>Face-to-face</td>
<td>English</td>
</tr>
<tr>
<td>5</td>
<td>Dennis Nordli</td>
<td>Logistics Manager</td>
<td>Momentum Industrial</td>
<td>28/4/2016</td>
<td>40 mins</td>
<td>Telephone</td>
<td>Swedish</td>
</tr>
</tbody>
</table>

The priority of the researchers was to perform face-to-face interviews as recommended by Biggam (2015), who states that personal interviews are more extensive. If face-to-face interviews are hard to carry out due to geographical constraints for example, then telephone or Skype interviews could be performed; this was the case with two of the interviews that were conducted with the logistics manager of Momentum Industrial. Furthermore, Biggam (2015) implies that interviews should be recorded to make sure that all the answers and information are saved, which is an approach that has been used by the
authors during the interviews. In addition, Hycner (1985) states that recording interviews is a very important step in the phenomenological analysis of interview data.

All interviews were planned to be semi-structured. Fylan (2005, p. 65) defines semi-structured interviews as “conversations in which you know what you want to find out about - and so have a set of questions to ask and a good idea of what topics will be covered - but the conversation is free to vary, and is likely to change substantially between participants”. Semi-structured interviews are suitable for use to answer “why” questions in a research, to find out more about the research topic through asking a set of questions and having a conversation within the topic, and to find out information that can be used in the study (Fylan, 2005). Semi-structured interviews can provide reliable, comparable qualitative data according to Cohen and Crabtree (2006). Furthermore, they give the informants the freedom to express their perspective in their own terms. The questions asked were based on the built theoretical framework, to make sure they are relevant, and to be able to compare the findings with theory in the analysis part of this paper. The same questions were asked in all the in-depth interviews, except for some additional questions that were only asked to the case company. The consistency of the interviews makes it easier to compare different responses in a systematic way.

As for data analysis, content analysis can be defined as a series of research tools for the scientific study of written communications with the goal of discovering key ideas and themes contained within them (Cullinane & Toy, 2000). Research adopting qualitative content analysis is concerned with the characteristics of language as communication with focus on the content or contextual meaning behind the text (Hsieh & Shannon, 2005). Text data can come in various forms like verbal, print, or electronic and it can be acquired from narrative responses, open-ended survey questions, interviews, focus groups, observations, or print media such as articles, books, or manuals (Hsieh & Shannon, 2005). Hsieh and Shannon (2005, p. 2) define qualitative content analysis as a “research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns”. They further classify it into three categories: conventional, directed, or summative.

Sometimes, incomplete theory or theory that can be further researched exist about a certain phenomenon. In this case, the qualitative researcher can choose a directed approach to content analysis. The objective of directed content analysis is to test the validity of a theoretical framework or extend it, Hsieh and Shannon (2005) imply.

Existing theory can help authors in forming a focused research question, and helps them in deciding on variables of interest. Furthermore, it can help in setting a coding scheme and understanding the relationships between codes. As the analysis of data goes further, the coding scheme can be refined, or extended (Hsieh & Shannon, 2005).

The directed content analysis method is seen by the authors as a method that complements the adopted deductive approach. The interview questions of the case study followed the logic of directed content analysis. Hsieh and Shannon (2005, p. 5) state that in a directed content analysis “if data are collected primarily through interviews, an open-ended question might be used, followed by targeted questions about the predetermined categories”. The authors of this paper started the in-depth interview questions by open-endedly asking the interviewees about their opinions of what is described to be VMI. The interview protocols are attached in the Appendix. After asking the open ended question,
questions about the predetermined categories were asked. The logic of categorization was established based on the research questions and theoretical framework. Figure 3 shows the logic followed to determine the coding scheme that aims to answer the research questions. All interviewees were asked about the benefits of VMI to both the customer and the supplier, to make the results extensive of all viewpoints.

![Figure 3: In-depth interviews coding scheme](image)

“The constant comparative method (CCM) together with theoretical sampling constitute the core of qualitative analysis in the grounded theory approach developed by Glaser and Strauss” (Boeije, 2002, p. 391). The dominant principle when it comes to analyzing the process of a qualitative research is comparison. The comparison principle is according to Boeije (2002) maintained by different kinds of support; from data matrices to close reading and rereading.

As mentioned earlier, the data empirically gathered from the case study will later on be analyzed and compared with the theory. When using CCM, it is therefore important to have a theory that is grounded in data. The data should later on be analyzed again, and compared with other data or theory, to increase the validity and minimize possible mistakes (Boeije, 2002).

When using the CCM method, Boeije (2002) implies that all interviews should be compared with each other. An important aspect is that all the interviews are made with persons that have the same experience, and work within the same area. When using this method, it is easier to compare the answers with theory. Furthermore, by using this method it becomes more evident which interviews can be grouped together and categorized based on their similar answers. However, when doing the comparison, it is important to carry out interviews individually (Boeije, 2002). According to Boeije (2002), interviews should be carried out in the same way with all respondents, to gain further information from each perspective within the chosen area. The interviews could be used to achieve a better understanding of the interviewees’ perspective. They will later on be
compared with each other to get a complete picture of the topic and to develop the information that has been gained during each interview. A comparison between all the interviews could also increase the validity of each answer. Furthermore, the author states that a comparison should be made with everything that crosses the researcher’s path, to gain a result that is as reliable as possible. Moreover, it is often the lack of explication, regarding where the research took place and the results of the comparison, that decreases the credibility of a qualitative report (Boeije, 2002).

For this research, data collected from interviews has been individually transcribed by each author. After that, analyses of the two authors were compared and merged to form one conclusion. In the analysis and discussion part of this paper, answers from different interviews were compared to each other. Answers from Momentum Industrial are given the supplier’s point of view. Answers from Stora Enso, on the other hand, are given the customer’s point of view. However, all interviewees answered what they think would be the benefits to both the suppliers and the customers. The result is a wide scope of different perspectives that when compared together, should construct a reliable database.

2.2 Case companies

2.2.1 MRO supplier - Momentum Industrial AB

Momentum Industrial AB is a Swedish company that is active in Scandinavia, and is one of the leaders in Sweden among MRO suppliers. The company is one of the companies that belong to the B&B Group, and specializes in supplying MRO inputs to customers in Sweden and other Scandinavian countries. The company has 270 employees, and 33 locations including a central warehouse. It serves customers 24 hours a day all year long with services, and a range of 100,000 stock-keeping units (Momentum-industrial, 2016). Momentum Industrial’s products are classified under bearings, seals, transmission, pneumatics, and lubrication and they come from different suppliers, according to the sales manager. The company is concerned with quality and environmental standards, and are certified with ISO 19001 and ISO 14001.

Momentum does not only provide MRO services. They also have an education program, which teaches its customers and suppliers how to enhance the lifetime of a product as well as the total economy of the organization. Furthermore, the company has developed an internal logistics concept called Trouble Free Supply (TFS). Momentum aims at being distinguished from other competitors by this concept. The goal of TFS is optimizing the inventory of Momentum’s customers, carrying out preventative maintenance of their production lines, and ensuring smooth uninterrupted production (Momentum-industrial, 2016). The company adopts this concept with certain customers only depending on several factors. The integration of supply chains and logistics between Momentum and its customers is very critical to both parties. The customers’ productivity is directly affected by the operating inputs, and the availability of goods at Momentum Industrial is affected by the information shared by customers prior to demand forecasting.

2.2.2 MRO customer - Stora Enso

Stora Enso is an international company, with headquarters in Stockholm and Helsinki, that provides solutions in packaging, biomaterials, wood, and paper. Their products are consumed in different areas including packaging, joinery and construction industries; they also supply publishers, printing houses, and paper merchants. The company has
around 26,000 employees that operate in more than 35 countries. In 2015, Stora Enso had sales of EUR 10 billion and their operational earnings before interest and tax was EUR 915 million (Stora-Enso, 2016).

Sustainability plays an important role in Stora Enso’s strategy. Forty-four of the mills across the different locations are ISO 14001 certified, while twenty-eight are ISO 50001 certified (Stora-Enso, 2016). A lot of focus is put on innovating environmentally-friendly products from renewable materials. In addition, the company continuously looks for innovative ways that can improve processes, and save energy and resources in their operations.

The company has its own logistics organization, Stora Enso Logistics, which is responsible for the design, procurement, and management of transport, storage, and distribution solutions. The organization develops logistics processes throughout the supply chain and efficiently manages the information flow of the supply chain. Stora Enso Logistics focuses on eliminating non-value adding costs, improving efficiency, and safeguarding logistics capacity. Stora Enso also encourages its suppliers to replace paper invoices by electronic invoices, as it reduces invoice handling and turnaround times (Stora-Enso, 2016).

2.2.3 Momentum and Stora Enso

Momentum is an MRO supplier to Stora Enso. Stora Enso usually sends manual purchasing orders to Momentum through mail. Moreover, Stora Enso has its own inventory and safety stocks for some parts. For other parts, they are ordered once they are needed only. Momentum is responsible for products delivery in this relationship. Momentum represents the supplier perspective in the case study, while Stora Enso represents the customer perspective.

2.3 Quality assessment

According to Biggam (2015), a valid research needs to have empirical data that has been gathered and analyzed using strategies and techniques that are relevant to the study. In this research, interviews have been used as a data-gathering technique, which is recommended as a valid technique by Biggam (2015).

Yin (2003) identifies four quality assessment tests for case study research: construct validity, internal validity, external validity, and reliability. Construct validity refers to “establishing correct operational measures for the concepts being studied” (Yin, 2003, p. 34). Yin (2003) further recommends some tactics that can be used to increase construct validity, such as using multiple sources of evidence during data collection, and having key informants review a draft of the case study report. These tactics were used by the authors, as multiple sources of evidence were utilized by interviewing two employees from the supplier perspective, Momentum, and one employee from the customer perspective, Stora Enso. Furthermore, a draft was sent to the key contact person at the case company, Momentum. To increase construct validity, the authors have individually analyzed each in-depth interview and conclusions were built based on the meeting points of both authors. Additionally, interviews were voice recorded in case they needed to be accessed after conducting the interviews.

Internal validity is about explaining how and why a certain aspect could lead to the conclusion. For example, how and why the authors draw different conclusions from the
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literature or interviews, and how the results were not influenced by an external factor (Yin, 2003). Schram (2005) states that internal validity is about being able to draw assured conclusions from the study that has been conducted. Internal validity is limited to explanatory or causal studies only and is demonstrated by “establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships” (Yin, 2003, p. 34). Yin (2003) suggests that using logic models in the data analysis phase increases internal validity. Even though our study is not considered explanatory, but rather exploratory, causal relationships were formed while developing the refined model.

