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SETTING UP A GLOBAL INVENTORY MANAGEMENT FOR A COMPANY

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ABSTRACT

The purpose of this study is to solve a challenge of unifying the inventory management and to create a common inventory management process in a global company, while ensuring to take into account the necessary change management interventions during the implementation. The necessity of inventory management has been recognized widely in the literature. Nevertheless, it seems that there is only little guidance on how the implementation of a detailed inventory management system should be built in a growing company. Therefore, this research seeks at investigating inventory management implementation and the related process development as well as change management in a global context in order to clarify which elements are crucial to succeed in the implementation of global inventory management process. The study is conducted in as a holistic single-case study with characteristics of action research included. The data is collected with 10 semi-structured theme interviews within the case company, as well as using observations to support the data. The current state analysis presented that existing policies and performance management model did not provide the support that was needed to ensure efficient controlling of the global inventories. The results indicated that the successful implementation of global inventory management can be facilitated with securing the enablers by creating structured processes for managing the global ways of working with inventory policies, performance management through KPI's as well as the global perspective of the inventory network. Those elements will ensure the smooth execution of inventory management globally and gathering the benefits of successful implementation.

TIIVISTELMÄ

Tämän tutkimuksen tarkoituksena on ratkaista haaste varastonhallinnan yhtenäistämisestä ja luoda yhteinen varastonhallintaprosessi globaalissa yrityksessä varmistaen samalla, että toteutuksen aikana otetaan huomioon tarvittavat muutoksenhallinnan toimenpiteet. Varastonhallinnan välttämättömyys on tunnustettu laajalti kirjallisuudessa. Näyttää kuitenkin siltä, että on vain vähän ohjeita siitä, miten yksityiskohtaisen varastonhallintajärjestelmän toteutus tulisi rakentaa kasvavassa yrityksessä. Siksi tässä tutkimuksessa pyritään tutkimaan varastonhallinnan toteutusta ja siihen liittyvää prosessikehitystä sekä muutosten hallintaa globaalissa kontekstissa selvittääkseen, mitkä elementit ovat ratkaisevan tärkeitä globaalin varastonhallintaprosessin toteuttamisessa menestyksekkäästi. Tutkimus suoritetaan kokonaisvaltaisena yksittäistapaustutkimuksena, johon sisältyy toimintatutkimuksellisia ominaisuuksia. Data kerätään kymmenellä teemahaastattelulla case-yrityksen sisällä sekä käyttämällä havaintoja datan tueksi. Nykytilan analyysi osoitti, että nykyiset käytännöt ja suorituskyvyn hallintamalli eivät antaneet tukea, jota tarvittiin maailmanlaajuisten varastojen tehokkaan hallitsemisen varmistamiseksi. Tulokset osoittivat, että globaalin varastonhallinnan onnistunutta toteuttamista voidaan helpottaa varmistamalla mahdollistajat luomalla jäsenneltyjä prosesseja hallitsemaan globaaleja tapoja työskennellä varastokäytäntöjen kanssa, suorituskyvyn hallintaa mittareiden kautta sekä globaalia varastoverkkoa. Nämä elementit takaavat varastonhallinnan sujuvan implementoinnin maailmanlaajuisesti ja onnistuneen käyttöönoton hyötyjen saavuttamisen.

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1 INTRODUCTION

The meaning of the word "inventory" has been explained in numerous ways in the literature. Basically, inventories are the stocks raw materials, materials used for packaging, work in progress and finished goods that that exists in multiple points throughout the company's supply chain. As a matter of fact, inventory management is most practical to be described as a set of policies, procedures and controls that systematically monitor and observe inventory levels. Systems to intelligently determine at what levels the inventory should be maintained, what point should the inventory be restocked and how large of an inventory quantity should be ordered. This means an ongoing process of planning, organizing, and controlling inventory that focuses in minimizing the investment in inventory while at the same time balancing supply and demand. (Karim, Nawawi & Salin, 2018, p. 1163-1178)

A well-structured inventory management calls for balance of scales between the invested capitals as inventory levels and customer satisfaction as service level. Inventory management optimization is particularly relevant in the inventory models where a organization has inventories in multiple locations globally. Especially in a situation where the company has gone through large changes recently and the management of stocks is scattered all over the world. In these kinds of situation, it is crucial to pay attention into development of inventory policies as well as performance of the inventories in order to keep the service level on sufficient level while invested capital is as low as possible. To manage these points well in a global picture a well refined process for managing the global inventory network is mandatory.

The process development is important task when planning and developing other topic in the organization. Therefore, the vision, strategy and policies around the original topic guide the process development as well. The top management should enable clear tasks and objectives to process development as well as reserve sufficient resources for the implementation of new ways of working. In that sense it can be said that the company management is in a key role when it comes to successful process development. (JUHTA 2002, 3)

Another topic related to new ways of working is change management, which has gained attention in organizational context widely. Change can be seen as an ever-present phenomenon in organizations, but it is also clear that the pace of change is nowadays higher than ever before, which has made change management a must-have skill in every organization (Moran & Brightman, 2000).

Process development and change management in inventory management context as separate are important and inviting for further research. Therefore, it is necessary to bring these topics together and discuss them in relation to each other. This thesis aims at filling the research gap and discusses about the successful implementation of global inventory management process and the change management related to it. Therefore, the purpose of this study is to create a clear guidance for the successful implementation of global inventory management process and show the role of change management during the implementation.

1.1   Background

This research is conducted in a relationship with a case company. Recently, Technology and Operations areas have been identified in the strategy work of the case company as one of the key areas where performance improvement can be achieved. Consequently, the significant role of inventory management is acknowledged. Due to expected significant impact, understanding inventories, inventory management and their affects in procurement have been selected as one of the strategic focus areas in which special strategic development actions are taken as part of the strategy execution. Therefore, a clear connection between the company strategy and procurement strategy exists.

As a part of the strategy execution, the company is undertaking a significant change in procurement and supply chain management that builds around implementing inventory management in a global level across the business units of the company. Until now, the procurement departments of the business units have been operating

autonomously and co-operation between them has been occasional and unstructured. It is important to mention that the planned new approach requires a significant amount of cross-divisional co-operation in order to succeed. The success of this co-operation. In another hand, is mostly depended on the change that is required in the tools that are being applied, and of course the ways of working and attitudes. On the contrary, changing those kinds of established habits is often easier said than done, and the change process of implementing new processes is likely to face several challenges. Therefore, finding tools, practices and ways to facilitate the implementation of new processes and the change process would be crucial to ensure the success of inventory management and the overall process and strategy implementation.

The research issue is that the case company doesn't have currently any kind of structure in order to manage their inventories. The material inflows and outflows are current being pushed and pulled strictly by the demand inputs. The supporting features of inventory base like safety stocks are also not well managed. The problem of not having inventory management guidelines are causing problems such as excess inventory staking up, material losses and financial losses and issues. The measurement of inventory performance is also very complicated, and the reporting is not accurate. In summary the company is lacking globally a common way to manage the inventories. Therefore, Inventory management process globally needs to be developed and implemented globally.

This thesis seeks to research connection between theoretical studies and the operational management of the inventories. Śliwczyńskin and Kolińskin (2012) state that inadequate analytical support behind inventory management lead to various challenges, such as bad allocation and structure of inventories, poor capacity as well as transportation and warehouse management, and challenges in material flow processes management. The management of change implementation together with well-defined analytical metrics to support inventory management has not received enough attention in the literature context. This thesis seeks to fill the research gap between those areas. The inventory management will be first covered from the inventory network area by taking a look into multi-echelon system introduced by Silver et al. (1998) and then seeing inventory management's expanded role as a distribution

chain management covered by Paakki et al. (2011). Inventory's main task is to hold items, which means tied capital. The inventory costs will be therefore investigated by the three main costs related to inventories introduced by Stevenson (2007). Inventory performance area is supported by classification models such as ABC analysis as well as ABC-XYZ analysis, which combines the ABC- and XYZ- analyses together, providing a more comprehensive way for classifying inventory categories. (Hoppe, 2006). The needed components to be considered in the process development of the inventory management process are introduced by Paim et al. (2008,767) and Aparecida da Silve et al. (2012, 767)

Consequently, from theoretical perspective, the research problem focuses on process development and creation, inventory management and for a successful implementation of the new approaches, also change management related to implementing this kind of supply chain initiative are considered. Both, inventory management and process management in relation to change management have not yet received the full attention in procurement literature even though management of inventories and different kind of changes in procurement causes severe challenges for many companies in practice. Hence, in addition to the research's managerial contribution for the case company in the form of implementation and change management guidance, the research can increase the academic understanding related to inventory management, its implementation and the required change in procurement context. Said this, as the research is conducted as a single case study from a perspective of one company, the results are not meant to be generalized to other contexts as they are. Nevertheless, the results may provide examples and best practices that can be validated and developed in future research.

1.2   Objectives & limitations

Based on the background information presented above, the research problem is narrowed down to the challenge of developing and implementing of global inventory management process considering the need of change management in the case organization. Consequently, the two main focus areas inventory management and change management which are also reflected in the research questions. In order to tackle the research problem, it will be approached through following research questions that are divided into one main research question and four supporting sub-questions:

How to facilitate the implementation of global inventory management process and the change management related to it successfully?
   a) What are the enablers of successful global inventory management process?
   b) What are the driving and restraining factors that either enable or decelerate the implementation of inventory management?
   c) Which methods can be used to strengthen the driving factors and reduce the restraining factors?
   d) What are the benefits of the successful implementation of inventory management?

The purpose of the sub-questions is to facilitate the solution for the main question which aims to provide guidance for the organization in the global inventory management implementation process. The first sub-question focuses on the enablers of inventory management process and targets to identify the preconditions that are essential to succeed in the implementation. Following, the second and third questions focus on the change that is required to achieve the anticipated future state of successful implementation. The last sub-question is dedicated to the desired target state by identifying the benefits that the successful implementation may bring. Assessing the target state is critical because without a clear goal the change has no direction. In the end, by merging the output from the sub-questions, an answer for the main research question can be proposed.

Accordingly, this research aims to create clear guidance with relevant change management interventions to support the successful implementation of global inventory management. The guidance helps to provide a structured way of facilitating the significant strategic change under investigation. The goal is to provide concrete steps, practices and supporting actions that can be utilized in the case company during implementation of the global inventory management process. In addition to the practical relevance for the case company, the research also seeks at filling the gaps in the existing academic literature related to inventory management and change management in procurement context. Additionally, by discussing them together, the study also provides new opportunities on the interconnected nature of the two concepts. Figure 1 below provides an outline of the theoretical framework of the study, illustrates the connected nature of the main themes, and simultaneously shows the research gap the thesis seeks to contribute.
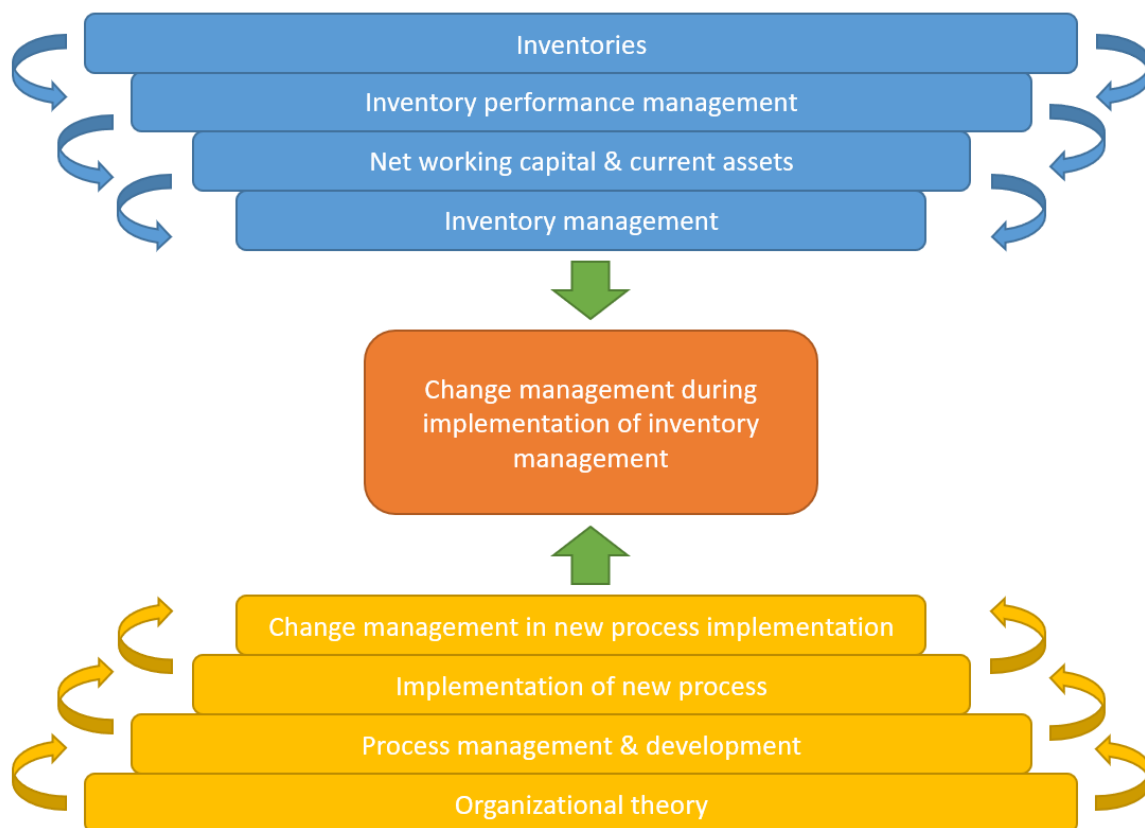
Figure 1. Theoretical framework of the thesis

Considering the limitations of the study, instead of developing the inventory management process itself, the focus is aimed to describe the inventory management process, its implementation and relating the change management aspects into it. The current inventory management process in the case company will be used as a baseline for the implementation actions and change management needs. However, as the case company's current state of inventory management is not structured or defined, the study aims to provide completely new process for global inventory management in the case company. Some actions related to current inventory management practices in the case company that are in place, might be reconsidered and given development suggestions to enable the implementation of new process if they are seen relevant from the change management perspective. In addition, the selection of a single-case study methodology limits the perspective of the study to cover only the company in question. Consequently, it is important to acknowledge that company- and industry-specific factors may affect the results, which makes the generalizability of the results challenging and not even meaningful. Therefore, the context should be acknowledged and taken into account when interpreting the results carefully.

1.3 Research methodology

This research is conducted as a qualitative research by utilizing two different qualitative research methods, to be mentioned case study and action research. Qualitative methods usually enable studying the complication of subject's phenomena in their context (Eriksson & Kovalainen, 2008). Therefore, that approach can be applied in this research because the implementation and change related to new processes can be considered as complicated and context-specific phenomena since they are heavily impacted by contextual factors such as organizational background, culture, and values of the individuals.

Likewise, choosing case study approach as an research approach is also supported by the requirement of need for in-depth understanding about the phenomenon as that is normally seen as the foremost strength of case studies (Ellram, 1996; Kähkönen, 2011). As mentioned before, inventory management and change management are

quite new topics in procurement literature, and according to Ellram (1996) case study is appropriate research method for such evolving topics that require exploratory approach. Meanwhile, as action research is described by active collaboration and involvement with the business when resolving the research problem (Eriksson & Kovalainen, 2008), this thesis also contains features of action research due to the researcher is involved in the inventory management implementation process in the case company.

About data collection, the majority of primary data for the empirical study is collected by conducting 10 semi-structured theme interviews within the case company. The interviewees cover multiple divisions of the case company group. Additionally, employees from procurement, business operations as well as group management are interviewed so that variety of perspectives in terms of data triangulation can be ensured. As the research involves also characteristics of action research, it is natural that observations are also used as a second main data collection method. For analysis purposes, the interview data was coded according to the main themes derived from the research questions and further categorized based on recognized appropriate frames.

1.4 Key concepts of the study

Inventories

Inventories are vital and unavoidable elements of business and critical supply chain resource. (Chikán, 2007, p. 54; Fawcett, et al., 2010, p. 510) According to Karim, Nawawi & Salin (2018) inventories can be defined in two ways. First, inventory can be a stored accumulation of material resources in a transformation system and then again, it can be described as a stock of any item or resource used in an organization. Inventories also represent a portion of the company's current assets on the balance sheet (Hofmann et al. 2011, p. 14)

Inventory management

Inventory management is one of the most important tasks of management. Inventory forms one of the largest costs in many industries and supply chains. Efficient inventory management is often misunderstood by associating it directly with reducing inventory levels in the supply chain. Clearly, this is a very simplistic view of inventory management. As a matter of fact, the target of efficient inventory management is to have optimal inventory at the right place at the right time in order to minimize the operation costs while ensuring the customer satisfaction requirements. (Simchi-Levi et al. 2008, p. 30; Stevenson 2007, p. 577)

Process

According to Paim et al. (2008, 707) and Hannus (2004, 104) process is a structured, measured group of activities designed to create a specific outcome. Trkman (2010, 125), Bai and Sarkis (2013, 284) and Lin et al. (2002, 19) define business process as a complete, dynamically coordinated group of activities or logically related assignments that have to be completed in order to deliver value to users and in which resources are consumed. The objective for business processes development is to align them with organization's strategic goals and to improve customer satisfaction (Damij et al. 2008, 1135).