External validity, according to Yin (2003, p. 34), refers to “establishing the domain to which a study’s findings can be generalized”. In other words, how generalizable are the findings of the research. A generalizable study, according to Morse (1999), is considered as a privilege of a quantitative research. If a qualitative research is generalizable, it will be more significant, appropriate, and useful (Morse, 1999). However, the research method being a single case study could reduce the generalizability of the results, as indicated by Yin (2011). By conducting only five interviews in this case study, the answers are limited to the thoughts from the case company and one of its customers. The authors of this paper believe that a wider perspective of results could have been achieved if a multiple-case study was performed, or at least more interviews with additional customers were conducted. However, that was not possible due to time constraints and lack of connections. To compensate for this limitation, and to increase the generalizability of the results, the interview questions tackled both perspectives. Momentum were asked about what they believe would be the benefits to them and to the customers in case VMI is implemented. Likewise, when the informant from Stora Enso was interviewed, he was asked about what he believes would be the benefits to Momentum specifically, and to MRO customers in general. During the in-depth interviews, the supplier was specified to be Momentum but the customer was not specified to be Stora Enso. Yin (2003) implies that the use of theory is one tactic to increase external validity for single-case studies. The researchers of this paper have also conducted a thorough literature review, which can be another way to compensate for the lack of a multiple-case study. However, the theory used does not include the benefits and limitations of VMI in an MRO partnership specifically, since the authors believe that this area has not been addressed previously.

Finally, reliability is described as “demonstrating that the operations of a study (such as the data collection procedures) can be repeated, with the same results” (Yin, 2003, p. 34). Golafshani (2003) states that reliability is a significant part of the study’s validity. He explains that the interviews need to have high consistency and accuracy in order to increase the reliability, which is the researcher’s responsibility. The authors believe that two aspects affected the reliability of this study. The first one is the language barrier, as none of the interviewees or researchers has English as their native language. This could have limited the level to which an informant expressed their opinions. The other aspect is bias from the authors’ side in the answers to questions. This can be apparent in the interview questions, attached in the appendix, as each question regarding organizational benefits or limitations was followed by this statement “i.e. number of employees needed, ease of information sharing, etc.”, which might have biased the answers from interviewees. Another incident worth mentioning is that one of the informants asked the authors if there were any more environmental benefits to VMI so he can agree or disagree with. One of the authors mentioned that with VMI, more time to optimize logistics would be available, and thus more sustainable means of transportation could be chosen. The
informant agreed with this statement and expressed his opinion on it, therefore, it was included in the results.

2.4 Ethical and societal aspects

There are some ethical concerns that are associated with conducting this study. First of all, the paper will not be published on any online database or exposed unless Momentum Industrial agrees on that after reviewing the final paper. Interviewees were introduced to the purpose of the interviews clearly. It is a form of deception when subjects do not realize that they are participating in research (Steane, 2004). In addition, interviewees were asked if sound recording interviews is permitted for later use. Privacy is violated if data are collected or spread without the participant’s awareness (Steane, 2004). Furthermore, researchers are supposed to avoid harming anyone in their study in anyway (Steane, 2004), so interviewees have the complete right to stay anonymous, and the researchers are obligated to hide anything that exposes the interviewees. For this case study, the authors asked the interviewees at the end of each in-depth interview if it is permissible to include their names, positions, and company names in the published paper. None of the informants disagreed to that, so the information has been included in the paper.

As when it comes to the societal contribution of the research, this paper aims at having a positive impact on the involved organizations and society in general. As stated in the introduction chapter previously, there is a link between supply chain information transfer and environmental sustainability. Sustainability is a very important aspect of corporate social responsibility. Sustainable development ensures utilizing already existing resources in a way that does not prevent future generations from meeting their needs (WCED, 1987). Thus, by minimizing negative environmental impacts, companies would be acting positively towards the society.
3. Theoretical framework
This chapter will start by presenting literature generally on supply chain management, supply chain integration, EDI, and sustainable logistics. The literature on sustainable logistics will later on be used to develop a linkage between VMI and environmental sustainability, in order to highlight the environmental benefits of VMI. Theory on VMI and EDI from previous researches will be presented later in this chapter. Finally, a theoretical model will be presented.

3.1 Supply chain management
Choon Tan et al. (2002, p. 66) explain supply chain management (SCM) as “linking each element of the manufacturing and supply chain process from raw materials through to the end user, encompassing several organizational boundaries and treating all organizations within the value chain as a unified virtual business entity”. According to Lambert and Cooper (2000), the term SCM was introduced in the early 1980s it has gained a lot of attention after that time.

Choon Tan et al. (2002) imply that it is important to involve suppliers early in the planning stage, to gain theoretical solutions, and choose the best components. Through working with SCM, manufacturers could eliminate waste materials, internal and external, as well as use the capabilities the supplier provides (Choon Tan et al., 2002). Sherer (2005) states that improved management in the supply chain has been recognized by companies as a reason for competitive advantage. Lambert and Cooper (2000) agree with this statement and fill in that a goal when working with SCM is to gain competitive advantages, which lies within the management’s ability to integrate business relationships across the whole supply chain. In order for this to work, the chain needs to contain multiple relationships and businesses, and should not be limited to business-to-business relationships. Through working with SCM, organizations learn to collaborate with other members of the chain along with a new way of handling the business and relationship (Lambert & Cooper, 2000). By working with SCM and focusing on knowledge sharing and learning, organizations can create customer value, that in the long run will lead to competitive advantage. Managing the customer demand and value is an important aspect when it comes to investing and developing resources in the whole supply chain (Esper et al., 2010).

To improve the management and work with competitive advantages, many companies have chosen to invest in software programs, such as EDI, which helps with handling information flow in the whole supply chain. Implementation of these software programs could be made without changing any process, and can also support the existing processes (Sherer, 2005). However, according to Sherer (2005), these programs will not solve any problems that may be in the supply chain, such as difficulties with information sharing and technology.

3.1.1 Supply chain integration
Lambert and Cooper (2000, p. 66) define SCM as an “integration of key business processes from end user through original suppliers that provides products, services and information that add value for customers and other stakeholders”. Vijayasarathy (2010) adds on to this definition of SCM and states that a core element of working with SCM is to integrate business processes with different boundaries of the organization. Through integrating the processes of other supply chain members, the information sharing within
the supply chain increases and the relationship between supply chain partners becomes stronger. Moreover, this process integration decreases the risks of added cost and waste, as well as increases the information exchange, which in return improves the flexibility and productivity (Vijayasarathy, 2010).

Flynn et al. (2010, p. 59) define the term integration as “the unified control of a number of successive or similar economic or especially industrial processes formerly carried on independently”. Furthermore, the authors explain that applying integration into a supply chain is what defines SCI. When doing the integration, the manufacturer collaborates in a strategic way with its supply chain partners, in an effective and efficient way, to achieve flows of products and services through information sharing. The goal is to provide high value to the customers, in a cost efficient way and at a high speed, and to achieve high collaboration within the organization (Flynn et al., 2010). Working with supply integration gives the opportunity to improve performance and provide competitive advantages for an organization, as well as value for the customer. Focusing on the environmental responsibilities and advantages is a way of achieving these opportunities and is supported by researchers as a way of incorporating the demand and supply activities into an organization (Kirchoff et al., 2011).

According to Flynn et al. (2010) SCI can be divided into three dimensions; customer, supplier, and internal integration. Customer and supplier integration are usually identified as external integration, which involves the customer’s core competence that is related to coordination with suppliers. Further, customer integration is about working with customers that are critical to the supply chain. Supply integration, on the other hand, is more about core competencies that are related to critical suppliers. Internal integration emphasizes the manufacturer and its activities. It also helps structuring the organizational strategies and processes, so it becomes more collaborative and can fulfill the customer's demand, as well as interact with its suppliers. Customers usually work with supply chain integration to achieve effective and efficient flows of products or information, to create and provide value to the customer in a cost and time efficient way (Flynn et al., 2010).

Close and integrated relationships is an aspect that different authors have stated as important, regarding the connection between manufacturers and supply chain partners (Flynn et al., 2010; Frohlich & Westbrook, 2001). This integration in a supply chain has become important since the competition is increasing and therefore more manufacturers seek ways to gain competitive advantages. SCI involves the manufacturer as well as the customer and supplier. Integration could be achieved by focusing on the flow of information or flows of material (Flynn et al., 2010). The goal of integration is to generate and manage the manufacturing process in the supply chain, in a more profitable way than the competitors. SCI has grown in popularity and developed a strategic importance for the suppliers; it also became a significant factor when it comes to competitive success. However, to achieve competitive success, it is important that the whole supply chain is integrated, all the way from the suppliers to the manufacturer and customers. Further, this could also lead to new product development, and knowledge learning (Frohlich & Westbrook, 2001).

Logistics is a topic that has increased in importance over the last decades, and has developed to focus on the total value between the supplier and customer’s systems (Frohlich & Westbrook, 2001). Lambert and Cooper (2000, p. 67) define logistics as “that part of the supply chain process that plans, implements, and controls the efficient,
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effective flow and storage of goods, services, and related information from the point-of-origin to the point-of-consumption in order to meet customers’ requirements”. Logistics also involves the suppliers’ integration of products in the supply chain, which is a key factor that is important when it comes to achieving aspects that lead to an increased competitiveness (Frohlich & Westbrook, 2001). Working with supply chain management in logistics provides strategic functions that could be used in an organization, and steers the focus to the logistic issues in a company rather than the product issues. It also helps the members of the supply chain to work more as a combined logistics unit. As a result, the business will work more competitively and coordinate all the logistics functions in an independent way. The goal with this way of working with SCM is to improve visibility and information sharing in the organization, to facilitate the restock of raw materials and finished goods. It is also important that suppliers play a role in the customers’ product development and provide them with technical knowledge (Choon Tan et al., 2002).

SCM is not limited to logistics and network, it also focuses on long-term benefits in the whole chain, through cooperation and information sharing amongst all involved parties in the process. SCM may create a win-win situation for all involved members if a coordination of different parties in the network is established, and information sharing is increased. Working with information sharing in a supply chain could create benefits among business connections (Yu et al., 2001). Different tools could be used to achieve these benefits, and at the same time improve SCI, such as working with vendor managed inventory and cross-docking, which are tools that have been used more often over the last decades (Pieter van Donk et al., 2008; Yu et al., 2001). It is important to reduce uncertainty between the supply chain members through information sharing, which could be achieved using EDI, a technique that improves the suppliers’ performance along with the supply chain system (Sherer, 2005; Yu et al., 2001).

3.1.2 Electronic data interchange

Cost and delivery information can be shared between a manufacturer and supplier with an EDI system. This system has been used for several years to achieve supply chain integration (Frohlich & Westbrook, 2001). EDI is a technique that changes how transactions within an organization are conducted, through this technique information and documents are shared through computer exchange. This way of working with electronic transactions and exchange are helping businesses improving their sales and purchasing functions (Premkumar et al., 1994). Gebauer and Segev (2000, p. 110) state that EDI “supports communication beyond organizational boundaries and automate the exchange of structured messages between independent computer applications, often over private networks”.