Key performance indicators (KPI's)

According to Hoppe (2006, 445) Key performance indicators make it possible to summarize a large amount of complex data into understandable and meaningful values and information. In other words, performance indicators are a combination of metrics that are used to quantify the efficiency or effectiveness of an action. KPI's are used as fundamental managerial tools in order to help decision-making in organizations (Gunasekaran & Kobu 2007, 2821).

Change management

Change management in organizational context can be defined to be "the process of continually renewing an organization's direction, structure, and capabilities to serve the ever-changing needs of external and internal customers". Even though the name is referring that change management is about managing the change itself, it is actually more about managing those people who deal with the change. (Moran & Brightman 2000, 66)

1.5   Outline of the study

This thesis begins with introduction chapter where the background of the thesis is described. After the reader has been familiarized with the background, the objectives and limitations are presented. At this stage the research question along with the supporting sub-questions are also defined. Introduction chapter also includes a section, where the research methodology used in the study are elaborated. Lastly, the key concepts of the study are explained.

The study begins by discussing about the relevant theoretical foundations. The theory part is split into two sections according to the two main literature subjects: the first part focusing on inventory management, performance measurement and analyzing of inventories, and the second main theory chapter focusing on process development, implementation and the change management related to that. Inventory management and process implementation combined with change management in procurement context are emerging topics and therefore, the literature cannot be limited to the

specific industry. For example, in the process implementation chapter, there is need to utilize the general process development and change management literature and apply its most relevant parts to the inventory management context.

After examining the theoretical background, the focus will be in the empirical research. The empirical part starts by presenting the case company as well as the progression to the current state. After that, the empirical section includes the analysis of the empirical data and showcases the main challenges to overcome. The fifth chapter then presents the main outcomes derived from the collected data. Finally, in the sixth chapter the answers for the research questions are presented and discussed in relation to previous findings in the existing literature and thereby the theoretical and managerial implications are collected together. Lastly, some suggestions for further research are presented to complete the study.

2 HOW TO CREATE COMPETITIVE ADVANTAGE THROUGH INVENTORY MANAGEMENT

Inventories are vital and unavoidable elements of business and critical supply chain resource. (Chikán, 2007, p. 54; Fawcett, et al., 2010, p. 510). Improving material management process in strategic as well as operational level plays a great role when improving the efficiency of the company. (Śliwczyński & Koliński, 2012, p. 297). The key aspect in the change in inventory research is that assessment of inventories needs to change from passive to an active role in the company's strategy. Strategic decisions have to focus inventory and thus, inventory policies must influence the overall strategy formulation and implementation though the company. Chikán (2007) mentions three interconnected elements of the strategic importance of inventories for companies: inventories contribute value creation, inventories secure flexibility, and inventories act as important indicators for macro and microeconomic phenomena. (Chikán, 2007, p. 58-59)

The complex nature of the material flow process can cause difficulties in material managements, especially when focusing on too many different factors that affect on efficient material management, like sourcing, warehousing, inventory management, and cash flow management. Taking in account the practical aspect of material flow there can often be found a lack of integrating the material flow process to the actual strategy. According to Śliwczyńskin and Kolińskin (2012) the most usual consequences of insufficient analytical support in material management decisions are non-adequate level allocation and structure of material inventories, non-adequate capacity and efficiency of transport and warehousing, and ineffective execution of material flow process. The research also introduces factors of material management efficiency. The factors are stated through the areas where managers in companies typically pay attention. Those areas include inventory costs, material value along supply chain, standards and operational costs in material flow process, various methodologies of analysis and a normative range of material management indicators. (Śliwczyński & Koliński, 2012, p. 297; 299)

Śliwczyński and Koliński (2012) list seven primary objectives of material management which are:

- Efficient materials planning
- Sourcing and purchasing
- Good supplier relationships
- Procurement and transport
- Storing and inventory control
- Financial management and controlling
- Quality assurance.

As introduced in the listing above, material management is a wider area of business than just controlling of inventories. Material management is covering the whole material flow process. However, material management consists of each very important factor as they are. Inventory management bringing the factors together.

2.1   Previous literature on Inventory Management

The inventory research was formed first time in the 1950's, when both, the conceptual and the mathematical models of inventories were defined. The inventory research from 1950's through 1970's corresponded to the expectations of the ordinary economic and business research of that time. (Chikán, 2007, p. 55; 61) The inventory management known nowadays has been developing since the mid 1970's. Prior to that the material flows were managed through excess inventories. During 1970's technology became increasingly available and affordable, which made tracking and measuring of inventories easier. The information flow through whole supply chain and between different supply chains has helped companies to achieve better control over inventories internally as well as externally. In the early years of 1990's managers already understood and accepted the challenge and responsibility, that is needed for an appropriate way to approach the area of inventory management. (Loar, 1992, pp. 70-71) Since 1980's many developments in management of inventories, such as Just-In-Time (JIT) and supply chain management have been remarkably popular in practice, but the successful implementation of those has proved to be challenging. These management practices highlight particularly reduction of inventory and controlling as beneficial as well as achievable. (Pong & Mitchell, 2012, p. 173)

Fawcett et al. (2010) define the basic characteristics of inventories so that they are considered as assets and stored as buffer and optimizing of inventories is practiced by balancing associated costs. The observations of inventories changed in the 1980's, when the JIT inventory philosophy was introduced, in which the lean thinking is highly associated. Since then, researchers have continuously proven that by optimizing inventories though lean management the greater levels of asset utilization and customer satisfaction is achieved, which in other hand leads to an advanced organizational growth, profitability and market share.

During past decades, inventory management has gone through tremendous changes. The development of inventory management practices has gotten a great influence from the improvement of information and communication technology. (Riezebos, 2006, p. 667) Besides for company's performance, inventories are also very important

in terms of wealth of a country, because a lot of money are tied up in them. Even though the importance is recognized, inventories have received just a minor portion of research compared to other areas of business activities. (Chikán, 2007, pp. 54-55; 61)

The role of inventories in business has changed over the years. The traditional direction of economy and business research has deviated, which has created to a need for new and better ways of doing economic and business research, however the area of inventory research has not followed this deviation and has been left behind development. (Chikán, 2007, pp. 54-55; 61) Through the development of the area of operations management research, also new concepts such as material requirement planning system (MRP), just-in-time (JIT) and ERP methods have been added to the list of relevant inventory factors. Beside these management adapted concepts another rising direction of the research assumes that demand and marketing environments play a key role in forming of corporate inventories. (Koumanakos, 2008, p. 355)

2.2 Inventory management

Inventory management is a core operation of management activity. Inventory forms one of the dominant costs in many industries and supply chains. Effective supply chain management is many times misunderstood by linking it directly with reducing inventory levels in the supply chain. Obviously, this is a very simplistic view of supply chain management. As a matter of fact, the goal of effective inventory management is to have the optimal inventory at the right place at the right time in order to minimize system costs while satisfying customer service requirements. As to be expected, inventory management in complex supply chains is naturally difficult, and inventory-related decisions can occur a major impact on the customer service level and systemwide costs of supply chain. (Simchi-Levi et al. 2008, p. 30; Stevenson 2007, p. 577)

Inventory management contains many sub-dilemmas. Happonen (2011, p. 1) defines that one of the main questions of inventory management is how to control stock ensuring availability of items efficiently. Items do not increase value added to the

customer in inventory nor advantage for the company from financial point of view. From other aspect, items value may even decrease in the stock and in addition stored items require resources. In its brevity, companies must determine which items are most vital for the operation of the company and what would be the most appropriate way to allocate control resources, which means the company should decide what items should be kept in stock, when orders should be placed and how much should be ordered. This also includes financial aspect, items in stock tie company's capital and need resources continuously stocking them. On the Contrary, the invested capital in inventories are not available to other investments and may therefore, for example restrict the growth of sales. Consequently, too high inventory levels can be seen as a financial burden for the company. One important aspect to overcome the mentioned challenges is how companies should measure customer service and material flow as well as analyze costs of inventories. (Happonen 2011, p. 1; Waters 2009, p. 335- 338)

At the same time, it is important to acknowledge that in the majority of supply chains inventories cannot be avoided due to, at some point of the supply chain its not possible to deliver products as for make to order. Every operation is unique and in some cases, the inventory responsiveness, delivery time, may even be a completely dominant factor for company success, because customers are accustomed to very short-term delivery times. Furthermore, continuously changing demand poses challenges for the supply chain. Therefore, continuous inventory controlling has turned out to be one of the most challenging and at the same time most important task to ensure the efficient operation. (Happonen 2011, p. 2)

Spare parts inventories have to be available at optimal spots in the supply chain, in order to provide sufficient aftersales and desired service level for customers. Inventory management with the aspect of spare parts demand is particularly complex to handle. The system normally includes a high number of parts to be managed, demand patterns are irregular and uneven, customers require high responsiveness due to their downtime cost, and there is a risk of stock obsolescence. (Bacchetti & saccani 2012, p. 722) Planning and designing a spare part supply chain includes many important special aspect that have to be considered. Huiskonen (2001, p. 125) introduces control characteristics of spare parts which should be considered; spare parts criticality,

specificity, demand pattern, and value of parts effect on spare parts network structure, the positioning of material, the responsibility of control and control principles.

In the case of project inventories it is important to not have excess inventory at all and therefore, for example safety stock principles are not applied in project inventories. The target is to have as low stock and as high turnover as possible. Just in time (JIT) model is the way to approach inventories with target like described. Basic idea of JIT is to produce only what is needed, as much as is needed and when is needed. JIT-model is is originally considered to be originating from Toyota motor company's management, namely Talichi Ohno's creation in the 1960's. It is important to remember that JIT is not only an inventory management model, but also way of manufacturing. The manufacturing has to be also planned carefully to fulfill the JIT requirements in order for the inventory to be efficient. (Lysons 2006, p. 341)

In many cases the inventory management of spare parts supply chain is more complicated when comparing to the supply chain of finished products. Its unique attributes cause the complexity of the spare parts inventory management. The life cycle of spare parts is longer than finished products, and the total number of stock-keeping units is very big. In addition, the demand of spare parts is relatively unstable and difficult to forecast. The previously mentioned features create tremendous difficulties to spare parts planning, ordering, purchasing, and logistics, as well as other operations. (Fortuin & Martin 1999, p. 949; Deloitte Consulting 2013, p. 4)

2.3 Inventories

Karim, Nawawi & Salin, (2018) introduce two definitions for inventory, firstly inventory can be defined as the stored accumulation of material resources in a transformation system and secondly, it can be described as the stock of any item or resources used in an organization. In summary, according to Abbasi (2011) the main function of inventories is to store various goods in storage facilities. Inventory management defines various requirements for warehousing, such as inventory size, location and the methods of holding inventory. The terms warehousing and inventory management are very tightly interconnected.

Warehousing includes warehouse buildings and facilities as well as warehouse operations. Warehousing affects the entire logistics chain and is therefore a significant factor in the supply chain. However, normally the target is to keep inventory stocks as low as possible. The reason for this is that inventory ties up capital and it would be more productive to release that capital for other activities. Even today there are still companies that do not keep track of their capital tied up in inventory and therefore unnecessarily keep their money tied to product inventory. In an optimal situation, where raw materials or products are delivered from the supplier directly to production or from the manufacturer to the customer, no inventory stocks would be needed at all. (Ritvanen, 2011, p. 79)

In a statement of financial position, the types of inventory can be divided into three common types, which include finished goods, raw materials, and work in progress. Finished goods refer to those goods produced by a business, completed and ready for sale. Those goods are sold by the company to wholesalers, retailers and customers. Raw materials are items acquired by purchase, exploitation of natural resources or growth for the purpose of processing into finished goods. Those goods flow into work in progress (WIP), and subsequently after processing is completed the flow will lead to finished goods. WIP refers to goods in the process of being manufactured but not yet completed as finished goods by the end of the accounting period. WIP values the cost of labor, materials and operating cost incurred to that level of completion. (Karim et al. 2018)

Inventory is one of the most important and at the same time difficult assets in a statement of financial position that can be efficiently and effectively managed by a firm, regardless of its size, whether a large corporation or small or medium enterprises. This is a fact because inventory, and its related handling process require substantial investment, particularly in sophisticated and modern systems, which remain fixed for a considerable time. For instance, enterprise resource planning can be used to integrate all systems in a company, including inventory management. It can be organized to for example identifying any potential of cost overruns and immediately alert the management. That said, this technology is typically expensive and complex. (Karim et al. 2018)

Inventories are responsible for many different type of costs, and when managing inventory, those costs have to be considered in determining optimal inventory levels. Three main types of costs related to inventories must be considered: holding, ordering and stockout cost.

1. Holding costs mean those costs that are caused by storage, insurance, taxes, obsolescence, theft and interest on funds or borrowing in financing the goods. Holding costs grow as inventory levels increase. Holding costs are typically assessed as a percentage of a unit rather than attempting to valuate it as monetary value for each cost individually. In order to minimize holding cost, it is typical to make frequent orders with small quantities.

2. Ordering costs mean those costs that are associated with placing an order. It consists of expenses related to workforce and personnel in a purchasing or procurement department, communication expenses such as telephone, mail and internet and other costs caused by handling the related paperwork. Ordering costs are normally stated as a monetary value per order. Decreasing these costs could be accomplished by placing a small number of orders with large quantity.

3. Stockout costs include the sales that are lost, both short and long term, caused by inability of the company to fulfill the customer's order. The customer might switch and buy their products temporarily or permanently from competitors, which can result in loss of valuable revenue. These costs are possibly the most

difficult to calculate but arguably the most important because it represents the cost incurred by customers when inventory policies falter. Failure in understanding these costs can lead management to maintain higher or lower inventory levels than customer requirements may justify. Effective inventory management system can reduce the risk of short inventories, which decreases the cost of lost customers. This also helps to minimize the risk of dissatisfaction of customers. (Karim et al. 2018)

2.3.1   Multi-echelon inventory system

The nature of supply chain structures in many global industrial sectors are driving companies to deal with increasingly more uncertain demand. Uncertainty of demand causes the critical effect of simultaneously increasing inventories and decreasing customer service level. (Kalschmidt et al. 2003, p. 397) Global industry is one of the most described as completed by complex systems which require great levels of backups in order to conform with the changing availability requirements. For a global business with customers all over the world, a multi-echelon structure is a standard necessity, especially when organization control many locations worldwide with different targets and competencies. In global business it is often reasonable to keep some local inventory stocks, in order to ensure high availability for important spare parts. Taking in account the failure rate of the items and its impact for the customers business and customer satisfaction, it is described that usually items have both a strategic and a economic value and the challenge of minimizing inventory costs, while at the same time maintaining good availability is crucial. Large stocks of items increase holding costs in warehousing process and, they will tie up invested capital to inventories. In addition, it is also important to recognize that every single shortage has an impact to customer satisfaction. Multi-echelon systems are done to service customers better and give a good response time. In the case of multi-echelon system, it is important to consider the demand variation between different sites. Therefore, the stocking decision is considered for spare part allocation, which has to take in account

the stock availability in local sites as well as central warehouse. (Costantino et al. 2013, pp. 96-97)

The central idea behind multi-echelon system is that a central warehouse replenishes stocks of local branch warehouses. Figure 2 illustrates a simple example of the multi echelon inventory structure. External suppliers replenish central warehouse. Inventory management in this system is complicated because demand at the echelon of central warehouse is dependent on the demand at the branch warehouses and finally demand from customers. Stocking decisions in branch warehouses affect demand profile in the central warehouse. (Silver et al. 1998, p. 475)
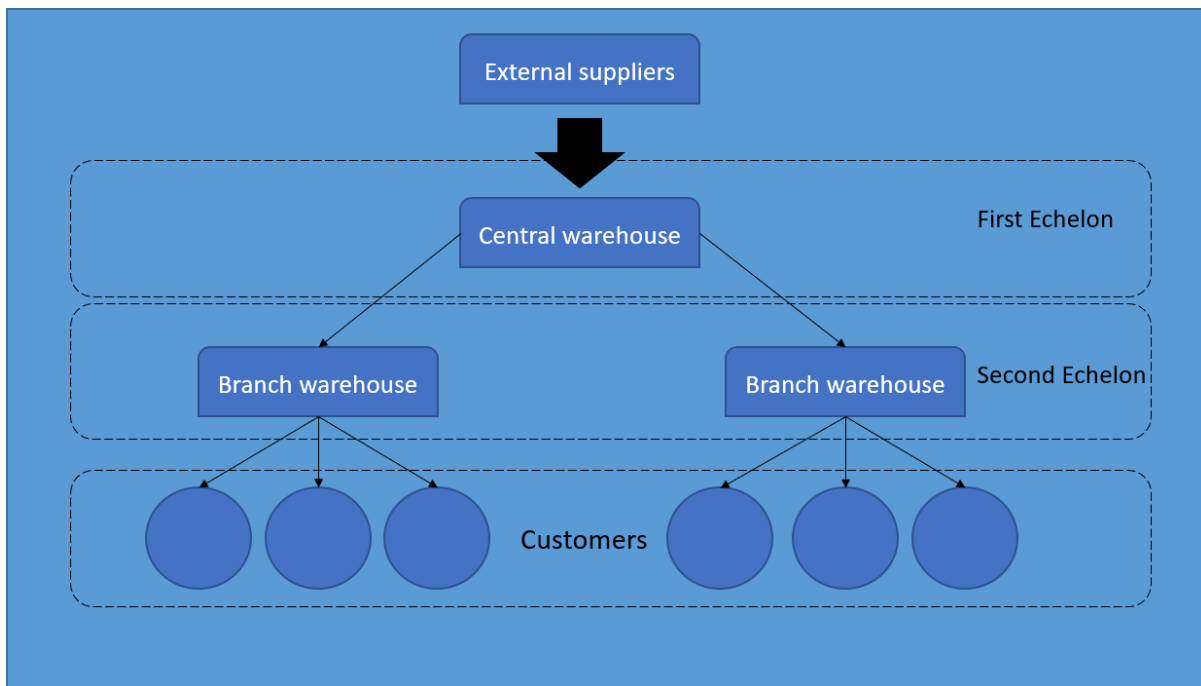
Figure 2 Simple example of an multi-echelon inventory system (Adapted from Silver et al. 1998, p.475)

Paakki et al. (2011, p.166) and Huiskonen (2001, p. 126) state that in order to achieve agile, cost saving and efficient supply chain, the primary focus should be in managing and controlling the whole supply chain rather than controlling and managing individual echelons and inventories. Key actions in order to create an efficient supply chain, are to improve transparency through open information systems and develop collaboration along the supply chain.

According to Lee (2004), successful companies do not try to adapt to changes in their supply chain network, but rather try to change the supply chain itself. If companies are not proactively controlling and managing supply and demand variabilities, the changes are taken as given from the supply chain, and inventory management has to adapt to the environment's constraints passively. Thus, is established a structure where the successfulness of inventory management is dependent of other stakeholders of the supply chain. Figure 3 presents the described structure. Taking in account the service point of view, a reactive management can be successful if the company's inventory management is performing appropriately. However, this can turn out to be expensive for the whole supply chain. Focusing to optimization of a single stocking echelon in a large distribution network can lead to sub-optimal results for the whole chain. As a matter of fact, this type of operation can decrease the whole supply chain's performance and efficiency. For instance, an individual branch warehouse replenishment behavior in their benefit leads to a demand type change from stable to unstable in the central warehouse. An organization can only control the variations in their internal processes and therefore, when reactive demand management and supply variability are not in control it will lead to lack of controlling and causing sub-optimization of internal processes. Additionally, if there is a pressure to increase supply chain performance without generating excessive inventory levels and costs, it can turn out to be insufficient. (Paakki et al. 2011, p. 166)
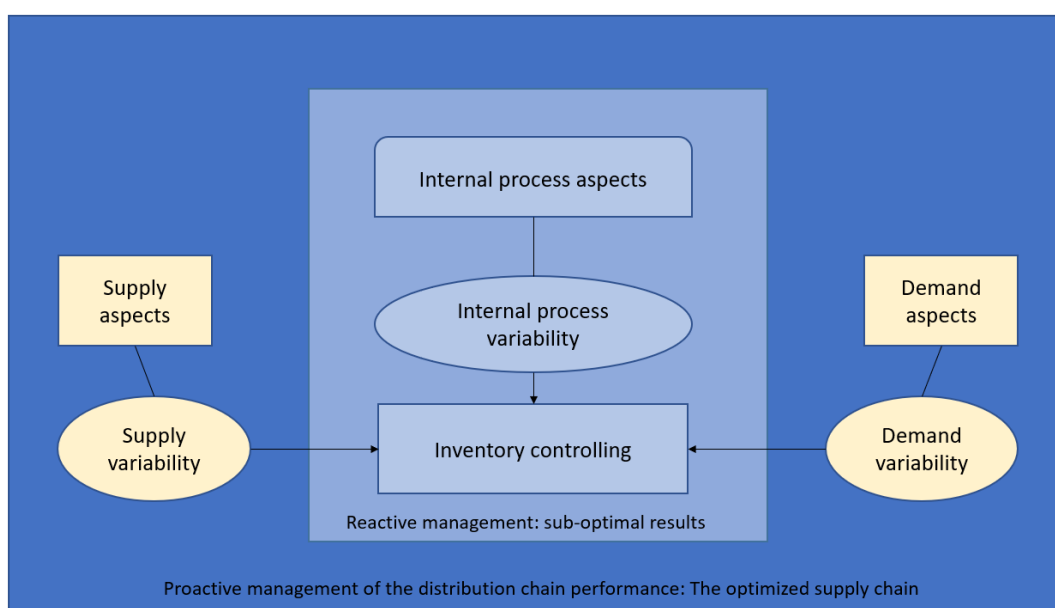
Figure 3 Three aspects of inventory management (Adapted from Paakki et al. 2011, p.166)

In order to proactively manage the distribution chain performance, the role of supply chain management should be focused to reduce demand and supply variability (see Figure 4). In short, the proactive management means that the scope of the inventory management has to expand to cover supply and demand management aspects as well as the internal inventory control processes. (Paakki et al. 2011, p. 166)
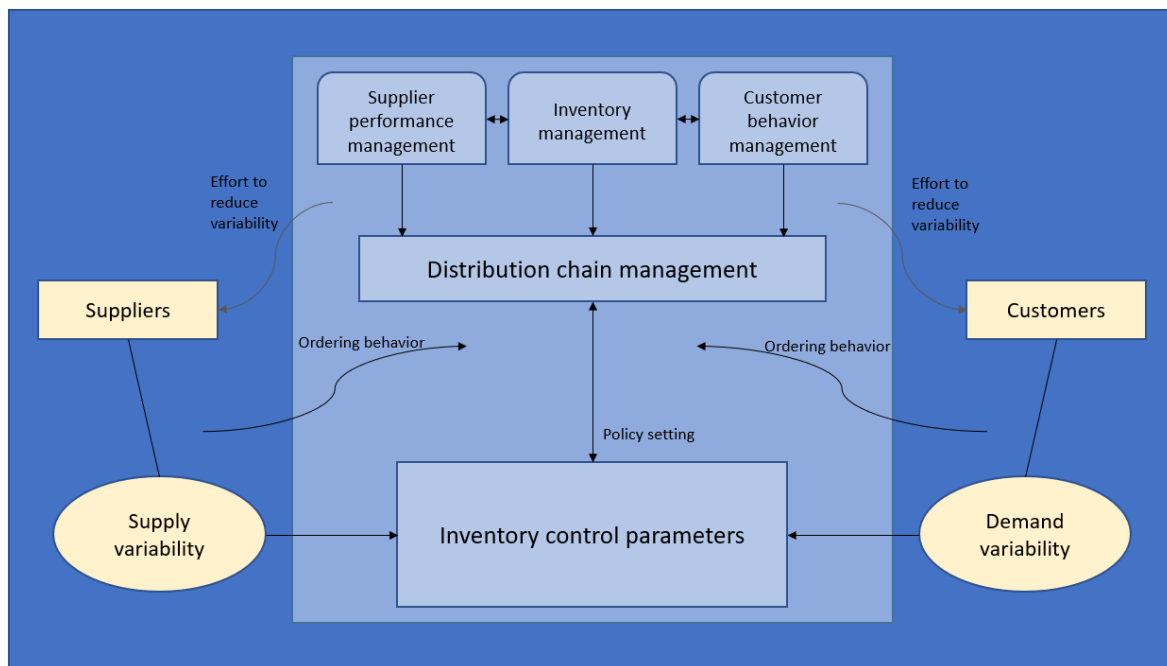
Figure 4 Inventory management's expanded role as a distribution chain management (Adapted from Paakki et al. 2011, p.166)

It is important to remember that the multi-echelon inventory system is not completely unproblematic and finished to function effectively. Silver et al. (1998, p. 487) identifies three serious flaws from the system. The customer is dependent on whether the branch warehouse has sufficient stock to fill the order. If there is no stock available, the lead time could be as long as branch warehouse's lead time added with the transportation time to end customer. So, there is a threat of duplicated lead time in the case of stockouts. Secondly, the multi echelon system ignores the cost implications at one echelon of using certain ordering logic at another echelon. The third flaw is that the system may cause bullwhip effect along the upstream supply chain, because even if customer demand is reasonably steady, the orders placed by customer become progressively larger, affecting more fluctuation and less frequent when moving to the upstream.

2.4   Net working capital and current assets

Net working capital (NWC) means the capital that the company uses to finance their current operations (Krajewski et al. 2013, p. 386). Arnold (2013, p. 510) describes net working capital as the investment a firm makes in assets which are continually in use and are turned over many times during a fiscal year. In a theoretical statement net working capital is described as the difference between current assets and current liabilities (Figure 5). Financially the net working capital is calculated by the formula presented below:

Net working capital = current assets – current liabilities
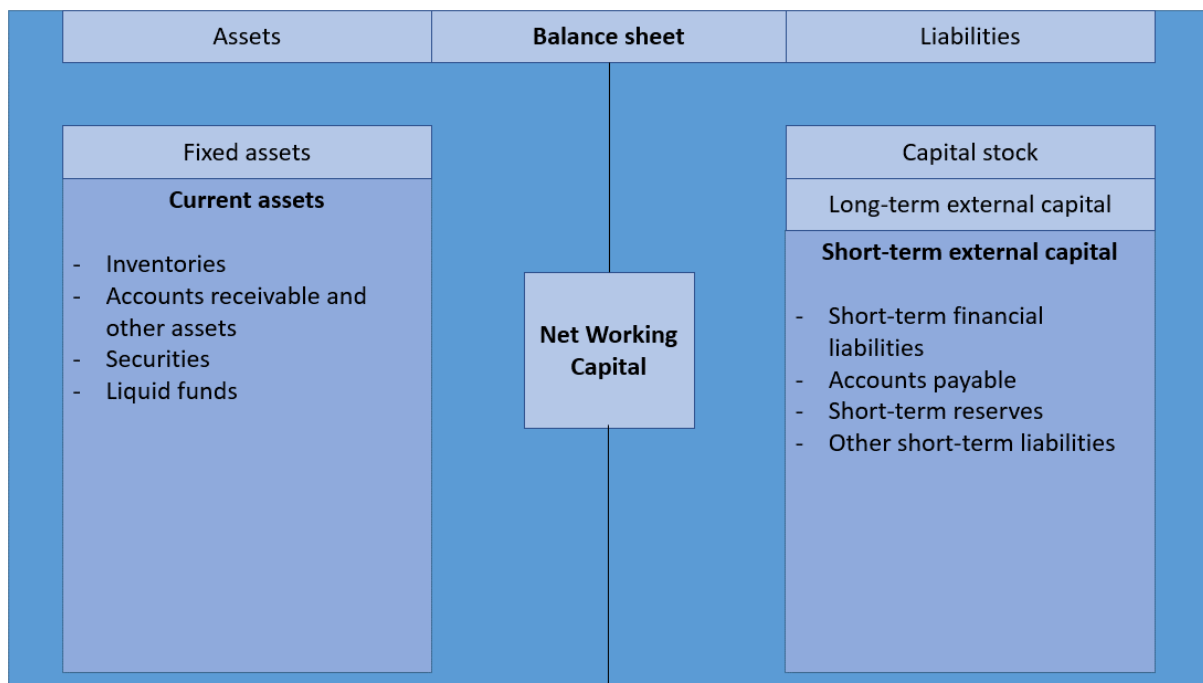
Figure 5 Net working capital presented on the balance sheet (Adapted from Hofmann et al. 2011, p. 14)

Working capital management plays a major role in cash management. In many cases the leading cause of an enterprise's failure is poor and unsuccessful working capital management. Working capital tells how well a firm manages its liquidity and how much capital is tied to the business. In addition, it measures the efficiency of company's liquidity management. Management of working capital is a crucial day-to-day activity, which enables a company to ensure that it has adequate resources to continue its operations. (Masson & Krawczyk 2010, p. 30) Ross et al. (2005, p. 43) and Gitman

(2009, p. 21) claim that the objective of working capital management is minimizing the cash conversion cycle and the amount of capital tied up in the company's enterprise process, in other words reducing current assets and extending current liabilities. The role of working capital management is significant for managing company's business successful, sustainable as it has a direct impact on company performance.

As mentioned previously, net working capital management involves important tasks which of the cash-to-cash cycle concept may be one of the most important. Cash-to-cash cycle is also called as cash conversion cycle (CCC). Cash conversion cycle is a good way for measuring and controlling the effectiveness of working capital management. The cash conversion cycle means the period between invested money in raw materials and received money from the customer. The cash-to-cash cycle is illustrated in the figure 6 below. (Hofmann et al. 2011, p. 14)
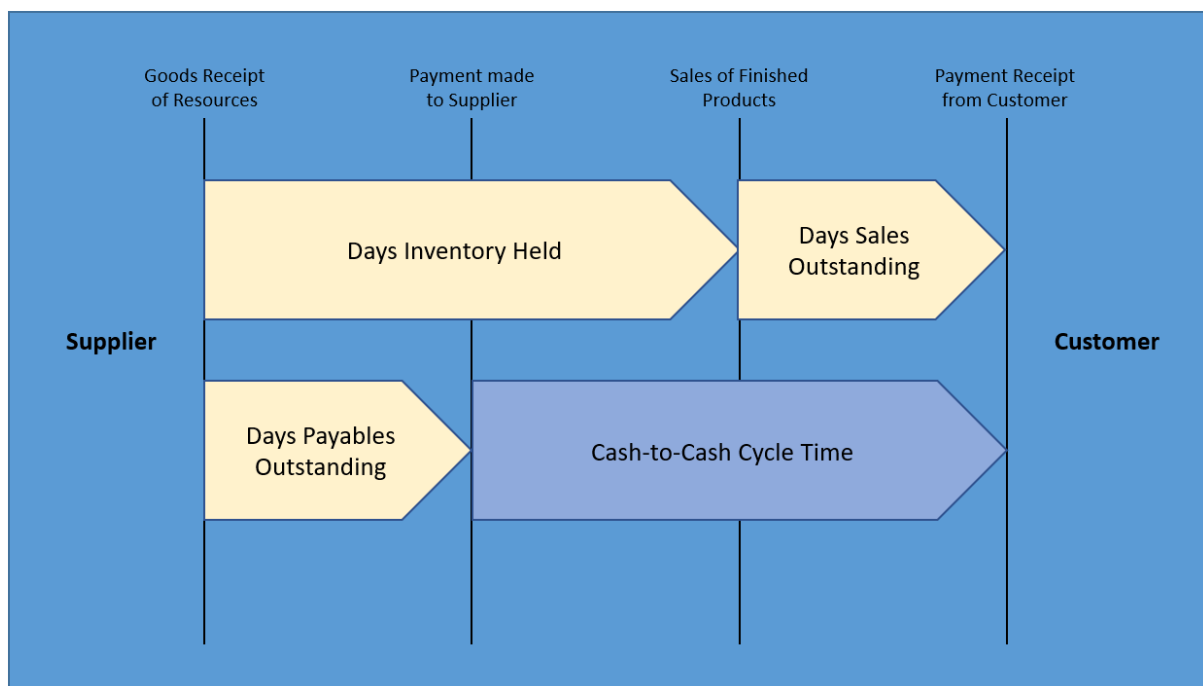
Figure 6 Cash-To-Cash Cycle time presented in relation with flow of goods and payments (Adapted from Hofmann et al. 2011, p. 14)

According to Deloof (2003, p. 574) a long conversion cycle means more investment in working capital. Shortening the cash conversion cycle to a optimal minimum level will affect positively in profitability. Cash conversion cycle time (CCCT) can be calculated as presented below.

CCCT = Days Inventory Held + Days Sales Outstanding – Days Payables Outstanding

Company's current assets mean the working capital, that is tied up to raw materials, finished products and work in progress inventories and the goods and equipment which are needed to produce the goods.

Inventories and current assets share many similarities with company's financial and actual operational processes. Well performed current assets management sustains production cycle, and it can also reach good profitability for the company. The basic factors that affect profitability include the firm's net sales, cost level and amount of capital tied to inventories. (Faden 2014, p. 3-5) Organization's capital segment of inventories are typically the least productive. Especially during an economic downturn, the input in management of inventories is emphasized due to typically it is more difficult to get loans at affordable costs. Naturally, the size of the organization and their business sector have an affect in the amount of needed current assets. Organization's performance in their current assets management is also many times monitored by third parties such as investors, current assets financers, and suppliers.

2.5   Inventory costs

Managing inventory is an vital task of supply chain operations because inventories tie up large amounts of capital (Syntetos et al. 2009, p. 292). Stocks management involve multiple costs which have to be considered in inventory management, especially in the spare parts inventory management because the specific features differ a lot, for example in comparison to the production stocks. Stevenson (2007, p. 547-548) presents three main costs which are associated with inventories. The main costs include holding cost, ordering cost and shortage cost. Holding cost represents the cost to have an item in inventory, ordering cost involves the cost of ordering and receiving in inventory, and shortage cost means the costs caused by demand exceeding the supply capability of inventory. The main cost types are described in more detail in following sub-chapters.

2.5.1   Holding costs

Inventory holding cost is the expense caused by having an item in inventory for a period of time, traditionally one year. These costs include interest, taxes, insurance, depreciation, obsolescence, deterioration, spoilage, pilferage, breakage and warehousing costs such as heat, light, other electricity, rent, labor and security. Holding costs can be presented in two ways, which are a percentage of unit price and the amount of capital per unit. Total inventory expense is then calculated by multiplying average inventory level by annual inventory carrying cost rate. In this case the purchasing cost is typically rather than the value of sales. (Stevenson 2007, p. 547; Vollmann et al. 2005, p. 138)

Stevenson (2007, p. 548) argues that the annual holding cost alter traditionally between 20 and 40 percent of the item value, but inventory management policy define the exact parameters for holding cost applied by the firm. The percentage value of holding cost is typically used in the inventory planning systems. According to Waters (2003, p. 256) the total holding cost normally settles to around 25 percent of the stock value per year. It is important to note that the holding costs can vary enormously

between companies and business areas. A rough guideline for percentages of holding costs types are represented in table 1 below.