Implementation of the EDI technique includes an information stream between the supplier and retailer. Information sharing is also an important aspect to improve relationship and establish supply chain partnership. EDI could further be used by supply chain partners to sustain a VMI strategy in different decision making for inventory (Yu et al., 2001). An organization can gain many different benefits through working with EDI, such as reduced cost, increased customer service, faster turnaround, and strategic competitive advantages. However, despite these benefits, organizations still have a hard time implementing EDI technology (Premkumar et al., 1994).

Several authors mention different disadvantages with the EDI system. For instance, it is incapable to match with other systems and is also expensive to both install and develop
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(Choon Tan et al., 2002; Frohlich & Westbrook, 2001; Gebauer & Segev, 2000). Gebauer and Segev (2000) write that since it is expensive to implement EDI, this system is most suitable for large businesses that deal with high transaction volumes and predetermined processes. Therefore, small and medium sized businesses only implement EDI systems when they are forced to do so by their business partners (Gebauer & Segev, 2000). Furthermore, some of the authors claim that the system ties the supply chain together, in a way that may affect the communication negatively. Also, it opens up the supplier’s network, so the competitors could get easier access to information that could lead to advantages for the competitors (Frohlich & Westbrook, 2001). Another negative aspect of EDI technology, is that it cannot be implemented and used separately in a company, it can only be implemented if working with similar business partners that are motivated to do the implementation. Otherwise, a company has to encourage their existing business partners to adopt the technology. In addition, once the technology has been implemented companies have to invest and work with it continuously and adopt further transactions to be able to achieve organizational benefits (Hart & Saunders, 1998). Further, EDI technology is not suitable for communication of orders that are in need of direct interactions (Gebauer & Segev, 2000).

Choon Tan et al. (2002) write that many suppliers see EDI as a negative aspect and unimportant, because of the costs, complexity, and difficulties that may occur in the implementation stage. Thus, over time the technical capacity of EDI will develop, as will the opportunities and challenges for the involved businesses. This leads to companies needing to think more about how to gain organizational benefits from working with EDI, through faster information sharing and more suitable data repossession systems with costs that are related to the limitations of the organization (Hart & Saunders, 1998). Instead of using a system like EDI, Frohlich and Westbrook (2001) suggest that suppliers should focus on New Internet technologies, such as “e-procurement software and advanced supply chain planning systems”, which help the manufacturer with integration and open up opportunities to rapidly implement a model into the supply chain (Frohlich & Westbrook, p. 196).

3.1.3 Sustainable logistics

There has been growing focus on sustainability and corporate social responsibility during the past decade. Sustainability in supply chains plays a very big role in a company’s responsibility towards the environment. Furthermore, if a company wants to implement a sustainability strategy within its supply chain, the logistics function will be a critical factor to work on, due to the magnitude of costs involved and the opportunity to recognize and reduce inefficiencies, resulting in a lower carbon footprint (Dey et al., 2011). Corporations should follow sustainable practices not only because of the economic aspects and other benefits, but also because it is the right thing to do, state Dey et al. (2011). Moreover, there are indirect benefits for a company being involved in sustainability practices. For instance, a “green” company image has the potential to improve sales. A study by Mahler (2007) shows that 60 of 100 studied firms across various industries adopt sustainability practices to enhance their brand name and make themselves differentiable for the customers (Dey et al., 2011).

Sustainability can be implemented in logistics in various ways. Transportation of products requires a big amount of fossil fuels. The burning of the fossil fuels results in CO2 emissions that affect the environment and people’s health negatively. Logistics managers need to carefully choose a transportation mode that can have the least impact on the
environment. Sustainability actions can be implemented in inventory management and warehousing as well. Logistics managers often follow techniques to minimize on-hand inventory as much as possible due to the significant cost it incurs (Dey et al., 2011). Examples of these techniques include reducing demand variability, improving forecast accuracy, reducing supplier and manufacturing lead times, improving supply reliability, and reducing the number of items. These techniques can also have a positive impact on the environment and CO2 emissions (Dey et al., 2011). For instance, lower inventory levels would require smaller facilities and thus less energy for cooling and heating of raw materials, inventory, and employees (Franchetti et al., 2009, as cited in Dey et al., 2011). Another opportunity for companies to practice sustainability is through information flow, purchasing, and package design. Effective information flow between organizations can lead to efficient inventory management and movement of goods. Companies can use various information systems to enhance the accuracy of communications between their suppliers and distributors (Dey et al., 2011). With better information exchange, empty trucks that recently delivered products can be used to deliver other products on their return journey, and thus reducing the amount of empty driving. Utilizing the space in each transport carrier is one of the most vital activities that companies can follow to minimize their carbon footprint (Dey et al., 2011).

Sanchez-Rodrigues et al. (2010) conduct a study that aims to investigate the different causes and sources of supply chain uncertainty in the UK freight transport sector, and how these sources affect sustainability. The research outcome is a clear link between economic and environmental sustainability, and transport uncertainty. The findings of the research indicate that the main drivers affecting the sustainability of transport operations are the following: delays, variable demand/poor information, delivery constraints, and inadequate supply chain integration. Furthermore, Sanchez-Rodrigues et al. (2010) imply that the consequence of these issues is reduced efficiency of the transport operations.

3.2 MRO (Maintenance, Repair, and Operations)

A supply chain involves all stages from the manufacturer and supplier, to retailers and customers. Every supply chain has its own strategic goals that it wants to achieve across the businesses, which contains systematic and strategic directions of strategies. The purpose of these goals is to accomplish the request that the customers have, as well as to improve the long-term performance in the whole supply chain. In order to achieve the purpose and make the supply chain more efficient, MRO suppliers have to exchange lots of planning and operational data with the customer (Kashyap, 2012). An MRO supplier does not have its own production, instead they directly provide products such as repair and maintenance parts to their customers (Michaelides et al., 2003).

Suppliers are important for a successful supply chain; the suppliers contribute to the general performance. A poor performance from the supplier affects the overall performance in the whole supply chain. A long-term collaboration and relationship is therefore important between a customer and its supplier (Sarkar & Mohapatra, 2006). Bechtel and Petterson (1997) contradict with this and imply that the supplier is in no need for close relationships with the customer. Sarkar and Mohapatra (2006, p. 150) write that “Centralization of purchasing function and reduction of supply base are two strategies that are simultaneously executed for MRO items”. Bechtel and Patterson (1997) imply that MRO suppliers often succeed with the quality of their work since they have little uncertainty about the MRO item and how the final quality will end up.
When choosing the right MRO supplier, Sarkar and Mohapatra (2006) recommend that a company should look for two important dimensions: performance and capability. If a supplier has both of these dimensions, it is more likely that the cooperation with the supplier will succeed. Performance is about meeting the requirements of the customers when it comes to cost and service in the short-term. Capability is more about the potential of the supplier in giving advantages in the long-term to the company (Sarkar & Mohapatra, 2006).

Various MRO suppliers are working with multiple companies to gain cost benefits. However, the procurement of MRO suppliers may include many transactions of low value, which might affect the MRO supplier in a negative way. Thus, working with MRO suppliers could lead to gaining higher service levels and at the same time maintain lower holding costs (Michaelides et al., 2003).

There are some weaknesses with MRO, for example, MRO suppliers spend too much time with processing paperwork which leads to less time to spend on issues of strategic MRO. Also, working with MRO could result in difficulty for companies in saving money from raw materials and other items, which is necessary to stay competitive. As a result, the purchasing manager needs to reduce costs in other areas (Bechtel & Patterson, 1997). Barry et al. (1996) continue this argument by stating that many firms are starting to work with MRO purchasing to gain opportunities such as value creation and cost savings. However, the authors also state that MRO has for a long time been considered as a high problematic area, as well as a small systematic area of purchasing (Barry et al., 1996).

Working with purchasing includes an extensive variety of items, such as spare parts and various services. Thus, purchases are hard to predict and occur on a rare basis with unpredictable demands (Gebauer & Segev, 2000). The customer of an MRO supplier has high demands and different quality requirements for items (Kashyap, 2012). In addition, the inventories are characterized by large numbers, which may lead to MRO inventories being difficult to manage.

Outsourcing of MRO procurement has been a trend among manufacturing organizations. This outsourcing makes it possible for organizations to focus more on their core business functions. MRO procurement includes all purchases, such as equipment maintenance and replacement parts, while it does not include the inputs into the production process (Michaelides et al., 2003).

### 3.3 Vendor managed inventory

Vendor managed inventory is a collaborative commerce initiative that authorizes suppliers to manage the customer’s inventory of stock-keeping units (Yao et al., 2007). However, it does not free the customer from its responsibility since it is the customer that needs to set, monitor, and adjust the framework on which the system operates (James et al., 1997). To ensure product availability for the customer and give flexibility to the supplier, maximum and minimum levels of stock are agreed on in an agreement framework (Disney & Towill, 2003). VMI integrates supply chain operations by using information technology techniques such as EDI, which enables real time information sharing between suppliers and customers (Yao et al., 2007).
In a typical supply chain, the customer decides on the date and the quantity of the replenishments to be made by the supplier. These decisions do not take into consideration the transportation costs and the costs for keeping the supplier’s flexible capacity. They are built on the customer’s inventory and handling costs information. VMI, on the other hand, gives suppliers all the information about stock levels and demand, and usually all supply chain costs. This allows them to make better decisions for the whole supply chain, resulting in a higher overall margin (Claassen et al., 2008).

The VMI is a powerful supply chain strategy that can obtain many of the outcomes achievable only in a fully integrated supply chain (Dong & Xu, 2002). Waller et al. (1999) state that replacing purchase orders with inventory replenishments allows suppliers to improve service levels while decreasing supply chain costs. This is a result of more frequent checkups on product inventory levels in a VMI setup than in a purchase orders setup. The more frequent review in the VMI setup should eliminate information flow delays of purchase orders for the average item (Claassen et al., 2008; Kaipia et al., 2002).

The increased inventory review that comes with VMI does not mean that more deliveries are required like just-in-time (JIT), but the supplier has more time to optimize its production and logistics (Kaipia et al., 2002). In JIT, the supplier has to adjust its performance very quickly depending on the customer’s requirements, which might result in unnecessary inventory or extra capacity dedicated to the customer. Moreover, Kaipia et al. (2002) imply that there is a significant reduction in time from VMI compared to JIT, and it leads to a conclusion that visibility and frequent exchange of information alone are not enough to create an effective supply chain; the shift of responsibility and authority of replenishment from the customer to the supplier is of significant importance.

James et al. (1997) state that the main advantages of VMI all relate to the efficiency of operations between suppliers and customers. In their case study of twenty companies, the main reason most of the customers adopted VMI was to reduce administration costs while maintaining or enhancing service levels to their customers. Another significant reason to adopt VMI was stock reduction, mentioned by one of the case companies.

VMI can be implemented in two stages according to Gustafsson and Norman (2001, cited in Claasen et al., 2008). During the initial stage, the responsibility for ordering, inventory management, and replenishment is shifted from the customer to the supplier. In this stage, significant improvement in customer service can be obtained, but no cost reductions yet (Claassen et al., 2008). Costs might even increase in the first stage. The supplier takes full responsibility of the pipeline in the second stage (pipechain phase). Major reductions in cost can be expected at this stage without forfeiting service levels (Claassen et al., 2008).

3.3.1 Economic benefits

Broadly speaking, three general benefits can be achieved by implementing VMI: higher customer service levels, improved control of the supply chain, and reductions in cost (Claasen et al., 2008). While many managers anticipate significant cost reductions from VMI, the main benefits actually come from improved service levels, Claassen et al. (2008) state.

Anecdotal evidence implies that in a VMI relationship, the customer may benefit from reductions in holding costs and operational costs in addition to cash flow benefits, while
the supplier needs to handle the responsibilities of carrying inventory and forecasting demand, but probably gains benefits in other production and marketing efficiency (Dong & Xu, 2002).

Dong and Xu (2002) conclude that VMI always results in higher profits for customers, whereas profits vary for suppliers. In the short-term, VMI tends to lower overall costs of the channel system, but under specific cost conditions between the customer and the supplier, the purchasing price and supplier’s profits could be decreased. Supplier’s profit is more likely to be increased in the long-term than in the short-term. Reduced inventory costs for the suppliers and customers, and improved service levels for the customers, such as higher fill rate and lower order cycle times, are potential economic benefits of adopting VMI (Yao et al., 2007). The VMI model decreases the total inventory-related costs for the system by optimizing shipment quantities (Dong & Xu, 2002). Reductions in safety stock obsolescence at the supplier can be expected (Claassen et al., 2008; Kaipia et al., 2002), since uncertainty is significantly lessened. The study of Yao et al. (2007) goes in line with other papers (Waller et al., 1999; Xu et al., 2001) and implies that VMI can help firms reduce inventory costs. Blatherwick (1998) states that shifting the responsibility of replenishment results in reduced inventory costs, and reduced total supply chain costs. Transportation costs are likely to be reduced with VMI (Claassen et al., 2008; Lee, 2004; Waller et al., 1999). The versatility in the replenishment schedules will allow the supplier to utilize truckloads if VMI is executed on a large scale (Claassen et al., 2008; Disney & Towill, 2003; Waller et al., 1999). Since large-scale materials requirement planning is no longer required, and individual purchase orders are substituted by comprehensive purchase orders, the customer benefits from reduced administration costs (Claassen et al., 2008; James et al., 1997). Administration costs will be further reduced because backorders will be eliminated (Claassen et al., 2008).

There are benefits to the information sharing accompanied by VMI, such as less information distortion (Claassen et al., 2008; Dong & Xu, 2002; James et al., 1997). Kaipia et al. (2002) state that when the supplier gets earlier access to information, they get more time to react (i.e. it levels demands) which results in enhanced production planning. The extra time obtained reduces the need to keep buffer stocks for suppliers with a wide range of stock keeping units. Moreover, the supplier will know which deliveries can be delayed without causing any lost sales for the customer. Better information-sharing results in decreased inventory and other production costs, while capacity utilization will be increased (Waller et al., 1999; Xu et al., 2001). James et al. (1997) state that the benefits of VMI include reduction in stock and storage space, and demand smoothing. A flatter and more accurate demand can help the supplier in reducing stock and waste, and improving the logistics. Enhanced service levels for the customer can be anticipated (Claassen et al., 2008; James et al., 1997; Vergin & Barr, 1999; Waller et al., 1999; Yao et al., 2007) owing to the higher degree of collaboration and improved understanding of each other’s’ requirements (Claassen et al., 2008).

For suppliers, a major benefit of VMI is that it allows them to synchronize their production processes with the demand forecast (Claassen et al., 2008; Xu et al., 2001). The VMI model, when applied to stock management, should obtain increased effectiveness and efficiency within the supply chain by attempting to optimize the operation of two separate nodes (James et al., 1997). James et al. (1997) imply that VMI eliminates one link or decision point, which allows suppliers to predict demands more accurately resulting in a more efficient inventory management. When the supplier gets
access to the customer’s demand, one more node is eliminated, and thus, the noise and distortion go down (Claassen et al., 2008; Dong & Xu, 2002; James et al., 1997). This results in lower stock, lower logistics costs, improved service level, as well as better communication (James et al., 1997). The bullwhip effect is expected to be reduced due to the early and ongoing information exchange between the supplier and the customer (Claassen et al., 2008; Disney & Towill, 2003; Xu et al., 2001). The bullwhip effect refers to the phenomenon of demand fluctuations being amplified as we go further in the upstream supply chain. This phenomenon results in unnecessary inventory, amplified costs, and longer lead times in the supply chain (Claassen et al., 2008).

### 3.3.2 Environmental benefits

As previously mentioned, Sanchez-Rodrigues et al. (2010) indicate that the main obstacles affecting the uncertainty in transport operations are the following: delays, variable demand/poor information, delivery constraints, and inadequate supply chain integration. Some of these obstacles can be drastically reduced by the implementation of VMI. For instance, VMI levels the demand and reduces the bullwhip effect (Claassen et al., 2008; James et al., 1997; Kaipia et al., 2002; Waller et al., 1999) and improves communication between the supply chain partners (James et al., 1997; Waller et al., 1999).

Logistics managers use techniques such as reducing demand variability, improving forecast accuracy, reducing supplier lead times, reducing manufacturing lead times, improving supply reliability, and reducing the number of items to minimize on-hand inventory and save costs. These techniques can also have a good environmental effect according to Dey et al. (2011). As mentioned earlier, lower levels of inventory would demand smaller facilities and thus less energy requirements for cooling and heating of raw materials, finished goods, and workers (Franchetti et al., 2009, as cited in Dey et al., 2011). VMI results in reduced inventory, according to James et al., (1997). Furthermore, the obsolescence of safety stocks at the supplier is reduced due to the significant reduction in uncertainty (Claassen et al, 2008; Kaipia et al., 2002).

Logistics managers need to pick means of transportation that can have the minimal effect on the environment (Dey et al., 2011). The VMI setup eliminates information flow delays of purchase orders for the average item according to Kaipia et al. (2002) and Claassen et al. (2008), this can be of benefit to logistics managers who want to choose sustainable modes of transportation. The increased inventory review that comes with VMI does not mean that more deliveries are required like JIT, but the supplier has more time to optimize its production and logistics (Kaipia et al., 2002).

When VMI is applied on a large scale, the versatility in the replenishment schedules permits the supplier to fully utilize truckloads (Claassen et al., 2008; Disney & Towill, 2003; Waller et al., 1999), causing transportation costs and CO2 emissions to be reduced. Utilizing the space in each shipment is one of the most vital activities that companies can follow to minimize their carbon footprint. With good information exchange, empty trucks that recently delivered products can be used to deliver other products on their return journey, and thus reducing the amount of empty driving (Dey et al., 2011).

### 3.3.3 Organizational benefits

Companies that adopted VMI have all seen improvements in their relationships with their partner according to a study by James et al. (1997). A major benefit for the supplier is the
development of a long trustworthy relationship with its customer, which secures the sales, as the customer will become more loyal to the supplier (Claassen et al., 2008). Dong and Xu (2002) also mention some intangible strategic benefits for suppliers, such as strengthening competitive advantage, tightening customer-supplier relationship, or partnership. Another organizational benefit is lower fluctuations in the workload for people working on operative logistics (Disney & Towill, 2003).

3.3.4 Success factors and limitations

Kaipia et al., (2002) talk about some practical issues with implementing VMI. The need for standard product identification and integrated information systems is one issue. Additionally, the supplier and the customer may not be willing to share information and lack of trust usually exists. Sometimes customers see purchasing as a core competency and thus insist on having a purchase-order system. Kaipia et al. (2002) imply that to establish trust in the relationship, a company should be able to outline to its trading partner the benefits of adopting VMI. They go on to say that the benefits of VMI vary in different supply chains and according to product demand. There may be situations where VMI does not result in any benefits.

If the customer is not willing to lose control or does not want to share potential sensitive information, VMI is unlikely to be beneficial (James et al., 1997). The lack of trust from the customer may lead to tight minimum and maximum levels of inventory in the agreement, which limits the flexibility for the supplier to optimize quantities (Claassen et al., 2008). Also, VMI can be of more advantage if the customer and the supplier did not previously have tight control over their stock levels (James et al., 1997). Another important factor is the criticality of VMI to the supplier; if VMI makes only a small percentage of the supplier’s demand, it is less likely that it will be of practical benefits when it comes to scheduling (James et al., 1997).

Yao et al. (2007) indicate that total benefits will be greater when the supplier’s order cost before the implementation of VMI is large compared to the customer’s order cost after the implementation of VMI. Also, total benefits will be greater if the supplier’s order cost before implementing VMI is little compared to the customer’s order cost before implementing VMI.

Disney and Towill (2003) present the upside and downside of implementing the VMI supply chain model:

Positive aspects:
- Main benefits noticeable soon after implementation (months).
- High return on investment.
- Better understanding to suppliers and customers for each other’s businesses and working processes.
- The software tool is fast to establish.
- The users of the software trust the system and find it logical.
- Less fluctuations in the workload for people working on operative logistics.

Negative aspects:
- Shifting of responsibility and adapting to the change in working procedures takes time.
- Adapting the process to the integrated enterprise resource planning (ERP) system creates work and takes time.
• The software tool does not suit specific businesses (i.e. short-term relationships with suppliers).

Disney and Towill (2003) conclude by stating that it is clear that VMI can bring the suppliers great benefit if they properly utilize the inventory and sales information in production and inventory control decision-making. Claassen et al. (2008) imply that customer-perceived VMI success is affected by the quality of the relationship between the two partners, the quality of the IT system, and by the intensity of shared information. Vigtil (2007) indicate that the status of current inventory and sales forecasts are the most significant information to be shared with the supplier. Also, kinds of information needed are different depending on the activities performed by the customer (i.e. if the customer makes to order or if it makes to stock).