Table 1 Annual holding cost as a percentage of unit cost (Waters 2003, p. 257)

Holding cost type	% of unit cost
The cost of capital	10-15
Storage space	2-5
Loss and obsolescence	4-6
Handling	1-2
Administration	1-2
Insurance	1-5
Total	**19-35**

2.5.2   Ordering costs

Ordering costs mean the costs that are related to ordering and receiving inventory, these costs vary with the actual placement of order. This is due to that the ordering costs are normally expressed as a fixed monetary amount per order. Therefore, the size of the order is not affecting on the cost per order. Ordering cost includes shipping, preparing invoices, inspecting of goods upon arrival for quality and quantity, moving the goods to temporary storages and other handling costs. Put into practice, the estimation for reorder cost can be calculated by dividing the total annual cost of the purchasing unit by the number of orders it sends out. Also, it is important to note that ordering cost does not meant the purchasing cost which represents the cost of goods (COGS). (Stevenson 2007, p. 548; Waters 2003, p. 256)

2.5.3   Shortage costs

The last main inventory related costs include the costs incurred when demand exceeds the available inventory stock of goods. According to Waters (2009, p. 342) the special arrangement caused by shortages include costs caused by corrective actions. Those actions can include expediting replacement orders, placing emergency orders, paying for special transports, and using of more expensive supplier. Vollmann et al. (2005, p. 139) state that sometimes the shortage cost may equal the product's contribution margin when the customer can purchase the goods from competitors. In other some

cases, it may as well involve only the paperwork required to keep track of a back order until the goods come available. Ballou (2004, pp. 339-340) makes a division of shortage costs between a lost sales cost and a backorder cost. Tangible costs, that occur from ordering process, such as additional transportation and handling cost are fairly easy to measure in the case of backorders. However, the intangible costs of lost sales are very difficult to measure.

The gathering of figures regarding any inventory costs, but particularly the shortages cause challenges. Shortage costs involve multiple intangible factors and thus it is challenging to determine an appropriate value for the cost. In any case, shortages are expensive, and it is reasonable to avoid them. Companies are usually more willing to face the costs of holding inventory, than the relatively large stockout costs. The turnback in this approach is that it tends to grow inventory levels especially when the demand is uncertain. This causes the situation where firm's capital is more and more tied up to the inventory and not available for other operations. (Stevenson 2007, p. 548; Waters 2003, p. 257)

2.6   Inventory stocking

Common models for inventory management are not valid as they are in most of cases, as the demand process is different and demand data is scarce for example when comparing spare parts and items reserved for projects. In an optimal situation, material transfer smoothly and continuously through a supply chain. In most real cases, there are delays from time to time and when material stops moving, they form stocks. Shortened, companies hold stocks to give a buffer between the variable supply and uncertain demand. Supplier deliver items to a warehouse in large quantities, but those items are sold in much smaller quantities to customers. Then stock is replenished with every delivery and is reduced over time to meet demand. Therefore, the stocks act like a buffer between supply and demand. Stocks enable the company to continue working efficiently, even when the supplier deliveries are late, or there is suddenly a high demand from customers. Inventories also enable operations to run smoothly and avoid disruptions. (Waters 2003, pp. 252-253)

Waters (2003, p. 254) introduces the purposes of stocks:

- act as a buffer between different sections of the supply chain
- allow for demands that are greater than expected, or at unexpected times
- allow for deliveries that are delayed or smaller than expected
- can take advantage of price discounts on large orders
- allow the purchase of items when the price is low and expected to rise
- allow the purchase of items that are going out of production or are difficult to find
- allow for seasonal operations
- allow to decrease transportation costs by ordering large quantities
- provide cover in case of emergencies
- can be profitable when inflation is high.

According to Huiskonen (2001, p. 126) the purpose of storage for companies is to generate sufficient service level with as low as possible invested capital to inventories and low managing costs. Sakki (2009, p. 103) states that storing, and logistics are functional opposites of each other in the logistics process. This is based on the assumption, that the larger the quantity of shipments are, the lower the transport unit cost are. From another perspective, the larger shipments increase the need for storing. Storing is needed due to long distances and transit times and this increases inventory costs. Also, it is necessary to consider, that the large amount of transportations of small quantities will be expensive. One of the key ideas, is to find an appropriate balance between these aspects.

2.7   Inventory performance measurement

Organized and planned supply chain often gives a feeling that the system is stable, but actually it always continues to evolve. Without proper measurement, it is not that simple to tell how well the supply chain is performing and how it could be improved. The performance of supply chain is supposed to be measured continuously. If it is not measured, it is impossible to tell how the supply chain is doing, whether it is improving or getting worse. Also, it is difficult to set accurate targets and follow up the targets met or compare the results to others. Many different reasons endorse the importance of measuring performance and productivity. Mainly the measuring is done because of the desire to ensure customer satisfaction and uphold a culture of continuous improvement within the operation. An old saying, "What you can't measure, you can't manage" describes the importance of measuring quite well. Effective measurement can help to discover potential issues before they escalate into major problems. The most usual challenge is to determine what to measure and how it should be measured. There are many different ways available to measure the performance of supply chain. A portion of the available methods include indirect measures that are often related to finance. Financial measures are easily to be found, sound convincing and give a broad view enable comparisons. In other hand, there are also recognized weaknesses in these measurements as they concentrate mainly on the past instead of current performance. Financial measures are slow to respond in changes and do not record important aspects of the supply chains. Thus, financial performance measures can indicate that something is not right, but the measure does not reveal the problem or tell how make it right. (Waters 2003, p. 197; Richards 2011, p. 230)

One of the most important objectives for measurement is to give basic information to use in decision-making. The measurement should tell how well the supply chain is achieving the targets. In order to get a reasonable view of the supply chain performance, it is a good idea to take a balanced view of measures. The total number of different measures is not the point, rather that the measures are in balance compared with each other. Usual challenge is that the different measures give different views. This also causes often conflicting results. It is therefore important to choose carefully the most appropriate measures for the company situation, when

implementing key performance scorecard for the supply chain. (Waters 2003, pp. 204-205)

According to Waters (2003, p. 205), the measures must be directed according to the objectives of the supply chain. The focus should be on significant factors and be measurable and reasonably objective. The purpose of performance measurement is to raise awareness about current status of the supply chain performance and therefore, the measures should consider the current performance, instead of historical. Additionally, the chosen measures must be applied in common manner in every department, so that it enables comparison over time with other organizations. One target for choosing the appropriate measures should be that they are reliable and difficult to manipulate to give false results. The measurement should also be useful in other analyses. It is important to ensure that the chosen measures are clearly understood by everyone concerned.

Stevenson (2007, p. 517) enhances the necessity of performance metrics. The metrics are essential to confirm that the supply chain is functioning as expected, as well as raise up the occurring problems in it. There are many commonly known measures which can be applied. Those relate normally to such matters as response time, quality issues, late deliveries, inventory turnover and the fill rate. The fill rate means the percentage of demand filled from stock on hand.

Another commonly used approach is to apply the Supply Chain Operations Reference (SCOR) model that reflects an effort to standardize measurement of supply chain performance. Successful supply chain management requires integration of all aspects of the supply chain. Integration requires tight cooperation among the partners in supply chain. The cooperation should work towards commonly agreed goals. Cooperation to reach commonly agreed goals requires trust and willingness from the partners. This means that information sharing must be two-way: which include sharing data about forecasts, sales volumes, and inventory figures between the partners. SCOR model metrics are presented in the table 2 below. (Stevenson 2007, pp- 517-518)

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Table 2 Supply Chain Operations Reference (SCOR) model metrics (Stevenston 2007, p. 518)

Perspective	Metrics
Reliability	• On-time delivery • Order fulfillment lead time • Fill rate (percentage of demand met from stock) • Perfect order fulfillment
Flexibility	• Supply chain response time • Upside production flexibility
Expenses	• Supply chain management cost • Warranty cost as a percentage of revenue • Value added per employee
Assets / utilization	• Total inventory days of supply • Cash-to-cash cycle time • Net asset turns

Key performance indicators (KPIs) make it possible to summarize a large amount of complex data into understandable and meaningful values and information. Thus, creating and applying KPIs in practice is not entirely straightforward. For example, data collection includes problems, such as key figure inflation and control issues, lack of consistency, and key figure errors. It is not reasonable to create overwhelming amount of different kinds of KPIs. Company should pay attention not to create new KPIs specifically if the significance is in the long run too low compared with the effort involved or other key performance indicator is covering it already. Inconsistency in the indicators can result in serious problems in decision-making. Therefore, it is reasonable to define KPIs carefully, while ensuring comparability over time and across organizations. (Hoppe 2006, p. 445)

2.7.1   Service level

Service level the performance target, which defines inventory performance goals, and it is specified by the company management. The definition of service level can differ in each case, but normally, it is related to the ability to satisfy a customer's requested delivery date. Service level can also be defined as the probability that demand is met directly from stock. For example, a service level of 95 percent indicates a probability of 95 percent that demand will not exceed the supply during the lead time but accepts that 5 percent of orders cannot be met from stock. (Bowersox et al. 2002, p. 286; Stevenson 2007, p. 565; Simchi-Levi et al. 2008, p. 380; Waters 2003, p. 268)

According to Richards (2011, p. 232), the most effective measures are those that are aligned and governed by customer expectations. In the same time, the also have to be in line with company's resources. Therefore, there is a need to find an optimal point between the level of customer service and the cost of providing the service. The relationship of service level and cost of services affecting the performance is illustrated in figure 7 below. The cost of increasing service level is increasing exponentially and as shown is the figure, increasing level of service from 95 to 100 is far more costly than increasing the level from 70 to 80 for instance.
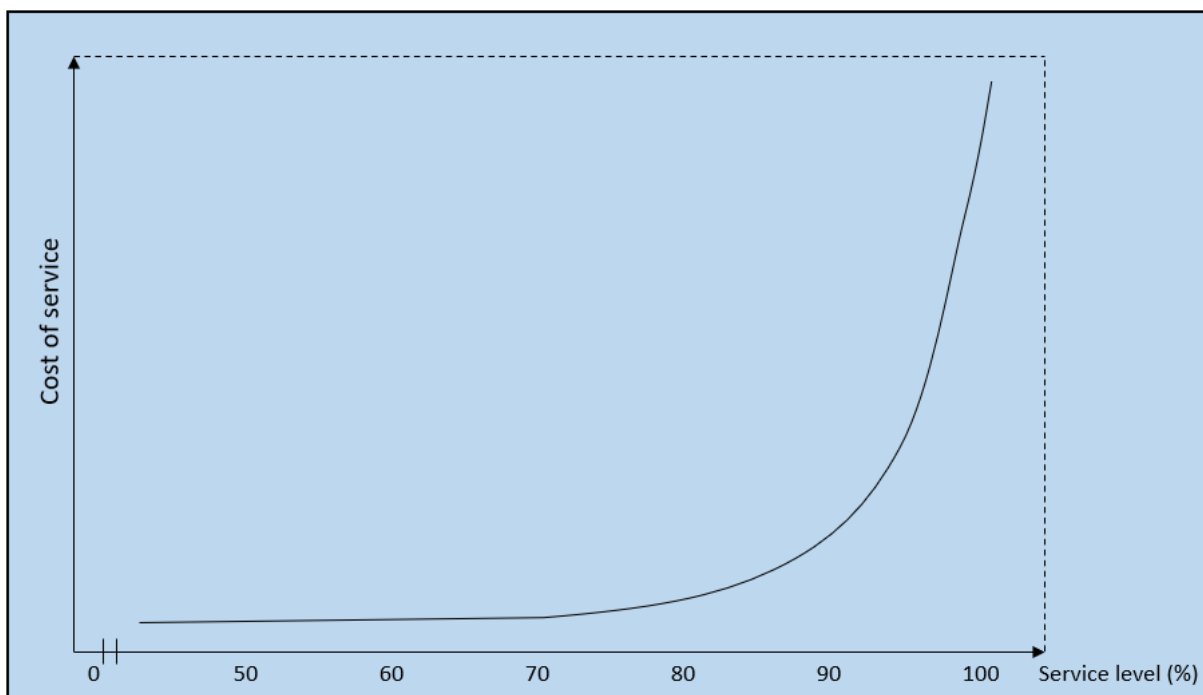
Figure 7 Relationship between service cost and service level (Richards 2011, p. 233)

Traditional ways to measure service level are considering for instance order cycle time, case fill rate, line fill rate, order fill rate or a combination of these. Commonly accepted good ways to go by with it are by measuring order fill rate and order line fill rate. (Bowersox et al. 2002, p. 286) The formulas for calculating these service level measures are as follows:

$$Order\ fill\ rate = \frac{Number\ of\ orders\ delivered\ completely}{Total\ number\ of\ orders} * 100\%$$

And

$$Order\ line\ fill\ rate = \frac{Number\ of\ order\ lines\ delivered\ completely}{Total\ number\ of\ order\ lines} * 100\%$$

2.7.2 Inventory efficiency

The efficiency of inventory management can be evaluated with various performance measures. The measures are often related to the rate of stock turnover or utilization of space. One of the basic and commonly applied measure is the value of stock held. Stock value tends not to be stable, as it varies over time. Thus, traditionally average or typical values are used. Average inventory value is useful metric to track value over time and looks for trends. If the value keeps rising, it might be cause for concern. Average total inventory value can be calculated by summing all products average number of units held multiply inventory cost value. (Waters 2003, p. 203) The formula for calculating average total inventory value is presents below:

$$Average\ total\ inventory\ value = \sum(Average\ number\ of\ units\ held * unit\ value)$$

Bowersox et al. (2002, p. 560) and Stevenson (2007, p. 544) state that inventory turnover rate is the most common performance measure of inventory management. Many variations of calculating turnover of inventory are used among companies. Therefore, it is important to make sure that the same calculation method is used when comparing turnover rates. The formula for calculating inventory turnover according to Bowersox et al. (2002, p. 560) is as follows:

$$Inventory\ turnover = \frac{Usage\ or\ sales\ during\ a\ time\ period\ at\ cost\ value}{Average\ inventory\ value\ during\ the\ time\ period\ at\ cost\ value}$$

Average inventory can vary significantly during the period. Therefore, it is necessary to determine the average inventory value using as many data points as possible. Using too few data points may cause a false image of the average inventory value and thus, mislead the management of inventory. (Bowersox et al. 2002, p. 560) Inventory turnover can be described best by how many times inventory rotates during a year period. Turnover rate can be calculated by total inventory days of supply. It tells how many days the company can manage average demand with current stock after the stock runs out. (Sakki 2009, p. 77) The two possible formulas for calculating Total inventory days of supply (TIDS) are as follows:

$$Total\ inventory\ days\ of\ supply\ (TIDS) = \frac{Average\ inventory\ value}{Usage\ or\ sales\ at\ cost\ value} * 365$$

According to Sakki (2009, p. 77) the most appropriate way to measure the efficiency of inventory is by measuring rotation of profit. It is a good tool for comparing profitability between items and item categories. It is a simplified return on investment for inventory items, which combines profitability and efficiency of logistics. The formula for calculating the rotation of profit is as follows:

$$Rotation\ of\ profit = gross\ profit\ \% * inventory\ turnover$$

2.8   Item classification and analysis

Item management has been well researched over the decades. Particularly the area of stocking strategies has received a good amount of attention and many models have been developed to answer the basic questions: What to stock? Where to stock? How much to stock? Handling of spare parts especially is many times difficult due to their variable characters. Items classification can be seen important when trying to find a solution for matching appropriate stocking policies to different classes of items. (Molenaers 2012, p. 570)

For most companies in asset-intensive industrial sectors, the item classification into relevant categories is a necessity in order to have control over the large and widely variated assortment of items and spare parts. By applying item classifications, it is possible to use a variety of forecasting methods and set targets, as well as make individual stocking decisions for different categories. The classifications help management to concentrate on the most important items and facilitate the decision-making process. In the case of spare parts and components, the importance of certain item can differ depending on the perspective. Classification criteria can differ quite a lot, when for example looking from a maintenance perspective or inventory management perspective. Maintenance perspective would stress the fact that unavailability would result in severe consequences, as in other hand inventory management perspective would consider value-based classification criteria, like holding cost and demand pattern when deciding suitable stocking policies for the different classes. (Molenaers et al. 2012, p. 570; Syntetos et al. 2009, pp. 292-293)

The cost variations, different service requirements and demand patterns cause wide variations in the item assortment in large companies. Therefore, normally the classification of these parts can vary widely. Many firms commonly assign higher service-level targets to some classification segments than others. Some companies in industrial field classify their spare parts according to their criticality for the machine's functionality. Criticality involves many different aspects, and therefore evaluating of criticality-based classification is often very complex. The criticality can reflect for example the potential affects of unavailability in the safety of people and environment, the cost of downtime, the quality of the processes, etc. (Syntetos et al. 2009, p. 294)

2.8.1   ABC analysis

Waters (2003, p. 274) states that even the most simple and highly automated inventory control system needs some effort to make it operate efficiently. Especially for cheap items this effort is not worthwhile. Only a small number of companies have, for example a routine stationery or nuts and bolts in their stock control system. In the other hand there are the expensive items that need special treatment over the routine calculations. To give an example, aircraft engines are very expensive, and airlines have to control their stock of spare engines very carefully.