3.6 Theoretical model

The benefits of implementing VMI found in the literature are summarized in Table 2. The benefits are classified under three categories depending on who will they serve, the customer, supplier, or the whole supply chain. Classifying the benefits will make the comparison of results with the theory more systematic, since the interview questions were developed according to the formed categories.
Table 2: Summary of benefits from the literature review

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Supporting Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer</strong></td>
<td></td>
</tr>
<tr>
<td>Improved service levels</td>
<td>Claassen et al., 2008; James et al., 1997; Vergin &amp; Barr, 1999; Waller et al., 1999; Yao et al., 2007</td>
</tr>
<tr>
<td>Reduced operational costs</td>
<td>Dong &amp; Xu, 2002</td>
</tr>
<tr>
<td>Cash flow benefits</td>
<td>Dong &amp; Xu, 2002</td>
</tr>
<tr>
<td>Higher profits</td>
<td>Dong &amp; Xu, 2002</td>
</tr>
<tr>
<td>Reduced administration costs</td>
<td>Claassen et al., 2008; James et al., 1997</td>
</tr>
<tr>
<td><strong>Supplier</strong></td>
<td></td>
</tr>
<tr>
<td>Reduced info. flow delays of purchase orders</td>
<td>Claassen et al., 2008; Kaipia et al., 2002</td>
</tr>
<tr>
<td>More time to optimize production and logistics</td>
<td>Kaipia et al., 2002</td>
</tr>
<tr>
<td>Reduced obsolescence of safety stocks</td>
<td>Claassen et al., 2008; Kaipia et al., 2002</td>
</tr>
<tr>
<td>Reduced transportation costs</td>
<td>Claassen et al., 2008; Lee, 2004; Waller et al., 1999</td>
</tr>
<tr>
<td>Demand smoothing, better planning</td>
<td>Claassen et al., 2008; Dong &amp; Xu, 2002; James et al., 1997; Kaipia et al., 2002</td>
</tr>
<tr>
<td>Better inventory management</td>
<td>James et al., 1997</td>
</tr>
<tr>
<td>Trustworthy relationship, secured sales</td>
<td>Claassen et al., 2008</td>
</tr>
<tr>
<td>Increased transportation fill rate</td>
<td>Claassen et al., 2008; Disney &amp; Towill, 2003; Waller et al., 1999</td>
</tr>
<tr>
<td><strong>Overall Supply Chain</strong></td>
<td></td>
</tr>
<tr>
<td>Reduced supply chain costs</td>
<td>Blatherwick, 1998; Claassen et al., 2008</td>
</tr>
<tr>
<td>Improved supply chain control</td>
<td>Claassen et al., 2008</td>
</tr>
<tr>
<td>Reduced inventory costs for supplier, customer, or both</td>
<td>Blatherwick, 1998; Claassen et al., 2008; Dong &amp; Xu, 2002; James et al., 1997; Waller et al., 1999; Yao et al., 2007</td>
</tr>
<tr>
<td>Reduced logistics costs</td>
<td>Blatherwick, 1998; James et al., 1997</td>
</tr>
<tr>
<td>Less information distortion</td>
<td>Claassen et al., 2008; Dong &amp; Xu, 2002; James et al., 1997</td>
</tr>
<tr>
<td>Reduced storage space</td>
<td>James et al., 1997</td>
</tr>
<tr>
<td>Better communication</td>
<td>James et al., 1997</td>
</tr>
<tr>
<td>Reduced bullwhip effect</td>
<td>Claassen et al., 2008; Disney &amp; Towill, 2003; Xu et al., 2001</td>
</tr>
<tr>
<td>Improved relationship with partner</td>
<td>Dong &amp; Xu, 2002; James et al., 1997</td>
</tr>
</tbody>
</table>

Furthermore, a theoretical model (Figure 4) was developed to illustrate the most frequent benefits to the customer, supplier, or the whole supply chain in a graphical demonstration. The model is a Venn diagram with two circles representing the customer (blue) and the supplier (green). The overlapping area where the two circles intersect represents the whole supply chain. The font size in which the benefits are illustrated in the diagram is proportional to how frequent each benefit is. For instance, “reduced inventory costs” is more frequent than “reduced supply chain costs” so it is illustrated in a bigger text.
The choice of how frequent each benefit is depends on how many sources in the literature review mentioned each benefit. The model is limited to the literature reviewed by the authors only and is not representative of all the literature available on VMI. Table 2 lists the authors that support each benefit. The benefits that were mentioned in one source only, are neglected in the theoretical model. For example, “reduced operational costs” and “higher profits” for the customer are neglected since they were mentioned by Dong and Xu (2002) only. The purpose of the model is to highlight the most significant benefits according to the reviewed literature, and reduce redundancies within them.
4. Results

4.1 Introduction

Several purchasing techniques are currently being used between Momentum Industrial and its customers, said Jimmy Haaranen, the sales manager at Momentum. Orders are made from the customer whenever their inventory goes beyond the safety stocks. Different agreements of payment and order-processing exist between Momentum and its customers. In general, the purchasing process can be illustrated in Figure 5 below. First, the customer sends an order through email, fax, phone, or paper to Momentum. Momentum registers the order and checks the delivery terms between them and the ordering customers, then packages the order and ships it to the customer, who receives and unpacks the product. In other cases, company representatives come to Momentum and make orders in person, and receive the products right away if it is available.

![Purchasing procedure for customers of Momentum](image)

Dennis Nordli, the logistics manager at Momentum Industrial, further emphasizes that smaller customers usually use phone or fax. Larger customers, on the other hand, use EDI or mail orders, since they know more what kind of products they need. Smaller customers call more often and ask for technical supervision. The risk is higher for the order being wrong if it comes through phone calls, since it could be hard to hear what is said and misunderstandings could occur. There is a smaller risk for wrong orders if they are received through mail, or using EDI, since it is often more detailed.

Momentum aims at automatically registering products in its system when customers send orders via EDI. Its relationship with customers has not reached the required level of collaboration to take this step further yet. To make the most use out of EDI, article numbers of Momentum and its customers should be combined, and the systems should be integrated, the sales manager of Momentum implied.

The logistics manager of Momentum stated that his company collaborates with SKF (Svenska kullagerfabriken), and has adopted VMI with them since 1995. SKF fills Momentum’s inventory stock through VMI. SKF could also provide help with calculating stock levels, however, this is not something that Momentum needs help with since they
do it themselves. Nordli further explains that Momentum believes that this is a convenient arrangement, and wants to implement it with its customers. Momentum also helps its own customers with calculating their stock levels, which could be of a big advantage to the customers, since it takes a lot of time for them to calculate their inventories. Momentum believes that this strategy could save time and resources for the customer, as they can utilize the employees in doing something that adds more value to the company.

Anders Malmborg, the purchasing manager at Stora Enso, stated that his company usually sends manual mails to order products from Momentum Industrial. Momentum is responsible for delivering the products. Stora Enso has its own stocks and safety stock for selected parts. For other parts, they are bought when they are needed only. Stora Enso is already looking to do something to decrease its large inventories and switch inventory to the supplier’s side. However, Malmborg does not believe that there is a need for real time information sharing with Momentum. The safety stock is usually enough for Momentum products, and in other cases parts are not urgently needed, where time is not an issue mostly. He thinks that an appropriate midway solution would be to review the current inventory with Momentum and other suppliers, to check the lead times of different parts, and reshape the inventory accordingly. Stora Enso is also open to have consignment inventory arrangement, in which the supplier owns the inventory placed in the customer's warehouse, and only gets paid for it upon consumption. Stora Enso currently has an agreement with a supplier of office materials, where automatic replenishments, to a level agreed upon, are sent to Stora Enso monthly. Invoices in this case are paid once in a month as well. Inventory in such an arrangement is not owned by the supplier, but the customer still benefits from lower administration costs. The purchasing manager said that such an arrangement could be discussed with Momentum, for example.

The following three sections will explore the economic, environmental, and organizational benefits identified by the case study informants. Table 3 below summarizes all benefits and categorizes them according to their beneficiaries. Benefits listed under overall supply chain bring advantages to both the customer and the supplier.
A framework for implementing the VMI model in an MRO partnership
Altabba, A. & Karlsson, L.

Table 3: Summary of benefits from the case study

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Supporting Informant(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Momentum</td>
</tr>
<tr>
<td></td>
<td>Sales Manager</td>
</tr>
<tr>
<td>Customer</td>
<td></td>
</tr>
<tr>
<td>Less risk of production downtime</td>
<td>✓</td>
</tr>
<tr>
<td>Reduced material handling costs</td>
<td>✓</td>
</tr>
<tr>
<td>Less inventory space required</td>
<td>✓</td>
</tr>
<tr>
<td>Less employees needed for handling</td>
<td>✓</td>
</tr>
<tr>
<td>Reduced stock-taking</td>
<td>✓</td>
</tr>
<tr>
<td>Reduced inventory stocks</td>
<td></td>
</tr>
<tr>
<td>Increased cash flow</td>
<td></td>
</tr>
<tr>
<td>Supplier (Momentum)</td>
<td></td>
</tr>
<tr>
<td>Secured business</td>
<td>✓</td>
</tr>
<tr>
<td>Easier performance management</td>
<td>✓</td>
</tr>
<tr>
<td>Faster invoicing</td>
<td>✓</td>
</tr>
<tr>
<td>Deeper relationship with customers</td>
<td>✓</td>
</tr>
<tr>
<td>Optimized products portfolio</td>
<td>✓</td>
</tr>
<tr>
<td>System running more smoothly</td>
<td></td>
</tr>
<tr>
<td>Overall Supply Chain</td>
<td></td>
</tr>
<tr>
<td>Reduced total logistics cost</td>
<td>✓</td>
</tr>
<tr>
<td>Reduced administration costs</td>
<td>✓</td>
</tr>
<tr>
<td>Optimized warehouse</td>
<td>✓</td>
</tr>
<tr>
<td>Reduced paper use</td>
<td>✓</td>
</tr>
<tr>
<td>Less material obsolescence</td>
<td>✓</td>
</tr>
<tr>
<td>Higher truck fill rates</td>
<td>✓</td>
</tr>
<tr>
<td>Opportunity to choose sustainable means of transportation</td>
<td>✓</td>
</tr>
<tr>
<td>Less employees needed for</td>
<td>✓</td>
</tr>
<tr>
<td>Opportunity to provide the customer</td>
<td></td>
</tr>
<tr>
<td>with better prices</td>
<td></td>
</tr>
</tbody>
</table>

4.2 Economic benefits

Several economic benefits were listed by Momentum’s sales manager when he was asked about potential economic gains that VMI could bring to his company. First of all, Momentum will secure its business, he said. He further explained that VMI will allow Momentum to get closer to its customers, making it very hard for customers to switch to another supplier. This is due to the investment made on integrating the systems of Momentum Industrial with its customer’s. In addition, the decision of purchasing will no longer be individual after cooperating in such a project, he stated. The decision will be made on an organizational level, which prevents individual purchasers from buying from another MRO supplier. Additionally, VMI will allow Momentum Industrial to reduce its administrations costs, he said. It will create more man hours, which allows the company to optimize its staff. More value will be created by involving the people who were working on administration in more proactive actions. Another benefit that VMI can bring is the opportunity to optimize the warehouse of Momentum. It will allow them to keep
track of every item that the customer needs. Vendor managed inventory will make it easier for Momentum to manage its performance. Furthermore, VMI will potentially speed up the invoicing procedure in the partnership, allowing faster cash flow. Momentum’s logistics manager explained that the main economic benefit for his company is less obsolescence of inventory. Moreover, he said that if they implement VMI, Momentum will have full control of the customer’s warehouse, which will affect both Momentum and the customer in a positive way. According to the purchasing manager from Stora Enso, Momentum could gain two economic benefits as a result of implementing VMI. They could increase the volume for certain parts, while decreasing it for others, after being involved in VMI. He believes that they will gain the opportunity to have a more standardized and optimized products portfolio. The other benefit is having less administrative costs, since in a VMI agreement, products will be predefined and there will be no time spent on finding what the customer wants to order.

The customer also gains economic benefits from implementing VMI. Haaranen from Momentum said that customers would get the opportunity to lower logistics costs. Reductions in administratons costs can be expected, and in handling costs if an optimized schedule of receiving materials is set. The customer will get a better optimized warehouse with products that meet their needs, and will not be overbuying materials. The optimized warehouse will also free up storage space and reduce required regular inventory stock-taking. Haaranen also thinks that the customer will benefit from having a lower risk of production downtime, by ensuring that machinery parts are replaced at the right time. According to the logistics manager, the economic benefits for the customers is above all, less inventory obsolescence. Other benefits include better time management, optimizing man hours, and providing the customer with better prices. From the customer's point of view, Malmborg from Stora Enso said that VMI can benefit the customer by having the employees who previously worked on administration and handling be utilized in more value-adding activities. He adds on to say that in the case of Stora Enso, an arrangement like VMI would also allow the company to increase cash flows. One of the strategies that Stora Enso follows to increase cash flows is reducing inventory stocks, which also includes MRO materials.

4.3 Environmental benefits

Four environmental benefits that can come with VMI implementation were listed by the sales manager of Momentum. First of all, there will be less paper consumption for both the supplier and the customer, due to electronic purchasing. Another benefit will be having less waste, since customers will not be overbuying, and less obsolete material will be generated. Moreover, VMI will increase the possibilities with delivering, resulting in a higher transportation fill rate. Momentum will be having more time to optimize the choice of transportation mode as well, making more room for environmentally friendly choices. Also from the supplier perspective, the logistics manager stated that transportation is one of the most important aspects that will affect the environment positively if VMI is implemented. Trucks could have a higher fill rate, better route planning, and reduced empty driving according to him. He believes that VMI could be good for both Momentum and its customers, since the customer does not need to handle several shipments throughout the week, instead, handling and unpacking could be done once a week with good scheduling. From Stora Enso’s perspective, the purchasing manager said that Momentum could be able to optimize their transports in an easier way.
He further elaborated that Momentum could optimize weekly trucks and increase fill rates for example, and not be required to send taxis for urgent deliveries.

### 4.4 Organizational benefits

Momentum’s sales manager talked about two different organizational benefits of implementing VMI. First, the company will need less dedicated employees working in administration. They can be involved in more value-adding activities instead. Second, the relationship with Momentum’s customers will become deeper. The logistics manager agreed with the point on utilizing employees who worked in administrative activities; he thinks that these employees could instead be put on other activities, to save time, such as working with delivery monitoring. He explained that just because a customer implements VMI does not imply that it needs to have its products at a high speed on the same day, but this implementation could be used even if the customer only needs its products once a week. He added on to say that another benefit would be having the system running more smoothly and in a systematic order, since everything will be done electronically, which saves time when it comes to order handling. Stora Enso also agreed that Momentum could benefit by involving people in productive activities instead of administrative activities. There will be less employees that are seeking product information, and less employees registering orders. The purchasing manager of Stora Enso also stated that it is important that Momentum keeps on interacting with its customers and offering its helping hand in choosing the right products.

From the supplier’s point of view, Haaranen believes that there are two important aspects that will affect the customer’s organization when implementing VMI. First, less people would be working in administration and handling. Second, less people will be needed to carry on the stock-taking of inventory. The logistics manager also stated that the customer’s administration work will become easier after VMI. According to Stora Enso, the implementation of VMI could help them in value creation at no additional cost. For instance, through utilizing workers in value-adding activities.

### 4.5 VMI limitations

The return of investment is an economic limitation of implementing VMI, stated the sales manager at Momentum. Moreover, different customers have different requirements when it comes to the return of investment to any project they consider being involved in. Haaranen believes that sustainability is high on the priority list of organizations nowadays, and sustainability managers have huge powers. The sustainability aspect of VMI can be one way to compensate for the economic limitations of the project if the effects on the environment can be proven. As for the logistics manager, he believes that there is a need for continuous review of contract terms and return policies in case VMI is implemented. He further said that a yearly revision of changes in the customer's production line items is needed to avoid having the wrong inventory.

There also exist organizational limitations according to Momentum’s sales manager, such as the cultural differences between companies and the different policies they have. For instance, some companies will not allow information out, while information sharing is a very vital step in VMI implementation. There are trust issues as well, in an organizational level, and in an individual level between company representatives. Moreover, there could be lack of system/data in some companies. Lastly, Haaranen believes that some
companies would resist moving to VMI because they do not wish to be dependable on one supplier only.

From Stora Enso, Malmborg also mentioned some organizational limitations to adopting VMI. He said that someone needs to be dedicated to follow up with such a project. Another issue is the uncleanness in mandate of stock. For instance, different departments have different interests. The production department is interested in having as much stock as they can to secure runtime. Financial divisions on the other hand are interested in keeping stocks low in order to save costs. Momentum also mentioned that it is important to know which department is responsible for the warehouse, to be able to have a good relationship and cooperate with each other.

Momentum’s logistics manager said that one of the organizational limitations is the employees of purchasing and handling believing that the implementation of VMI will make them lose their jobs, so it is important to be clear on how the implementation will be carried out and what will their new responsibilities be. Furthermore, Nordli explained that it is important to have a close relationship with the customer, because if there is a weak relationship then there is no need for adopting VMI. He further explained that some customers do not want to work with VMI, because it is a new concept that they are unfamiliar with. However, through implementing VMI, the customer can keep track of what is exactly in their stock. For successful execution of VMI, it is important that the supplier together with the customer write a detailed agreement that describes the obligations of each party. The agreement will let the customer feel more comfortable with sharing its information with Momentum, while not being worried about its information spreading to competitors.
5. Analysis and discussion

In this chapter, the empirical results from the case study will be compared to what has been presented in the theoretical framework. Moreover, the authors will compare the different perspectives of Momentum as an MRO supplier, and Stora Enso as an MRO customer.

5.1 Economic benefits

The literature has focused on the point that VMI will bring inventory cost reductions to the supply chain (Claassen et al., 2008; Waller et al., 1999; Xu et al., 2001; Yao et al., 2007). This seems to go well with the findings from the case study, as they indicated that VMI will reduce supply chain total logistics costs in general.

In particular, the customer and supplier could both be able to optimize their warehouses, according to the results. Moreover, VMI will allow the customer to reduce its inventory stocks. The customer could further benefit from cost reductions as Momentum declared that after VMI, less inventory space and stock-taking would be required from the customer. This goes in line with what James et al. (1997) wrote about reduced storage space throughout the supply chain being an outcome of VMI. The case shows that the customer and supplier will both benefit from less material obsolescence. The literature, on the other hand, focused more on the supplier benefiting from reduced obsolescence of safety stocks (Claassen et al., 2008; Kaipia et al, 2002).

Momentum and Stora Enso both believe that VMI could potentially reduce administration costs for both parties. They implied that less employees would be needed for administration after implementing VMI. Stora Enso’s purchasing manager further explained that no time would be spent by the supplier trying to figure out what the customer needs, as all products would be predefined. Contrarily, the literature has not put a lot of focus on the reduction in administration costs for the supplier, as it shed light on it more for the customer (Claassen et al., 2002; James et al., 1997) From the supplier's point of view, the two informants mentioned that their customers could benefit from reduced material handling costs. The sales manager further explained that less workers would be needed in handling as VMI could optimize the schedule of shipments and unloading of material could be done less often. Furthermore, Dong and Xu (2002) stated that VMI can benefit the customer with reduced operational costs. However, from the customer's point of view, Stora Enso did not mention any positive outcomes of VMI related to material handling.

Many authors have indicated that VMI can benefit the customers with improved service levels (Claassen et al., 2008; James et al., 1997; Waller et al., 1999; Yao et al., 2007). The authors of this paper believe that improved service levels are an objective benefit, and can be achieved in different ways according to different industries. In the case of Momentum, it was indicated that their customers can benefit from a lower risk of production downtime, since Momentum would be responsible for replenishing inventories and replacing spare parts that will potentially get spoiled soon. VMI, in this case, would allow for drastic improvements on service levels for the customer.

Benefits to the supplier include securing the business, according to Momentum’s sales manager. This would be the result of getting closer to the customer. Additionally, making
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it very hard for the customers to switch to another supplier after investing in VMI with Momentum. After such an agreement, individual decisions of purchasers will not affect the choice of supplier, as the decision would be made on an organizational level. The logistics manager did not mention such a benefit, neither did Stora Enso. However, Claassen et al. (2008) stated that VMI will help develop a trustworthy relationship between the two parties, which in return leads to secured sales.

Stora Enso stated that one of the strategies they follow to increase cash flows includes reducing available inventory stock levels. They believe that an arrangement such as VMI could reduce stocks and thus help increase cash flows. This goes in line with Dong and Xu (2002) who stated that VMI could bring cash flow benefits to the customer. From the supplier's point of view, none of the informants stated benefits related to increased cash flow for the customer with the exact wording. However, the sales manager thinks that the customer could benefit from cost reductions in administration, inventory, and material handling. Moreover, he believes that VMI could allow faster invoicing for his company, as a supplier, due to the faster way of purchasing. Kaipia et al. (2002) and Claassen et al. (2008) support this point by expressing that VMI results in reduced information flow delays of purchase orders.

Some of the benefits that have been highly focused on in the literature are demand smoothing for the supplier (Claassen et al., 2008; Dong & Xu, 2002; James et al., 1997), the reduction of the bullwhip effect throughout the supply chain (Claassen et al., 2008; Disney & Towill, 2003; Xu et al., 2001), and less information distortion (Claassen et al., 2008; Dong & Xu, 2002; James et al., 1997). In contrast, the focus on these benefits has not been that significant from the empirical results. Momentum did mention that the customer and supplier would both be able to optimize their warehouses, having only what they need in stock. The sales manager and the logistics manager said that VMI would result in less obsolete material for both parties. Lastly, Stora Enso stated that an arrangement like VMI could reduce stock levels. These outcomes might all be results of demand smoothing, but the informants did not explicitly mention demand smoothing or the bullwhip effect. The reason for the difference in focus between the literature and the case study results might be the nature of the MRO industry, as product volumes might not be so large and demand forecasting is less focused on. On the other hand, the literature mainly focuses on consumer goods and retailing when it comes to VMI. These industries deal with larger volumes and demand forecasting plays a very important role to them.

The supplier could benefit from lower transportation costs after implementing VMI (Claassen et al., 2008; Lee, 2004; Waller et al., 1999). It has been stated in the literature that VMI could increase the transportation fill rate (Claassen et al., 2008; Disney & Towill, 2003; Waller et al., 1999). The empirical data gathered also supports this finding, as informants from both Momentum and Stora Enso stated that higher fill rate could be achieved from VMI implementation.