ABC inventory classification systems are widely known and applied by companies to streamline the organization and management of inventories consisting of large amounts of distinct items, referred to as stock-keeping units (SKUs) (Teunter, Babai & Syntetos 2010, p. 343). According to Ng (2007, p. 344) there might be thousands of inventory SKUs even is moderate size companies. The traditional approach for having a good control over this huge amount of items in inventory is to classify the inventory into different groups. This helps to apply different inventory control policies to different groups. Ernst and Cohen (1990, pp. 574-576) state that, the most important reason to use ABC classification is that the number of different SKUs is too large to implement SKU-specific inventory control methods.

ABC analysis sorts items into categories that represent the amount of effort worth spending on inventory control. ABC analysis is a well-known and useful classification based on the Pareto "80/20" -principle, which means that 20% of inventory items require 80% of the attention, while the remaining 80% of items need only 20% of the attention. For instance, group "A" SKUs are those that make 70% of company's business (annual capital usage) but only representing 20 % of the inventory. It means that those SKUs are critical to the functioning of the company. Group "B" would be representing 20% of the company's business and taking up about 30% of the inventory. Lastly group "C" SKUs are representing the remaining 10% of company business but taking up majority of the inventory by 60%. Classification methods based on cumulative percentage of use by value is illustrated in the figure 8 below. (Waters 2003, p. 274; Ng 2007, 344)

The basic approach for categorizing items according to Waters (2003, p. 274) is:
- A items are expensive and require special care
- B items are ordinary and require standard care
- C items are cheap and require little care.
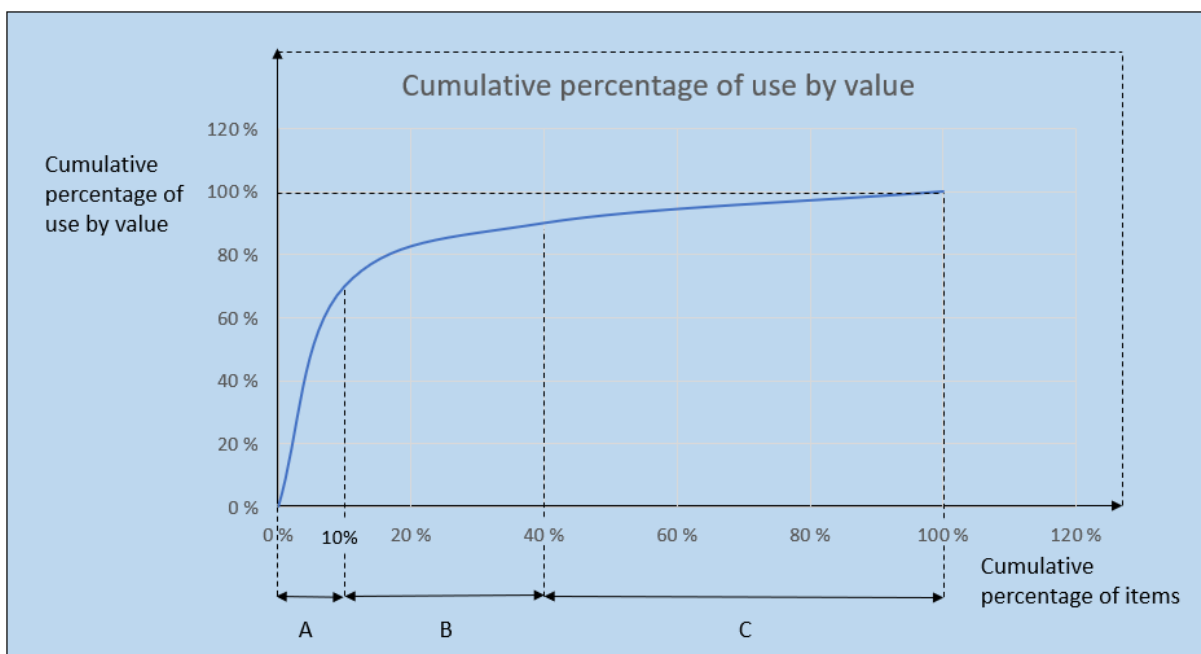
Figure 8 Normal result for an ABC analysis (Adapted from Waters 2003, p. 274)

Waters (2003, p. 274) suggests to start an ABC analysis by calculating the total annual use of each item by value. Typically, a few expensive items account for a lot of use, while many cheap ones account for a small portion of use. By listing the items in order by decreasing annual consumption by value, A items will be at the top of the list, B items in the middle after A items, and C items are at the bottom after B items. Typically findings might be as follows in table 3.

Table 3 Usual result of plotting the cumulative percentage of annual use against the cumulative percentage of items (Adapted from Waters 2003, p. 275)

Category	% of use by value	Cumulative % use by value	% of items	Cumulative % of items
A	70	70	10	10
B	20	90	30	40
C	10	100	60	100

The ABC-classification is very easy to understand and present. However, it is also very rough classification method. In most cases the analysis should go into more detail after classification and if needed, extend the separation to four or more classes. This is not necessary every time, but many times it is justified to further subdivision each class due to classes typically contain huge amount of data. Lastly, it is important to remember the quality of data, if data is not consistent, the ABC analysis can be very contradicting. (Hoppe 2006, pp. 54-55)

2.8.2   Multi-criteria classification methods

ABC classification method is a single criterion method and it is able to give expression to for example, how important is classified product relation to the annual usage. Other important aspects, such as the product delivery time or availability of the product are completely separated from this classification. Many authors have discussed about the importance of using multiple criteria, as for example, certainty of supply, the rate of obsolescence, the lead time, cost of review and replenishment, design and manufacturing process technology, and substitutability. (Happonen 2011, p. 4; Teunter et al. 2010, pp. 344-345)

According to Ultsch (2002, pp. 2-3) ABC analysis in item classification results in segmentation between different classes as in A class includes a few items, B class some or some extent items and the classes after that have a large amount of items. The ABC classification is good for recognizing the top items and the bottom items, but the method has received criticism due to it does not give meaningful results for middle-class items or for controlling these items. The B class involves a great portion of items of which economic value is major in relation to the firm's annual result or the value of inventory, also the annual demand is admittedly considerable. It is simple to agree on controlling methods, for instance, outsourcing the management of class C items due to these items annual usage is very low but need much resources to control them. From another perspective, it is necessary to optimize and follow up tightly A class items. A class involves only a few items in the class which are high volume items by annual usage. B class includes a lot of items with high demand as well as items close to C class and therefore, B class causes problems. It is difficult to find a clear and individual management policy for B class items because of the very different items in the class. (Happonen 2011, pp. 4-5)

Traditional and well-known ABC analysis is based on a single measurement for example annual monetary usage. The analysis is clear and simple to understand as well as easy to use. The previous academic study has shown that it is important that ABC classification is not the only way to classify items. It has been learned that other criteria, like inventory cost, part criticality, lead time, commonality, obsolescence, substitutability, the number of request per year, scarcity, durability, reparability, order size requirement, stock ability, demand distribution and stockout penalty, are also important in inventory classification. Multi-criteria classification tools have been developed during the previous decades to overcome these challenges. Many different multi-criteria classification tools have been considered, including weighted linear programming, operations-related groups (ORG) and analytic hierarchy process (AHP). A good alternative for using multi-criteria methodologies is to use multiple way classifications, e.g., a two-way classification by purchase cost and volume. (Happonen 2011, p. 4; Ng 2007, p. 345; Teunter et al. 2010, pp. 344-345)

2.8.3   Classification based on demand and ABC – XYZ analysis

One practical and usable supplementary classification is XYZ-analysis. It is a classic secondary analysis which is basically a modification from ABC-analysis. The way of doing these classifications is quite similar, but in XYZ-analysis the item classification criterion is the consumption pattern of each item. The classification criteria can be for instance the number of sales transactions or pick-ups from stock over a certain period of time. Items can be then divided to different classes depending on how regularly they are sold. Logistics costs are normally correlated to the number of transactions. Furthermore, XYZ classification provides valuable information about items from logistics point of view. (Sakki 1999, pp. 1005-106; Hoppe 2006, p. 53)

Hoppe (2006, p. 87) introduces a method of combining ABC- and XYZ-analyses. It describes the third step in a detailed inventory analysis after computing individual ABC and XYZ analyses. Combining these two analyses to one ABC-XYZ matrix allows to implement a specific inventory optimization process for each value. Earlier studies have found out that this process can discover remarkable optimization potentials. Commonly ABC and XYZ analyses include three classes, therefore the ABC-XYZ matrix contains nine different classes. The ABC-XYZ matrix allows to develop actions to optimize inventories. The matrix assists to choose correct inventory and purchasing policy for each class. The matrix reveals item class corresponding to each ABC analysis result and XYZ analysis result. AX items have a high potential for rationalization and optimization. In the other hand, CZ items only show a low economization potential. This means that CZ items should be planned automatically and use human resources valuable time for AX and so on classes. Therefore, the optimization potential is higher for A and B items and the control overhead is higher for Y and Z items. The optimization potential and actions to optimize inventories are illustrated in Figure 9 below. One typical aspect is that normally fluctuation increases when going from AX class to CZ.
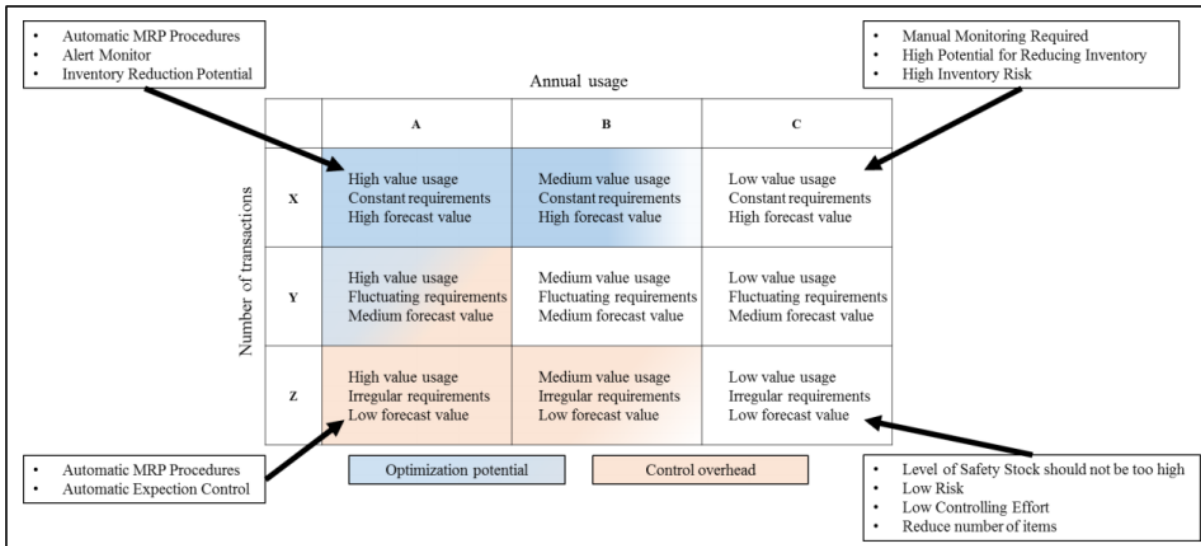
Figure 9 ABC-XYZ matrix including inventory optimization actions and optimization potentials (Adapted from Hoppe 2006, p. 88)

The planning process for AX items should be automated while maintaining good transparency and information on changes and exceptional situations. This type of classification helps to focus and manage the correct items in correct manner. For instance, the focus can be directed to AZ items and plan them manually due to their consumption fluctuation they cannot be automatically planned. (Hoppe 2006, p. 89)

2.9   Demand forecasting

Demand forecasting and methods have been researched and tested a lot in the past years. One critical aspect that should be mentioned before going more in depth in to the subject of forecasting is that it is important to remember the following basic rules about demand forecasting; the forecast is always wrong, the longer the forecast horizon is the worse the accuracy of the forecast and aggregated forecasts are. Nevertheless, forecasting tools should not be underestimated because those are important and critical tools in the management toolbox. (Simchi-Levi et al. 2008, pp.56-57)

According to Manzini et al. (2010, p. 411), the primary objective of efficient inventory management system is to minimize the total cost. Thus, it may be tricky as the trade-off between storage costs and production downtime costs have to be identified. In order to identify the optimal level of inventory, two analyses should be considered: The forecasting of future demand and its efficient management accordingly. Numerous different methods are available for identifying the future inventory requirements. Experience of maintenance personnel is a unique source of information which can be used in advance when planning future needs. Local demand can be forecasted based on distribution center real demand, work experience or different developed tests. Statistical forecasting models elaborate the consumption of spare parts registered in the past and estimate the future demand based on that knowledge.

The large variation of different forecasting tools and methods can be divided into four general categories: judgmental, market research, time-series and casual methods (Georgoff et al. 1989, pp. 1-9). Idea behind judgment methods is to gather the opinions of variety of experts in systematical way. For instance, by a combination of salespersons' estimates, using a panel of experts approaching or the Delphi method can be a very systematic way to gain information about components and spare parts that are needed in the markets. In the case of new product markets, testing and surveys are good tools for developing forecasts. Those responses can then be extrapolated to the entire market to estimate the future demand of products. (Simchi-Levi et al. 2008, p. 58)

Time series methods are based on using of different kinds of past data to estimate the future data. Bacchetti & Saccani (2012, p. 722) state that, time series demand forecasting, such as moving average or single exponential smoothing, will overestimate the mean level of intermittent demand. According to Johnston & Boylan (1996), an adjusted exponentially weighted moving average method is optimal for forecasting intermittent demand. Their research shows that the method performs better with intermittent demand and forecasting errors do not occur. Especially for spare parts, it is very common that there are seasonal variations in the demand. Methods that remove the seasonal pattern from data and then apply the approaches to the edited data are used for this type of forecasting. If the trend exists, methods

such as regression analysis and Holt's method are more useful, as they can better take in to account the trends from data. Rapidly moving and smooth demand does not require the use of any special forecasting methods, instead the regular time-series demand forecasting method can perform accurately for this kind of demand. (Simchi-Levi et al. 2008, p. 59)

Many researches in the recent years have shown that forecasting should be done according to individual demand patterns, using different forecasting methods. This is best seen when demand fluctuation is high and a single forecasting method is used; demand will cause distortion and unnecessarily high inventory levels. Kalchschmidt et al. (2003, pp. 397-411) present a model where additional information about demand is gathered from the largest customer, and then this demand distortion can be smoothed, and it will help to reduce inventory levels as well as keep the service level high.

As discussed before, there is no single right and best forecasting method for all demand patterns. Choosing the most appropriate method from the large variety of different methods is not simple or easy. Chambers et al. (1971, p. 68) claim that, if sales estimations are sufficient, a less complex method may be appropriate. In the other hand, if detailed estimations are necessary, more advanced methods may be required. In the aspect of spare parts inventory, the past data is very useful and important, since in many cases the demand during a products life cycle is stable, therefore time-series methods make sense. However, if the past includes for example significant systemwide changes, the past data is less important and methods like judgment and market research can be more appropriate. (Simchi-Levi et al. 2008, p. 59)

3   PROCESS MANAGEMENT & DEVELOPMENT

According to Paim et al. (2008, 707) and Hannus (2004, 104) process is a structured, measured group of activities designed to create a specific outcome. Trkman (2010, 125), Bai and Sarkis (2013, 284) and Lin et al. (2002, 19) define business process as a complete, dynamically coordinated group of activities or logically related assignments that have to be completed in order to deliver value to users and in which resources are consumed. Processes exists all over the company's functions and this thesis focuses on business processes particularly from the inventory management point of view. A simple process is illustrated in Figure 10 below.
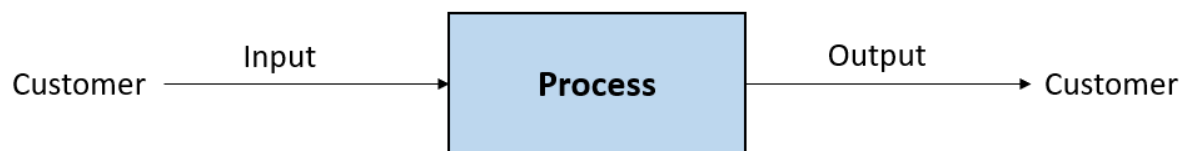
Figure 10. A simple process (Martinsuo &Blomqvist 2010, 4)

- Customer: process always starts and ends to the customer. Customer or user can be either external or internal to the organization and it always drives expectations, needs, and demands of process.
- Additional value: process receives inputs, in which through process additional value is created. Additional value relates to expectations, needs or demands of a customer and the output can various things, such as product, information, solution, service experience etc.
- Resources: process needs and consumes resources, which can include for example: raw material, labor, capital, equipment, and information. Resources cause expenses and they are never unlimited. (Martinsuo & Blomqvist 2010, 4)

According to Lee and Dale (1998, 215) processes can be divided to core processes and support processes. Core processes are always connected to external customer, whereas support processes are internal and they serve core processes. It should be remembered that every process is not equal. There are also alternative allocation criteria for processes, such as two groups presented:

- The processes that start when necessary and finish sometime in the future
- The process that is constantly running

Strategies are realized through processes and by perceiving and developing operations through processes, performance can be improved. During the execution of strategy, changes in process capabilities like quality, speed, flexibility and efficiency are needed. Operative efficiency and effectivity are often depended on functionality of processes, especially on the functionality of information systems. The efficiency is important to take into account, since the method to refine inputs to outputs is the key of success. Normally, the activities of processes are improved by the process owner. (Laamanen & Tinnilä 2009, 13, 29)

Three key factors related to determination of processes are strategic importance, rate of standard format and coherence. Rate of standard means that other processes repeat always in the same manner and same order and other processes are more informal and the chain of actions can vary according to the existing situation. Coherence means the situation where an organization has different offices and how likely the offices perform a specific process. (Hannus 2004, 107)

After recognizing the optimal process features it is time to create or develop the process further to support organization needs as best as possible.