5.2 Environmental benefits

Although it was mentioned in the literature that VMI could result in a higher truck fill rate for the supplier (Claassen et al., 2008; Disney & Towill, 2003; Waller et al., 1999), the focus was more on the economic aspect of this benefit. As a higher fill rate could result in lower transportation costs. On the other hand, higher fill rate was not mentioned by the case study informants as an economic benefit, but rather as an environmental one. All the informants mentioned having a higher filling rate as an environmental benefit to
VMI. None of them mentioned it explicitly when asked about the economic benefits, although Haaranen from Momentum implied that lower logistics costs for both parties is one of the benefits of VMI. It is also noteworthy to mention that interviewees were asked about the economic benefits prior to being asked about the environmental benefits.

The logistics manager at Momentum indicated that VMI would allow them as customers to have more environmental benefits than just a higher fill rate. He said that they would be having more time to choose better routes and their chance to adopt green transportation will increase. The sales manager agreed that more time would allow Momentum to choose more sustainable means of transportation. From the literature, Kaipia et al. (2002) indicate that VMI will result in more time for the supplier to optimize their production and logistics. However, the environmental effects of such an optimization have not been discussed.

Franchetti et al. (2009, as cited in Dey et al., 2011) state that having less inventory would require smaller facilities and thus less energy for heating and cooling of inventory and people. Although some authors like James et al. (1997) and informants from the case study agree that VMI results in reduced inventory, none of them has pointed out that less energy would be required in the warehouses as an outcome of VMI implementation.

Momentum’s sales manager believes that less waste generated, because of less obsolete inventory, will have a positive impact on the environment. Moreover, he mentioned an environmental benefit that was not mentioned neither in the literature nor by other informants, which is reducing the usage of papers throughout the supply chain, since electronic purchasing will be adopted.

### 5.3 Organizational benefits

As for organizational benefits of implementing VMI between the two partners, James et al. (1997) and Dong and Xu (2002) believe that it will improve the relationship between both parties. Momentum agrees with this point to some extent, as the sales manager said that VMI will allow his company to get closer to the customer, as well as develop a “deeper” relationship with them.

Momentum and Stora Enso both pointed out that less number of employees would be needed for administration in Momentum in case they implement VMI. However, when it comes to the benefits the customer would be getting, Momentum mentioned that less man hours would be needed for administration as well as handling and stock-taking. The work in administration will be easier for the customer after VMI, and less man hour would be needed for handling. Stora Enso declared that VMI would allow the customer to work on value-adding activities instead of administrative. The informants emphasized that having less people in administration does not necessarily mean that employees who worked on administration would lose their job, but they would rather be utilized in doing something of higher value to the organization. The focus on literature has been steered towards economic benefits, so the details of cost reductions did not include organizational effects and number of employees needed. The authors believe that the interview questions may have biased the interviewees into stating these answers in some cases, as they included (e.g. number of employees needed, ease of information sharing, etc.) after every question regarding organizational benefits or limitations.
The logistics manager from Momentum thinks that the system will be running more smoothly and in a systematic way in case of VMI implementation, as everything will be done automatically. He believes that using electronic means of communication such as EDI or email provides more details into what the customer requires. James et al. (1997) agrees with this, as he states that VMI brings better communication to the supply chain.

### 5.4 Refined model

A theoretical model (Figure 4) has been presented earlier in the paper which highlighted the most frequent benefits to the customer, supplier, or both after implementing VMI in the supply chain in general. The model in Figure 6 is a refined model that highlights the most important benefits that might be achieved by implementing VMI in an MRO partnership. The refined model is based on the case study results, summarized in Table 3, and the theoretical framework.

This model follows the same logic of the model presented earlier. Only benefits that were mentioned by at least two informants or an informant in addition to a source from the literature are considered. Table 3 indicates how many informants support each benefit. The benefits that were presented in the previous model are omitted if they were not mentioned by any of the informants. For example, “reduced inventory costs” and “less information distortion” were present in the previous model, but omitted from the refined model since none of the case study informants talked about them as benefits of VMI explicitly. Likewise, some benefits were not considered in the previous model since they were only supported by one source, but are considered in the refined model since at least one informant supported them. “Cash flow benefits” is an example to that, as it was not present in the previous model, but it is present now since one informant mentioned “increased cash flow”. Moreover, some benefits such as “reduced administration costs”, “increased transportation fill rate”, and “less material obsolescence” were moved to become benefits for the whole supply chain instead of being benefits to the customer or supplier only. This is because at least two informants mentioned them as benefits to both the customer and the supplier. On the other hand, “optimized warehouse” was mentioned as a benefit for both parties by one of the informants. However, it was considered as a benefit to the supplier exclusively because only one source supported “better inventory management” as a benefit and specified it to the supplier alone. “Less employees needed for handling” as a benefit to the customer was mentioned by one informant. However, it was included in the model because one author mentioned “reduced operational costs” as a benefit to the customer, and the authors of this paper believe that less employees in handling would reduce the operational costs for the customer. Likewise, “less risk of production downtime” was mentioned by only one informant, but it was included in the model because the authors believe that this benefit represents improved service levels for customers in an MRO partnership. “Reduced inventory stocks” and “reduced stock-taking” were stated as two different benefits by two informants, but the authors considered them as one benefit which corresponds to “reduced inventory costs” from the literature. Similar to the previous model, the text size of each benefit in this model represents how frequently each benefit was mentioned by informants or theoretical sources.
5.5 Limitations and practical issues

An EDI system can help businesses improve their sales and purchasing functions by sharing information and documents through a computer exchange system (Premkumar et al., 1994). Yu et al. (2001) state that EDI contains an information stream between a supplier and a retailer. They further argue that information sharing is an important factor to improve relationship and establish supply chain partnership (Yu et al., 2001). The case study indicates that Stora Enso is in no need for real time information sharing with Momentum, since lead times are not an issue for most of the products and safety stocks exist. Momentum, on the other hand, explained that a customer does not necessarily need to have their products at a high speed just because they implement VMI, but the implementation could also prove to be useful with deliveries once in a week, for example.

The literature mentions different benefits that a customer, like Stora Enso, could gain by implementing VMI and using an EDI system. Benefits include increased customer service, faster turnaround, and a strategic competitive advantage (Premkumar et al., 1994). However, there could be more reasons than the ones mentioned by Stora Enso, for customers not to integrate their EDI systems with their suppliers. The theory mentions many disadvantages such as the inability of integration with other systems, and the high cost of installation (Choon Tan et al., 2002; Frohlich & Westbrook, 2001; Gebauer & Segev, 2000). Sometimes the customers already have another system that they are using to share information with their suppliers, and therefore choose not to implement EDI, or in other cases they lack the funds for such a change. Furthermore, the system cannot be implemented separately in a company, and all business partners that are involved have to implement it (Hart & Saunders, 1998), which indicates that if Momentum is striving towards using EDI, their customers also need to work on system integration. This is a
point that was highlighted by Momentum, that the lack of system/data in companies could be a limitation of implementing VMI. The integration of EDI is a step that Momentum is looking forward to, according to the sales manager, since it will allow them to automatically register orders in their system. However, he said that their relationship with their customers has not reached the required level of collaboration for such a step. To integrate the systems, Momentum has to match product article numbers with that of the customers. From the theory, Kaipia et al. (2002) mention that some of the practical issues regarding VMI implementation are the need for standard product identification and integrated information systems.

The case study indicates that larger customers use EDI or mail when placing an order, because they are more aware of what kind of product they need, which goes in line with what Gebauer and Segev (2000) imply, that EDI systems are more suitable for large businesses with higher transaction volumes and predetermined processes. Gebauer and Segev (2000) further explain that small and medium sized businesses only implement the system when their business partners force them to do so. Momentum further expressed that smaller customers place their orders through phone or fax. However, when using these methods, there is more room for wrong orders, since it is easy to misunderstand what the customer intends to buy. On the other hand, there is a smaller risk of wrong orders coming through mail or using EDI, since they provide more details, according to Momentum’s logistics manager.

Good information sharing between involved members is an essential aspect in supply chain collaboration, in order to increase the information flow of materials and finished goods (Vijayasarathy, 2010). If lack of trust exists between the supplier and customer, they might not be willing to share information with each other (Kaipia et al., 2002). Waller et al. (1999), and Xu et al. (2001) indicate that better information-sharing could result in decreased inventory and other production costs. They further state that information sharing could create benefits among business partners. Information sharing is a very important aspect of VMI since the supplier needs to have access to the customer’s inventory. One of the organizational limitations of adopting VMI, according to Momentum, is that some companies are not willing to share information. Moreover, the logistics manager believes that it is important that the relationship between the supplier and customer is good, otherwise they should not be involved in a VMI partnership.

Lack of trust from the customer may lead to tight minimum and maximum levels of inventory in the agreement, which could lower the supplier’s flexibility to optimize quantities (Claassen et al., 2008). From the case study, Momentum mentioned that it is important that the supplier and customer together write a detailed agreement of their obligations towards each other. This could improve the trust between the two partners and motivate information sharing. Kaipia et al. (2002) state that one way to establish trust in the relationship is by highlighting the benefits of VMI to business partners.

James et al. (1997) indicate that VMI is unlikely to be beneficial if the customers are unwilling to lose control or share sensitive information. Momentum mentions another limitation to VMI from the customer’s side. The sales manager believes that some customers do not want to be dependent on one supplier only. He states that there could be trust issues in an organizational and individual level, between representatives from the supplier and customer. However, after implementing VMI, the decision will not be individual anymore, but rather organizational, he implied.
James et al. (1997) state that the customer needs to set, monitor, and adjust the agreement framework on which the system operates. Momentum’s logistics manager said that contract term and returns policy should be continuously reviewed. He believes that the customers need to annually review items that they use in production lines. For instance, if a production line or machine of the customer changes, Momentum will not be needing the parts of that machine for that customer anymore and should be aware of that.

Stora Enso pointed out another organizational issue with implementing such a project. The purchasing manager thinks that different departments have different interests regarding stocks. For instance, people in production are not very concerned about limiting inventories as much as people working in management, as they are interested in always having what they need for continuous production. The result is unclearness in the mandate of stock. Stora Enso believes that someone needs to be responsible for driving the project. From Momentum, the sales manager also said that it is important to decide which department is responsible for the warehouse. The literature has not tackled this issue significantly in contrast.

Momentum mentioned one important aspect to be taken into consideration, which is the employee's fear of losing their jobs. The logistics manager explained that it is therefore important to be clear on how the implementation of VMI will be carried out, and how the employees will be receiving new responsibilities. This is something that the authors think is very important, as by the company being open and honest, the employees may show more trust to their organization, which in return may increase their performance.

When asked about the economic limitations of VMI, Momentum’s sales manager mentioned that the return of investment could be one. He further elaborated that different companies have different policies when it comes to investing in such projects. Companies can compensate for this limitation if the environmental benefits of the project are highlighted and proven to be valid, he believes. The logistics manager also stated that the return of investment and payback period could be limitations to some companies. On the other hand, Disney and Towill (2003) indicate that one of the upsides of VMI implementation is the high return of investment.
6. Conclusion

This paper aimed at investigating the feasibility of implementing the VMI supply chain model in an MRO partnership. The research highlighted the economic, environmental, and organizational benefits, and limitations of the model from the literature. Furthermore, a case study was conducted with Momentum Industrial, an MRO supplier in Sweden, and its customer, Stora Enso, a manufacturer in the paper and packaging industry. The purpose of the case study was to gather empirical data and compare it to the theoretical findings from the literature review.

Research findings indicate that VMI implementation in general, could bring various economic benefits to the supplier and the customer. These benefits include secured sales for the supplier, improved service levels for the customer, and reduced administration, inventory and transportation costs. The VMI model allows the supplier to better plan its demand forecasts, since the bullwhip effect will be diminished due to real time information sharing. Delays in information flow will also be reduced, giving more room for optimization of logistics and production. For VMI in MRO partnerships in particular, the case study suggests that the partners would benefit from the same general outcomes that VMI brings, but the focus on demand smoothing has not been as significant as it is in the literature. Improved service levels for the MRO customer can be achieved by having a reduced risk of production downtime and an optimized warehouse.

It was implied in the theory that VMI implementation results in an improved relationship among business partners. The case study supports this finding as the relationship with the customer will become deeper, according to the sales manager at Momentum. The better communication that comes with VMI will result in less man hour requirements for administration, handling, and transportation. This is the result of reduced invoices and stock taking, and increased truck fill rate. The case study suggests that employees who worked on administration prior to VMI, can be utilized in value-adding activities after implementing VMI.

Previous research reviewed on VMI lacked focus on the environmental benefits that VMI can bring to the supply chain. However, it mentions that VMI leads to reduced inventory and higher transportation fill rates. Other literature on sustainable logistics indicates that reduced inventory results in less energy consumption, due to less required heating and cooling of facilities. Higher transport fill rate is said to be one of the ways that a company can use to minimize its carbon footprint. Effective information exchange can result in reduced uncertainty, which is one factor that enhances transport sustainability. Findings from the case study go in line with these conclusions, as they suggest that VMI could enable increased truck utilization as well as provide more time to optimize means of transportation and routes, as information delays in purchasing are reduced. Moreover, the VMI setup will result in a lower consumption of papers, as less invoices are needed.

Even though many benefits can be gained through VMI, it is important to take into consideration the limitations of EDI, which is the tool usually used to implement VMI. For instance, the inability of integration with other systems, cost of installation, and the fact that both parties should implement it to make it of use.

The literature review has shown that information sharing is an important aspect that creates benefits among business partners. It is especially important when working with VMI, as the supplier needs access to the customer’s inventory. However, the empirical
findings showed that some customers may not be willing to share information with other companies, and further indicated that a close relationship between the supplier and customer is an important factor to work with VMI. An additional limitation that may affect the implementation of VMI is the lack of trust from the customer. To increase the trust between the partners, there needs to be a detailed agreement that describes the obligations for each party. Furthermore, a continuous review of the contract term and policy, along with yearly review of items that are being used in the production line are important. Another limitation of implementing VMI, based on the empirical findings, is that some customers do not want to be dependent on one supplier only.

The findings also showed that there might be organizational limitations to implementing VMI, such as the unclearness in mandate of stock. Different departments could have different interests regarding stock. Another organizational aspect to be considered, is that it is important to be clear on how the implementation of VMI will be carried out. The purpose is to inform employees that they will be having new responsibilities, and they will not be losing their jobs.

Another point to take into consideration is the different returns of investment for different companies and the risk of investing in such a project. This point, however, can be compensated for if the environmental benefits of the project are highlighted and proven to be valid.

6.1 Contribution, limitations, and further research

This paper contributes to the field of supply chain and logistics management by adding to the knowledge on the areas of vendor managed inventory, electronic data interchange, supply chain integration, and sustainable logistics. Previous researches on VMI have focused on the economic factors it brings, while not shedding light on the environmental and organizational benefits that come with it. This research has developed a linkage between VMI and environmental sustainability. Moreover, focus was put on the organizational benefits of VMI. The authors believe that this paper further contributes to the knowledge on MRO supply chain management, as it tackles the feasibility of VMI in an MRO partnership specifically.

As for practical implications, this research specifically serves as a framework for logistics managers in companies supplying or buying MRO services. It will provide them with the incentives of why to adopt VMI, and why not to, given the limitations and practical issues. The framework can generally be beneficial to any company that is considering VMI.

This research is not limited to VMI implementation in a relationship of an MRO supplier with a customer in a specific industry. Even though only one customer in one industry (paper and packaging) was interviewed, the questions asked were general. The authors did not limit the questions to Stora Enso, for instance, and the informants from Momentum were talking about the benefits and limitations broadly. However, the informant from Stora Enso was more limited to the benefits that his company in particular would get, from a VMI partnership with Momentum. This limitation arises from the research being based on a single case study, with only three in-depth interviews. The authors believe that a wider perspective could have been tackled if more interviews, from the customers’ side specifically, were conducted. However, that was not possible due to the limited time and industry connections.
Another limitation worth mentioning is that VMI is not currently implemented between the case companies. The informants were only pointing out potential benefits and limitations that they think could be the result of implementing VMI.

The generalizability of the research could have been affected by the fact that both case companies are based in the Nordic region, as Momentum is based in Sweden and Stora Enso is based in Sweden and Finland. Therefore, the authors believe that the results of the case study might not be representative of MRO partnerships in other geographical regions.

The authors suggest that future research could tackle a wider customer perspective by interviewing various MRO customers in different industries. The authors also suggest that future research could be conducted on the benefits and limitations of VMI in different fields (supplier and customer), as they believe that VMI has general benefits and industry-specific benefits. For instance, the reduced risk of production downtime is an industry-specific benefit limited to MRO partnerships. Potential research could also study MRO suppliers in different geographical locations, in order to increase the generalizability of our findings and highlight any potential differences.
References


Appendix

Initial interview protocol: Jimmy Haaranen (1/3/2016) and Dennis Nordli (2/3/2016)

- Can we voice record the interview?
- What are your responsibilities as the logistics manager in Momentum?
- How does the logistics department contribute to the company’s vision “customer’s best choice”?
- How many warehouses does the company have?
- What methods of transportation does the company use?
- Are the materials categorized according to criticality?
- What are the requirements of Momentum’s customers?
- What are the priorities when delivering to customers?
- How do you coordinate the flow to different customers?
- How important is reverse logistics to Momentum?
- How can the project that aims to streamline and coordinate the flow of logistics be developed?
- What strategies are followed when choosing a shipper? (replaced old ones)
- What requirements does Momentum impose on its suppliers?
- How can the preventive maintenance become more “Lean” or “just in time”?
- How does Momentum work to minimize downtime of customers?
- What are the challenges that face the logistics department?
- Is there any data that you recommend us to analyze?
- Do you have any recommendations for candidates for the next interview?
In-depth interview protocol: Jimmy Haaranen (22/4/2016)

- Can you introduce yourself (role in the company, years... etc)
- What is the purchasing procedure between Momentum and its customers?
- Some customers give the authority of replenishment to the supplier, such that the supplier will be having real time information on the inventory of the customer and will automatically supply the customer with the required parts. In this case, Momentum can manage the inventory of the customer and carry out the required maintenance with them, after setting an agreement to automatically do so without any purchase orders.
  - What is your opinion on this scenario?
  - For Momentum:
    - What do you think would be the economic benefits in this case?
    - What do you think would be the environmental benefits?
    - What do you think would be the organizational (i.e. number of employees needed, ease of information sharing, etc.) benefits?
  - For the customer:
    - What do you think would be economic benefits?
    - What do you think would be environmental benefits?
    - What do you think would be organizational (i.e. number of employees needed, ease of information sharing, etc.)?
  - What do you think are the economic limitations of implementing this idea?
  - What do you think are the environmental limitations of implementing this idea?
  - What do you think are the organizational (i.e. number of employees needed, ease of information sharing, etc.) limitations of implementing this idea?
- Do you think that there are specific customers who would be interested in this?
  - If yes, how close is the relationship with these customers when it comes to information sharing?
- Do you mind if we put your name and position as well as the company name in the published paper?
In-depth interview protocol: Anders Malmborg (28/4/2016)

- Can you introduce yourself (role in the company, years… etc)
- What is the purchasing procedure between Stora Enso and Momentum?
- Some customers give the authority of replenishment to the supplier, such that the supplier will be having real time information on the inventory of the customer and will automatically supply the customer with the required parts. In this case, Momentum can manage the inventory of the customer and carry out the required maintenance with them, after setting an agreement to automatically do so without any purchase orders.
  - What is your opinion on this scenario?
  - For Momentum:
    - What do you think would be the economic benefits in this case?
    - What do you think would be the environmental benefits?
    - What do you think would be the organizational (i.e. number of employees needed, ease of information sharing, etc.) benefits?
  - For the customer:
    - What do you think would be economic benefits?
    - What do you think would be environmental benefits?
    - What do you think would be organizational (i.e. number of employees needed, ease of information sharing, etc.)?
  - What do you think are the economic limitations of implementing this idea?
  - What do you think are the environmental limitations of implementing this idea?
  - What do you think are the organizational (i.e. number of employees needed, ease of information sharing, etc.) limitations of implementing this idea?
- Do you mind if we put your name and position as well as the company name in the published paper?
In-depth interview protocol: Dennis Nordli (28/4/2016)

- Hur ser tillvägagångssättet för inköp ut mellan Momentum och era kunder?

- Vissa kunder ger kontroll (auktoritet) för påfyllning till leverantören, så att leverantören kommer att ha realtidsinformation (hur lagernivån etc. ser ut just nu) om kundens inventeringar, och kommer då automatiskt att kunna förse kunden med de nödvändiga delarna. I detta fall kan Momentum hantera kundens inventeringar och utföra nödvändiga underhåll med dem, efter att ha ställt en överenskommelse, för att då automatiskt göra detta utan att behöva några inköpsordar.
  - Vad är din åsikt på detta scenario?

  **För Momentum:**
  - Vilka tror du är de ekonomiska fördelarna i detta fall?
  - Vilka tror du är miljö-fördelarna i detta fall?
  - Vilka tror du kan vara de organisatoriska fördelarna i detta fall (exempel, antal anställda som behövs, lättare till informationsdelning)?

  **För kunderna:**
  - Vilka tror du är de ekonomiska fördelarna i detta fall?
  - Vilka tror du är miljö-fördelarna i detta fall?
  - Vilka tror du är de organisatoriska fördelarna i detta fall (såsom, antal anställda som behövs, lättare till informationsdelning etc.)?

  Vilka tror du är de ekonomiska begränsningarna, vid implementering av denna idé?
  - Vilka tror du är miljö-begränsningarna, vid implementering av denna idé?
  - Vilka tror du är de organisatoriska begränsningarna, vid implementering av denna idé (såsom, antal anställda som behövs, leder det till lättare informationsdelning, etc.)?

  Tror du att det finns några specifika kunder som skulle vara intresserade av denna idé?
  - **Om Ja,** hur nära är relationen till dessa kunder när det kommer till informationsdelning?

  Får vi skriva med ditt namn och position i Examsarbeteet?