3.1 Development of processes

The development of processes is always related to other planning and development of the organization. Thus, it is based on the same vision, strategy and policies that guide organizations other activities. The company management is in the key position when it comes to successful process development. Management has to give clear assignments and objectives to process development as well as reserve required resources to implementation and deployment stage. (JUHTA 2002, 3)

The objective for business processes development is to align them with organization's strategic goals and to improve customer satisfaction. This can be achieved by developing the quality, effectiveness, availability and by lowering the costs of these processes. Process development normally aims to improve the sharing of information and data, effectively deploying IT and reducing overlapping activities and duplicated processes. Key to success is to maintain constant improvement and the measurement of impacts. (Damij et al. 2008, 1135)

Paim et al. (2008, 767) and Aparecida da Silve et al. (2012, 767) recognized the elements of organizational functions that should be considered when managing and developing processes:

- Strategy
- Information technology (IT)
- Information and knowledge
- Performance indicators
- People and skills
- Policies and procedures
- Coordination of work and production systems
- Control and audit
- Innovation and improvement

Development of processes may have numerous targets but generally it aims to improve the quality of operations and enhanced service level, managing problem situations and achieving cost savings. In practice this can mean new kind of centralization of things, removing overlapping work stages or adding collateral stages to shorten the lead time. Most of the times, the goal of finished process is to increase measurability, decrease the need for multiple approvals, and improve the usability and reliability of the process. Development often leads to forming new work teams or new ways to manage processes. (JUHTA 2002, 3)

The current situation of process should be compared to the objects: does the current process create the desired outputs? It might not be necessary to completely redesign the whole process again and consider reforming only areas that won't meet the expectations. In some cases, it is however worthwhile to generate the whole process again. The scope of process development can alter from broad development projects to continuous developments. A large-scale development project can include for example deployment of new methods but often the change is about improving some part of the process. (Martinsuo & Blomqvist 2010, 7)

Damij et al. (2008, 1128-1129) stress the role of IT in development of business processes. The development involves more than just observation, people should learn about processes. If the development needs assist from IT, there should be a good specification on basis. Participants of the process must have a good understanding of each other's part of the process. In order for process to be able to improve, the existing problems need to be answered. In most cases, the development of process starts from a problem that needs to be solved. (Damij et al. 2008, 1136)

The process should be kept simple and practical in mind, when planning the target of process. The following questions should be considered, when piloting the new process: does all tasks add value and are all information and material flows considered. All excess tasks, resources and systems that won't add value should be left out from the target process. The typical steps of the development of processes are illustrated in figure 11. If the target process is reviewed together with the different

stakeholders participating in process, more aspects are likely to be considered and problems are understood better and stakeholders are committed to the process and its changes better. The feedback that process gives, can be then used to improve and management. (Martinsuo & Blomqvist 2010, 13-14)
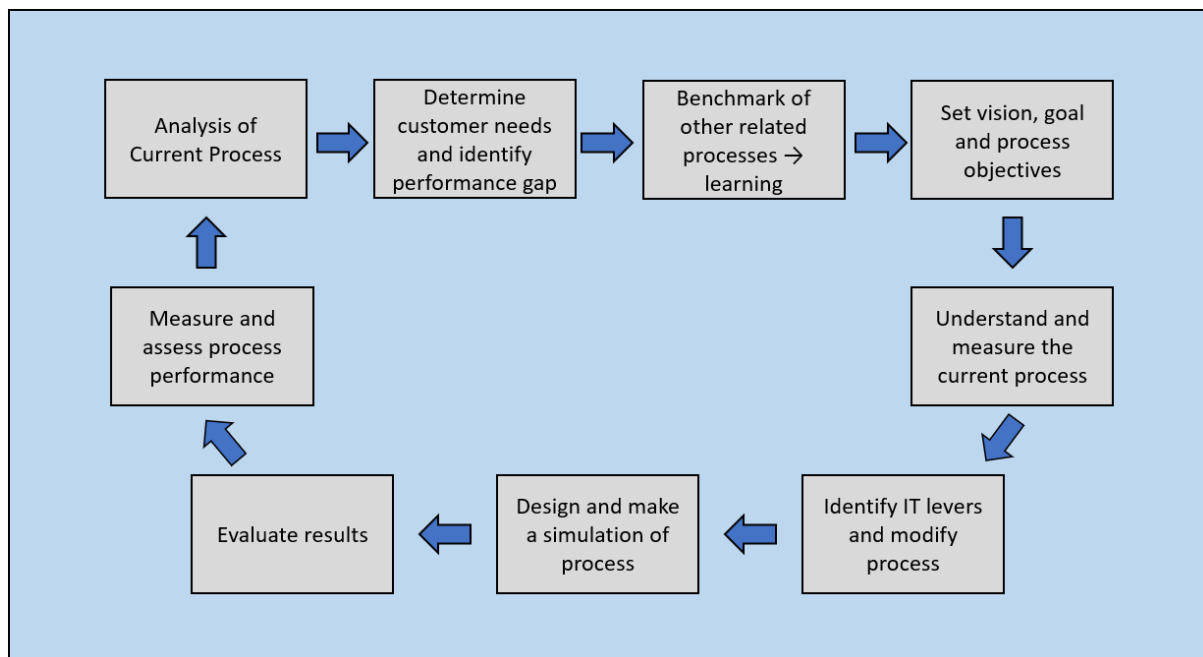
Figure 11. Phases of process development (Adapted from Budiono & Loice 2012, 35, 36)

Prior to a wide scale implementation of new process, it should be piloted in real or in a modeled situation. Then corrections can be made and unsuccessful process consequences can be prevented, while at the same time giving information whether the new process solves any problems which it was created to solve. The personnel and other participants need to be instructed well to work according to the new process. (Martinsuo & Blomqvist 2010, 7)

Lee and Dale (1998) stress the importance of top management leadership in process development due to they are the starting point of all improvement processes. Senior management are responsible for defining vision and strategies, designing processes, lowering hinders and enabling employees to influence. Process development should form a feedback loop in order to support constant improvement. BPM performance can be evaluated through measuring and taking in account the feedback from

participants to see whether the process is reaching strategic goals and objectives. It is also important to align the overall strategy of an organization and BPM in order to reach long-term success and improved performance. (Bai & Sarkis, 2013, 283) Additionally, relevant in process development is to change the way of thinking, create readiness to question and break borders. Developing know-how and generating commitment are also crucial. (Hannus 2004, 109)

3.2 Modelling of processes

In order to be able to develop the current performance, it is necessary to have information about the current levels of performance and the reasons affecting to it. Process modeling is a method to clarify present of target process and visualize its possible challenges and needs for development, at the same time reducing cost and seek for alternative ways to work. In order to portray the current situation, different data gathering methods can be used, such as interviews, group work, database analysis, observation, and process modeling as simulation. (Damij et al. 2008, 1140; Martinsuo & Blomqvist 2010, 3, 7; Laamanen & Tinnilä 2009, 10-11; Lin et al. 2002, 19)

The modeling of processes is easiest to start by defining who are the customers and other stakeholders of the process, what resources it uses, is it core or support process, who is involved to the process, what are the prior and continuing processes, what are the inputs and outputs, what are the value adding activities, and what kind of chain it comprises. A good way is to model a map from the process: where it starts and ends, what is the direction. The function that gives an impulse to start the process should also be considered or notice if the process is constant. Good documentation ensures the quality, consistency, and repeatability of performance.

Defining of the current process is normally started from the starting point. On the other hand, when modeling the target process, it is preferred to be started from the end by defining the outputs first and the proceeding towards the starting point by listing the actions which need to be done in order to reach the output. It is crucial to notify all value adding activities, the decisions needed to be done and the factors supporting the process. It is easiest to start by drafting a rough description from process, but when going deeper into to the functions of process, a more detailed description is required. A detailed process description should separate tasks. Also, all essential know-how, tools and systems and other critical matters should be determined. (Martinsuo & Blomqvist 2010, 10-11; JUHTA 2002, 5)

There are many different kinds of description methods available to present detailed processes, some of them are established methods and some organization's own, and they serve different processes in a different way. A written report of the process supports the graphical description in most cases. Damij et al. (2008, 1128) presented many business process modeling methods such as flowcharts, data flow diagrams (DFD), TAD methodology and Petri-nets. These techniques can be used to model the current process and desired future state. Flowcharts will be used in this thesis. Flowchart is a visual way to display the process. There are also other computer-based methods that allow for example a simulation of a process. This work will apply a computer program specifically made for designing and illustrating business processes.

3.2.1 Lean management

Rethinking of work tasks is the most notable way to gain continuous flow of work. Thus, Business process re-engineering (BPR) emphasize rethinking of the current processes a good way to find improvements. In order to achieve the continuous flow of designing, ordering and providing of the service, the focus must be on the service and its needs, instead of the organization or the equipment. Lean thinking can be summarized in following principles in order to maximize the flow:

- Define the value of specific product or service accurately
- Recognize the value stream for each product and service
- Enable the value flow without any interruptions
- Enable the customer to pull value from the supplier
- Aim for perfection (Womack & Jones 2010 10, 22)

The last principle can be enhanced in the organization by encouraging employees to notify development areas and make development suggestions. Emiliani and Stec (2004, 634) discovered similar methods to repair the operations: question the process, encourage system improvement, support the improvement opportunities, and recognize and eliminate bottlenecks. Steady information flow helps to foresee future and assists in decision making.

All events when the consumer has to spend time for no return in value, should be considered as waste and the provider should think how the process could be changed to eliminate that wasted time. Removing the inefficiencies from the provision stream solves both, providers and customers troubles. Process restructuring is a key factor in attaining improvements. (Ward & Zhou 2006, 179-180; Womack & Jones 2005, 4)

Traditional mass-production measurements rely on belief that an organization can maximize profitability by maximizing the use of different resources. On the other hand, lean thinking states that profit is maximized by maximizing the information, material, and cash flows at the pull of the customer. (Maskell & Kennedy 2007, 61) Ward and Zhou (2006, 179) mentioned that Lean is focusing on excluding everything that is not necessary and IT normally does the opposite by enabling larger amount of information, more functions and features; more is better. According to Womack & Jones (2010, 15) Lean thinking responds to these wastes by providing a way to define value. Line-up value-creating actions in the most appropriate stream lead these activities without interruption at any time someone asks for them and make them more and more effective. Briefly, less equipment, less human effort, less time, and space to meet customers needs more and more better. Also, it is stressed that human respect is crucial.

Lean organizations typically prefer simple visual systems instead of complex systems. Visual systems make it easier to run the businesses for the different stakeholders of the company. The most important starting point is to understand the customer value and value stream performance. (Maskell & Kennedy 2007, 65) Lean thinking drives to standardize the processes and utilize the efficiency from the standardization. Without standardization the processes are too unstable to be controlled efficiently. (Ward & Zhou 2006, 195)

3.2.2 Digitalization

Lean thinking in digital administration philosophy aims at developing and re-designing processes to eliminate unnecessary work steps and to perform the remaining works as fixed as possible. Digitalization reduces mistakes when systems and connections take care of the major of work phases which are traditionally done manually. Human errors and miscalculations reduce vastly. The disadvantage can be that mistakes duplicate in masses and are depended on the system, also the correction of mistakes can be tedious. (Lahti & Salminen 2008, 21,28)

Digitalization is the only method to be able to survive from the increasing control and accountability requirements. It enhances transparency and makes it possible to drill into data. Integration of different systems reduces handling and feeding same information many times and improves and accelerates the information flow. In order to be able to fully exploit the benefits of digitalization, the information should be taken to systems from their original source. This means that the data is fed in first systems by employees, customers, or other stakeholders. This also means that the data can be taken from Excel lists if it can be fed into the system. (Lahti & Salminen 2008, 2-29, 78)

3.2.3   Modelling

One method to look for bottlenecks in processes is value stream maps. Value-stream maps can be divided into two kinds: current state and future state maps. Current state maps describe the present way how material and information are processed. Current state value-stream maps reveal the wastes that exist in a process and point out the distracting information signals. By investigating the results of current state map, the consumption of resources (time, huma, financial, equipment, space) can be optimized. Future-state value stream maps illustrate the desired future condition, where the necessary improvements are made. The improvements are developed from current state map and by thinking creatively how the process can be improved. Future-state value stream map can be made for a longer time span. (Emiliani and Stec 2004, 623)

From the inventory management perspective, the modelling value stream mapping of current and future state will allow to identify the waste, which can then be solved by re-organizing the processes like production process or sourcing policies. The adoption of different kinds of indicators like demand attendance, inventory turnover and inventory accuracy will help greatly to measure the results of the re-engineered process. Benefits such as, reduced material costs, reduced inventory levels and the demand and supply to guarantee customer satisfaction can be achieved. (Franca 2019, 218)

While modeling the process it is good to remember the possibility to simulate analysis if resources used by the task, lead time, labor input, and costs can be added to the job description. It assists at recognizing overlapping actions and furthermore eliminating them. (Hannus 1993, 32, 52)

3.2.4   Other methods

In order to be able to reach successful results steadily it is important to think about the whole process instead of just focusing on the result. If only results are considered, it is unlikely to be able to repeat those results and poor results are likely to be recurred

regularly. Furthermore, the root cause for the errors can be found quicker and counteractions adapted faster. The first step to developments is to question the process. Personnel ignore easily the development opportunities if they are not encouraged to do that. Individual managers may encourage to local process efficiencies in their own field, but then the entity might suffer. (Emiliani & Stec 2004, 630, 634) This enhances the role of executive employees. The vision of necessary developments needs to be common for all managers, in order to not create conflicts between different operations of the company. That is why it is crucial to support the flow of information.

Value analysis is a method where the whole process is looked over in order to analyze are the actions value adding or non-value adding activity. Non-value adding activities are then eliminated as best as possible by streamlining the process. Then the released resources from deleting non-value adding activites are used to value adding activities or released completely. (Hannus 2004, 111)

Total Quality Management is based on development of capabilities and thus creating preconditions for success and excellence. Quality costs mean all costs that would diminish if everything would be done in the absolute optimal way in the first place. (Laatukustannukset 2013, 2) It is important to perform everything optimally from the beginning. Unnecessary activities which are secondary to final results need to be given up. These are producing useless documents or feeding same information several times. Target is to do thing in the correct manner from the start and avoid inspections and correction of errors. (Martola & Santala 1997, 32)

Process management is crucial to succeed in development of efficiency business processes. Team working and apposition are in central of Process management. Apposition means elimination of unproductive time, shortening of toal time and producing information that corresponds to the needs of customers and stakeholders. Tools to apposition are simplifying, standardization, free information flow and tools that support it. (Hannus 1994, 159)

3.3   Measurement of processes

According to Aparecida da Silva et al. (2012, 767), measurement is necessary, but even more important is the continuity of the measurement, monitoring and process inspection. In practice, the process must be observed, and desired results understood in order to be able to define what to measure. BPM has a big role in supporting with the increased responsibility through the results of processes and requirement to monitor processes and continuous improvement. Process measures can be divided into three main groups: cost, quality and time parameters. (Lee & Dale 1998, 220)

The target of the service provider is to deliver a quality product, ready when a customer requests it, while doing this in a smooth continuous flow. Appropriate measures to reflect the company's progress to meet these goals include for example the number of faults (quality), on-time delivery (customer satisfaction) and day-by-the-hour (continuous flow). The value stream should target to smooth flow from material receipt though customer delivery, product cost, profitability and inventory reduction. (Maskell & Kennedy 2007, 67) Cost, quality and time are essential. Operations management, strategic priorities and situations determine the design, execution, management and measurement of processes. (Bai & Sarkis, 2013, 283)

Performance measurement is a good way to support the evaluation of processes. Organizations have roughly two reasons to understand and measure the existing processes before the are re-designed. Challenges of the current process need to be understood so that they will not repeat in the new process. The performance measurement of existing processes is important due to knowing the baseline for further improvements. (Budinono & Loice 2012, 38-39)

A great monitoring system takes into account both inputs, outputs and process functions with respect to objectives. Good measures characterize the real performance of process and produce reliable, simple and understandable information. Work should be as automatic as possible, and it should give a clear vision, how operations should be developed. The main reason of measurement system is to help the control of process and constant development. (Martinsuo & Blomqvist 210, 16)

Lean organizations prefer performance measurements that reflect to the strategy of the firm and motivate to Lean actions. Measurements of the key processes within the value streams allow a great control over the processes. Value stream team can be motivated by measuring the value stream as an entity, this drives for continuous improvement. Corporate level measurements enable executive personnel to monitor the success of the strategy of the company. (Maskell & Kennedy 2007, 61)

3.4 Implementation of new process

According to Bai and Sarkis (2013, 281) there are numerous potential operational, strategic, organizational and technological factors have an affect on the success or failure of an implementation of a new process. Development and implementation of new procedures often suffer from resistance to change. A successful implementation of a new process model requires overcoming barriers and restrictions. Previous research has shown some of the main barriers linked to people and company:

- Hesitations related to technology
- The same organizational culture
- Process concept is poorly understood
- Integration between the methodologies, techniques and tools of different business areas is poor
- The absence of basic process-oriented management culture for the whole organization
- Participation of the executive staff and leadership is lacking
- Incentives and rewards to encourage to adapt to new methods or processes are missing
- Required resources to process implementation are missing or mismanaged (Bandara et al. 2005, 352-353, Bandara et al. 2007, 1245; Trkman, 2010, 126)

Organizational variables have a great effect on company's capability for change. Also customers might have set their own restrictions to development projects, if the development are concerns customer service. Culture is definitely on of the most notable barriers for change. If people feel that the change is beneficial to them, negative attitude towards new process and methods will decrease. Administrative changes can lead to new organizational structure. (Gurd et al. 2002, 207-208, Paper & Chang 2005, 125)

In order to achieve the desired involvement it is critical to have participation of non-executive as well as executive staff members. New processes typically might create conflict between those who favor receiving orders and those who favor more responsibilities. In order to avoid the possible conflicts it is important to provide support for the transition. (Aparecida da Silva et al. 2012, 766)

Culture consists of values, beliefs, attitudes, and behaviors in peoples' mind that separate one group of people from another. Those values hen appear in visible actions and structures. Typically, the effect of culture-related activities has usually much longer time horizon than activities related to other challenges. It has been recognized that there is a need to identify areas where intervention is needed, and resources are allocated. The new process model has to be culturally fitted in order for process objectives to be able to be achieved. (Bai & Sarkis, 2013, 284; vom Brocke & Sinnl 2011, 358-359, 369)

Improving cross-functional communication and co-operation in a company, it results as mutual understanding and congruence of strategic direction and goals of the organization. Clear and effective communication through all levels of an organization is required. In order to motivate the movement for development, executive staff must communicate with employees in a uniform manner. (McCormack et al. 2009, 794, 803; Bai & Sarkis, 2013, 283-284)

According to Gurd et al. (2002, 209-210) elements for adopting of new processes successfully consists of following aspects:

- Leadership skills combined with clear communication of strategy and targets
- Committed management and sponsorship (especially key individuals) with compatible strategies
- Incentives aligned with company's objectives
- Corresponding reporting systems
- Personnel involved into development from the start to commit the people to the development project

According to Cheng et al. (2011, 34) an organization should present operative objectives for functions of the company to make process objectives match to corresponding business policies and to give a direction to how these objectives can be achieved. Hannus (1994, 146) states that the most challenging thing in implementing a new process is driving a new approach into the organization and train and commit people to use new working tools and procedures. Emiliani and Stec (2004, 627) have recognized that, in some cases it is possible that the team is not enabling to execute the future state because the change requires simultaneous changes in many functional areas. Typical reasons are resistance to change, unfamiliarity of improvement methods, or a fear that the improvements cost too much or take too much time to execute.

Determining performance levels, forming a process vision, defining of new processes, thoroughly defined roles and operational program are important tasks in process renewal. The relevant challenge is implementation and change management related to it. Typically, change management and control face remarkable challenges when developing broad process renovations. (Hannus 2004, 110)

According to Savvas (2005), cultural resistance is one of the main causes for new procedure failures. That is caused by the scarce identification of a need for process change or general process thinking of employees. Thus, a project's success might depend more or less on a shared mutual understanding of why and how, for instance

the process orientation is benefitted by a new IT system. (vom Brocke & Sinnl 2011, 358)

Methods that highlight learning, typically aim at improving people's ability to work with new successful way. This might require new skills and knowledge, new kind of attitude or understanding. When the new way of working requires new kind of thinking and attitude, change management is in a key role to guarantee that the change succeeds. If the managers won't show an example by changing their thinking and actions first, the new procedures do not remain. Following statements are important to remember regarding change management:

- Employee is only able to commit to new procedures and processes if he or she is aware, understands and accepts the new method of working. It is also important to remember that if the new way of working needs development of skills, training is required.
- Influential person can be initiative for prevention of remarkable changes in organization. That is why their support is crucial. However, the influential persons do not make the revolution alone.
- People's reactions are often based on emotions and they cannot be influenced only by factual basis. Human will not change their actions based on sole information, also time to consider the change and possibility to affect to the change is important.
- People are different and so are their reactions, some seek for adventure and some look for security (Laamanen & Tinnilä 2009, 41)

Paper & Chang (2005, 121) found out that implementation of new process or working methods can fail if there has not been enough investment into training. Employees may bee too tied to old technologies and manners or if the IT does not support new processes. The meaning of people's skills, reward system and change readiness of IT capabilities are very important. The readiness of change is affected by how employees experience the situation.

4   SETTING UP A GLOBAL INVENTORY MANAGEMENT

This section presents the current state of the case company's global inventory management. The purpose of this chapter is to describe the current situation and find objectives for a development project to create a solution for the main problem. The source information of current state is collected by observation and interviewing people globally in the case company. Also, author's personal experience from the career in the case company are used. Information related to inventory data and KPI's is gathered from the case company's ERP, material planning systems and the reporting system.

4.1   Presentation of the case company

The case organization in this thesis is a global group, which includes the main organization, having five companies, as well as eleven wholly owned subsidiaries globally. The company was established 1979. The main field of business is the design, manufacture, sale and service of integrated water and waste management systems. As well as corrosion-protection systems, for marine, offshore and building industries. The case company is the only provider in its field of business who is capable to cover the whole integrated waste and water management systems as well as having its own in-house product development, which is a competitive advantage for the case company.

In 2019 the case company employed around 500 personnel and the company's net sales turnover was 180 MEUR. The global presence of the case company is covered by a global network including 25 own offices in 14 countries and representatives in over 70 countries.

The supply chain of the case company covers both global and local chains, and it is divided into two; spare parts and components and system deliveries. Spare parts and components are in most cases sourced from a third- party component suppliers.

Systems are manufactured by either technology or manufacturing partners or by own production facilities which the case company has in United Kingdoms and France. Majority of manufacturing is outsourced, which makes the SCM strategically critical to case company's business. In addition to the own manufacturing facilities and offices the case company has numerous inventories globally, which include from own warehouses, virtual inventories as well as third- party inventories. All of those inventories include stock owned by the case company.

The case company is under constant change due to a large-scale organization re-structure, change of management and employees, acquisition of new companies and development in the way of working and processes.

4.2 Data collection

When considering data collection, case studies normally apply multiple data collection methods such as archives, interviews, questionnaires, and observations (Eisenhardt, 1989) This study also utilizes two primary data collection methods such as, interviews and observations. Data is collected primarily by conducting interviews inside the case company, but in addition, observations are used to support and complement the interview data. Interviews conducted in the case company comprise of a sample of interviewees across the division, positions and the global boundaries. 10 interviews were conducted in total. The interviews cover company's operations and divisions from areas such as Sourcing and procurement, logistics, supply chain management, category management and inventory management. This sample set of informants was selected to cover the area of inventory management and the surrounding functions as best as possible. When selecting the interviewees, also sufficient language skills were considered, as the interviews were conducted in English which is not a mother tongue for many of the interviewees nor for the researcher. These approaches were chosen in order to achieve triangulation in both, data collection methods as well as interviewees.

The interviews were conducted as semi-structured theme interviews. Furthermore, the interview was built around selected central themes that must be covered during the interview, but neither was forced to follow a strict structure of questions, nor the questions were totally open without any guidance for the interviewee. (Vilkka, 2015) In this thesis, the interviews were structured by following three main themes that were organization and role of inventory management, inventory management, and implementation as Appendix 1 presenting the interview questions shows. Each theme consisted of multiple supporting questions that were used to structure and guide the interviews. The interview and set of questions were the same for all interviewees, but according to semi-structured nature of the interviews it was allowed to adjust and ask further questions if needed. All of the interviews were conducted as individual interviews. Due to the wide geographic coverage and the Covid-19 pandemic that was present during the interviews, all of the interviews were conducted remotely.

4.3   Inventory management in the case company

Currently, inventory management is organized in the case company in a decentralized way as the inventory management team of the parent company consists only few people coordinating group-wide activities, whereas the different departments of the divisions are working independently and autonomously in the interface of the business operations. The current way of working with inventory management is not unified in any way globally and the ways of working are mostly guided by accounting requirements of different countries. There are no real structures to work with inventory management. The parent company's procurement department is mainly responsible for group-wide development activities, reporting, creating, and implementing common guidelines and policies related to for example item parameters and stocking policies.

Generally, the organization of inventory management can be seen as a matrix as the leaders of divisional procurement or inventory controlling organizations do reporting to the local executive when requested, whom further report to the group management. The co-operation between the group-level inventory management and inventory management of the inventories in each unit is guided by a bi-weekly meeting practice

where common topics and reports are discussed, and activities in the entities are reviewed. Although, a formal meeting structure exists, the group-wide co-operation can be still considered as very light as there are no common rules or processes in place. Additionally, the existing meeting practice covers only the largest entities in the group. Therefore, an increasing need to enhance the co-operation and control and measurement in inventory management has recognized. As a part of the strategy execution the group-level inventory management has been established to manage the inventories and NWC as efficiently as possible in global level. Consequently, a clear target is to move from fairly decentralized management of inventories towards a more hybrid approach, more precisely center-led model, in which inventory management has a strong role in fostering the co-operation and integration.

Inventory management is currently executed in the case company in different levels. Firstly, some divisions practice category management inside their own division and even have dedicated responsible employee for inventory management related practices. Also, the variation of the level of actions is very large from minimal actions to moderate. On the other hand, some divisions do not have any local inventory management practices currently. Secondly, during the ongoing year the case company has initiated a group-level inventory management project which is directly in the scope of this thesis and will be discussed here in more detail. Generally, the group-level inventory management has been established by a result of the recent company strategy work that has identified inventory management as on of the key contributors for operational excellence in the area of supply chain management. Additionally, Inventory management was recognized as a good contributor for achieving performance improvements, increasing the intra-company collaboration, utilizing the full purchasing power, by having visibility in the total inventories of the group that has been so far fragmented to a divisional level, as well as improving the Net Working Capital of the group. Moreover, one of the core motivations behind initiating the group-level inventory management is the power of collaboration that can be achieved by having a globally steered inventory management process, which then enables streamlined visibility over the group's inventories, sharing and developing of best practices and learning from each other.

Inventory management is organized currently in different ways in each division. The group-level inventory management is then controlled via bi-weekly meeting practice between the responsibles of the largest inventories of the group. The divisional inventory management is done by the local team, which is not very well defined in most divisions. Normally the team is managed by a operations manager from the supply chain operations and the team consists of players from the finance and the supply chain operations, such as purchasers, financial controller and warehouse manager. Recently, as the inventory management project was launched the need of global controlling was recognized and therefore, also employee from the parent company has been involved to the divisional teams in order to pull the actions and data together in a global perspective. The current focus in inventory management has been mainly in the inventory levels. The progress and decision-making of each division is being monitored by the steering committee of the project. The steering committee is also getting executive support from the management board of the group. All in all, the whole inventory management structure is built up on the different divisions of the group, where the responsibilities and processes are unclear and different in many ways. This fact highlights the role global management as well as the divisional operations management in the implementation of new inventory management process.

The current Inventory management process of the case company is illustrated in Figure 12. The process is illustrated in a circular manner and six phases have been identified: Developing of inventory management strategy, strategy execution, Implementation and follow-up, as is analysis, engaging stakeholders and analysis of development actions. The circular process is used as there is not currently a clear ending and starting point, as the process keeps evolving continuously. First phase is the as-is analysis and it aims at creating a clear vision of the current state of inventory by investigating the current inventory level, Days in stock and the comments from the company contact person. Engaging stakeholders include the identification and engaging of internal stakeholders whose support and knowledge is needed during the process. Third phase is to analyze the development actions and define new potential inventory savings as well as think through the previously determined actions, whether they are working or not. Three previous steps enable the fourth step, which is the

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Inventory Management strategy development. This phase combines the output of the previous steps and gives direction how the inventory management should be handled in the future. Inventory management strategy means the determination of scope and planning of the inventory specific strategies on how the inventory should be managed in future. Also, at this point the effect of the future management practices in other areas and the total supply chain functionality should be considered. The fifth phase focuses on executing the development strategy that was defined in the previous step. This means implementing of the best practices that were defined in each inventory accordingly. After this, the concrete work in the warehouse location and inventory has to be implemented. The action plan in order to manage the inventory in the manner defined previously is also done at this point. The execution of that action plan is then reviewed regularly and discussed in the follow-up phase. To conclude, the circular process is acknowledged since inventory management is seen as a continuous way of working.
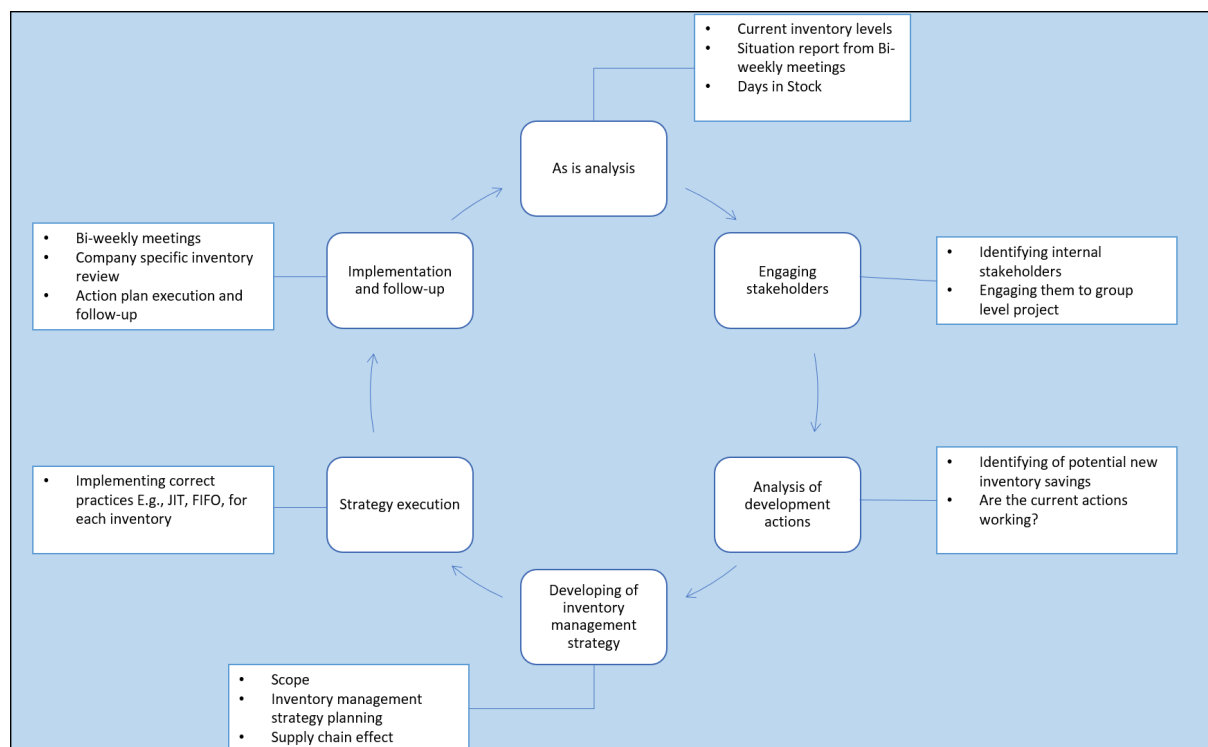

Figure 12. Inventory management process in the case company

It is good to mention that the current inventory management process in the case company focuses strictly on the work among the selected inventories. Therefore, it does not describe and preparations such as selection of the category or team

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formation. The practice in the case company is that each inventory responsible selects the actions inside their own inventory, which are then validated by the steering comity from the main company. Then the local inventory responsible start to work through the process steps and follow-up will be done through virtual meetings and workshops. Secondly, the most important flaw of the current process is that the engagement of stakeholders has been so far illustrated as a single step in the process even though the contribution of the stakeholders is required through the entire process. Additionally, the current way of managing the inventories is very new to the whole organization and the current actions and the maturity in each phase is very low. Therefore, it is important to strike into this matter early in the project and get clarification in the process and roles.

4.3.1 The progression of current state

The case company's business has grown and globalized rapidly in the last decade. Group's Turnover has increased a total of 32 percent in the last four years as seen from figure 13 below. It is important to consider the challenging times of marine business in the year 2020 due to the global Covid-19 pandemic. This has led to lost sales in year 2020. The growth has been accelerated by many company acquisitions. The inventory management and unified ways of working have not received enough attention throughout this period. It has led to a unclear situation, where the company has no clear ways of working with the global inventories on a group level.
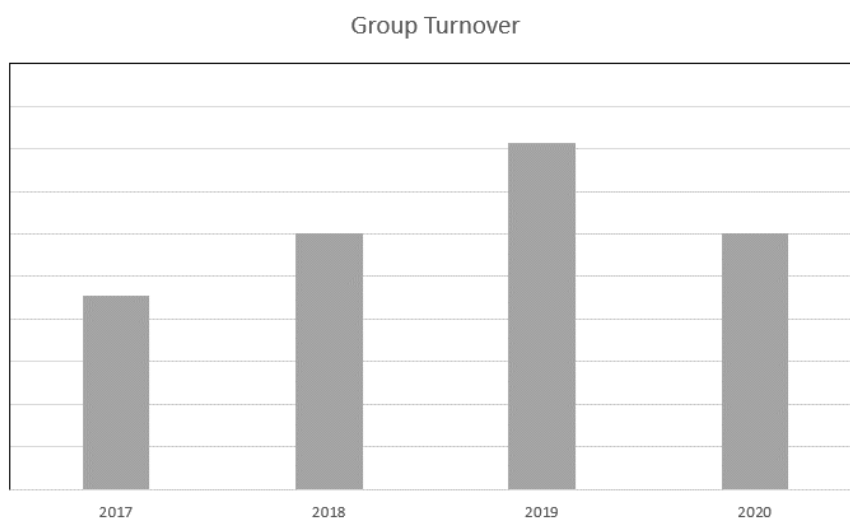
Figure 13 Case company's turnover development

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Despite the fact that the case company's turnover had decreased during the latest year 2020, the inventory value of the group has been increasing slowly during the recent years. As shown in figure 14 below the company's inventory has been fluctuating and slowly increasing during the last two years. A more alarming sight and on of the key drivers of initiating the global inventory management practices was the recognized rapid increase in the Days In Stock (DIS) value. During the last six months the DIS has almost doubled and quick actions are needed in order to find the root cause and analyze it in order to be able to perform the corrective actions.
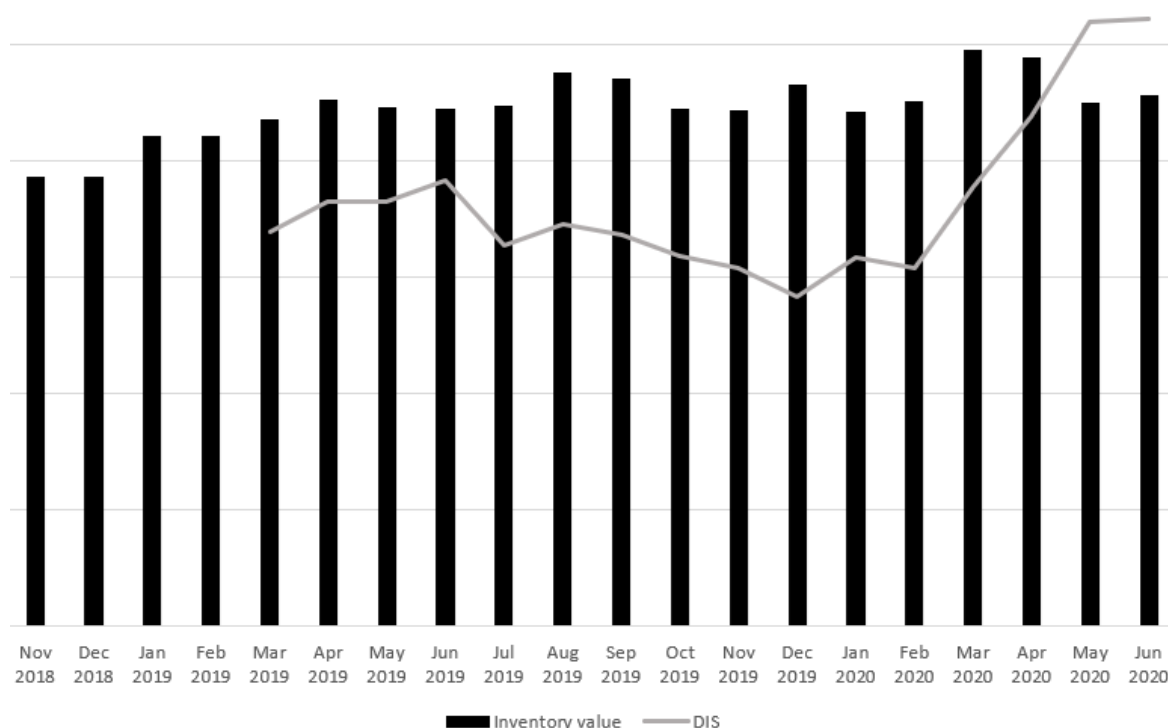
Figure 14. Inventory value & DIS development in the case company

During a rapid growth, the company has not been able to cope with the global inventory management in a sufficient and profitable manner. Policies and processes have not developed necessarily as fast as needed and implementation and philosophy of continuous improvement have not been considered enough globally. For the inventory management, there has been also difficulties to handle new products; product assortment has grown while in the same time having to protect customers satisfaction who have older products and machines in use. This has caused difficulties to handle the aging items as well as the total stocked items portfolio.

Due to the nature of growth caused by company acquisitions also the amount of inventories has been increasing. The total inventory quantity is over hundred and it is very complex to control such a high amount of different types of inventories located globally. Therefore, many of the inventories are in quite poor shape, with low turnover ratio which is further causing the high DIS values. Slowly moving inventories cause items to be aging and old, which also refers to that there is no demand for those items. The unallocated stock is one of the recognized disadvantages in inventory controlling and it is considering those aging items and the project specific items that have no demand. The recognition of the poor shape of the above discussed factors was the main initiative to launch the global inventory management project, which of this thesis is part of.

4.3.2   Supply chain and inventories in the case company

The case company group consists of 16 subsidiary country companies which are spread worldwide. The service network consists of those 16 country specific companies and 25 own offices. This network is able to cover the service need all over the world. All in all, the group holds inventories in 106 different locations. This total consists of company owned warehousing facilities, as well as external warehouses provided by either a logistics service provider (LSP) or a supplier. Management of supply chain consisting such a large quantity of inventories is complex and therefore this thesis focuses in creating a group level management module for the inventories. The thesis scope is limited to investigate the inventory management on group level and not defining the specific parameters and management practices for each inventory specifically.

The supply chain of the case company consists of many different players and the key roles in the supply chain are the component and spare part suppliers, assembly suppliers, distribution center in Finland, spare part warehouses all over the world and interim storages for project deliveries. All the material and finished goods are transited between the stakeholders in supply chain and end customers by the LSP's. Figure 15 represents case company's global supply chain and the network of subsidiaries location.
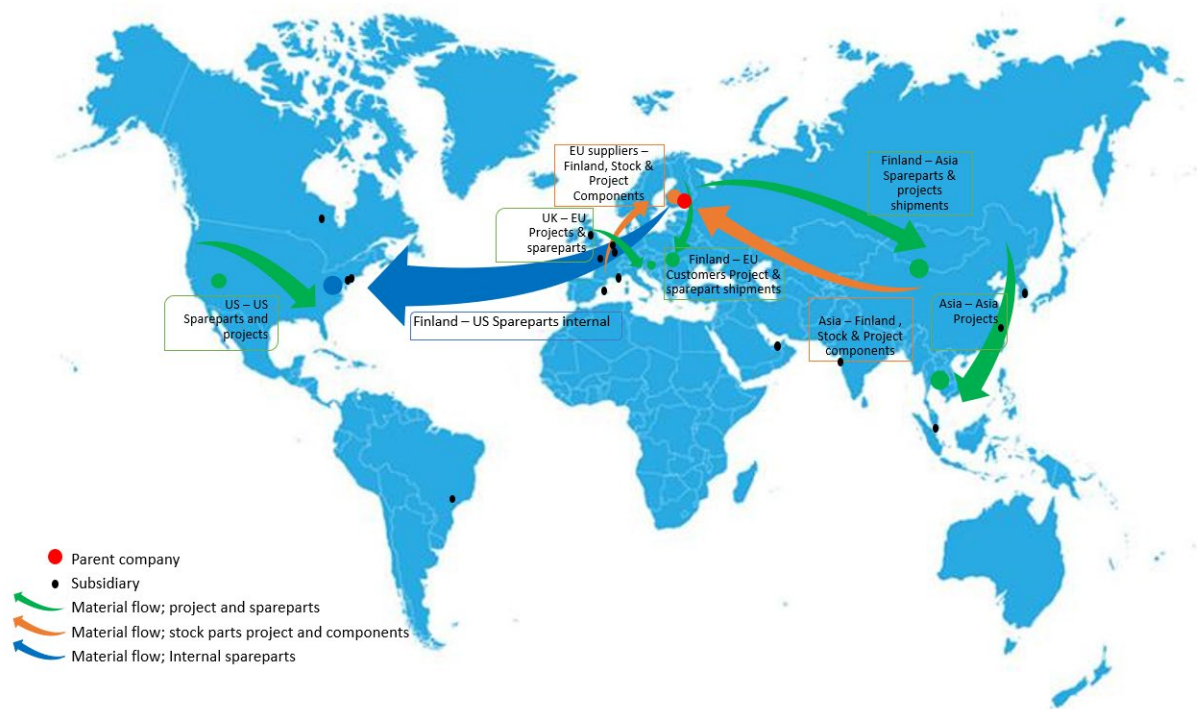
Figure 15 The case company's service network and the key material flows

This thesis focuses on the global inventory management of the case company and therefore it is important to recognize and visualize the global footprint and the main material flows of the group. The Parent company and the subsidiaries have also their own inventories and the location of those can be also visualized from the map.

In addition to parent company's inventories in Finland, the case company holds largest inventories in United Kingdom, United States, France and Germany. The main distribution center for spare parts is located in Finland. The largest inventories also hold spare parts stock and some of it is supplied by the distribution center in Finland. Additionally, most of the group's entities have inventory for project specific stock. All of these inventories are then managed by the owner entity.

4.3.3 Delivery process

The delivery process of case company can be divided into two streams. Project's delivery process differs from the spare parts delivery process so its important to take a look of both perspectives. The main players in both delivery processes include suppliers, Case company warehouses, customers and in the Project delivery process also Manufacturing partners are in key role. Figure 16 below illustrates the Project material delivery process of the case company.
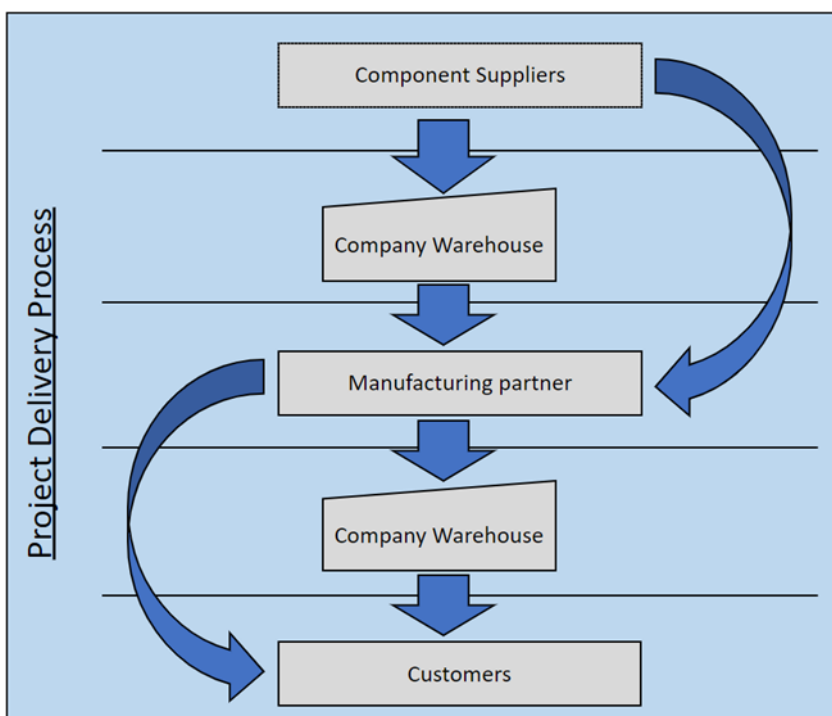
Figure 16 Case company's Project material delivery process

All of the flows presented in by arrows in the figure 16 represent the movement of case company owned material which has been purchased from suppliers, so the process starts from procurement. Supplier then confirms the delivery date and price in most cases manually by email. After that the components are either delivered to a warehouse or directly to the manufacturing partner who will then assembly the final product which is later supplied to the project customer. Components are received and checked at either warehouse or manufacturing partner upon arrival. Depending on location, the arrival is also informed to the purchaser, who then completes the reception process. After the manufacturing partner has finished manufacturing and the

product is ready to be delivered it is either sent directly to the customer or transported to a consolidation warehouse, where the total project scope is gathered and then delivered at the correct time to the customer. All of the players are also responsible for the shipping arrangements depending on the case, but normally the component supplier arranges the first-tier shipment from supplier to warehouse or manufacturing partner and the second tier to the customer is normally arranged by the case company's logistics department. The term of delivery is controlling the responsibility of transport arrangements.

The spare parts delivery process illustrated in the figure 17 as well starts from purchasing of the spare parts. Supplier then delivers the goods to the distribution center. In addition to this flow, also the global entities have their own sourcing, and they purchase some spare parts directly to their own warehouse. In other cases, the distribution center then supplies the local warehouses. When goods arrive to either distribution center or the local warehouse, the warehouse personnel inspect the delivery and receive to order. Then goods are taken to stock, until shipment to customer. The main difference for the entities outside of European Union is that they have to manage import declaration for arriving goods.
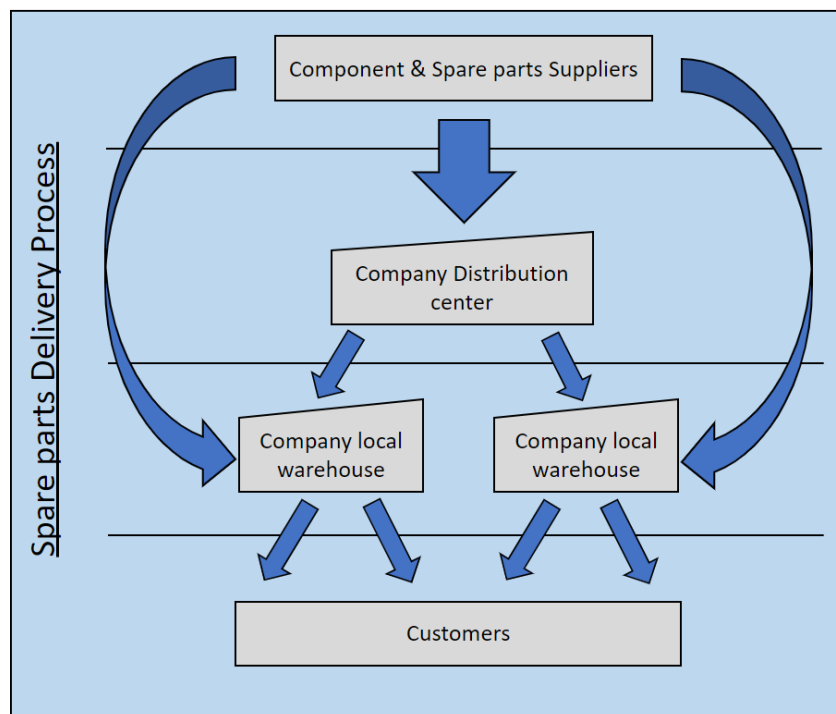

Figure 17 Case Company's Spare parts material delivery process

Group's procurement is not very centralized, and many entities have their own procurement departments in addition to the global team of the parent company. This causes a situation where multiple material flows are used, and the supply routes of components and spare parts have quite a lot of deviations. This has also increased the total number of suppliers and further complicated the supply chain.

4.3.4   Item classification and policy

The case company holds inventory for item quantity of 1,5 Million and over 5000 different stock items. Currently the case company splits their items in two categories; Buy-to-Order (BTO) and Inventory controlled, stock items. Stock items have safety stock level (SST) and Material Requirement Planning (MRP) for controlling method. BTO items are mostly used in the project business of the case company and Stock items traditionally consider the spare part business. This is due to nature of each business side. Project business usually requires a lot of configuration and system wide planning within the scope to determine correct items. Spare part business then again has requirements for shorter lead times, and the order backlog is more stable. Determination between BTO and stock category is made based on order frequency and value of the item.

Stock items are classified in five different classes based on the economical meaningfulness of the goods. Classification is done by calculating a percentage of the yearly spend and multiplying it with average cost and quantity of sold items. Idea behind this classification is to reduce the effort used for low spend items and focus to increase the turnover of items that have high spend. This helps to focus resources on items that create the most inventory costs.

Safety stocks are determined and set up when it is economically feasible, or the part's technical criticality so requires. The safety stock level acts as a Re-order point (ROP) in the case company. SST is determined on base of weekly demand and it is different on each determined class. Technically critical items are specified as those items that

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the case company has a contract of keeping stock for certain customers and items that cause a hazard or comparable difficulty in case of failure to supply.

The management of stocks has not gained enough attention in the case company and there is no global control or unified rules among the entities. There is no specific predetermined schedule for managing the stocks and making the calculations for SST or to determine the stocking categories of items. The inspection period for the current stock have been also neglected and the amount of excess and obsolete stock has not been verified and dealt with. Additionally, there has been slipping also in the entity level practices and therefore the number of stocked items has been growing uncontrollably.

4.3.5   Current performance management and measures

As stated in the theory, performance measurement, monitoring and action follow-up of the progress have key position when managing global inventories. The case company has organized the inventory management team so, that it includes a responsible person from each entity and the group level responsible. Also, a global inventory coordinator is working together with the entity responsible and group level inventory management. This team meet twice a month. Currently inventory management is practiced with a narrow scope and local entities have defined their own performance measures. In the group level practice only inventory values are measured. The follow-up of this measurement is done in the bi-weekly meeting practice. This meeting is dedicated to track and follow up the main actions of each global entity in order to develop the inventory values. This review meeting focuses also to pay attention in significant changes and trends in the inventory characteristics. Also, future goals and ways of working are agreed in this meeting.

The case company is relying with KPI reporting in the ICT systems. The main systems are considering the Enterprise Resource Planning (ERP) system and a reporting tool, that is connected to the ERP. The reporting tool acts as a main resource for gathering the group level data for KPI's. Roughly half of the group's entities have a different ERP

system in use than the system used by the parent company. This causes some difficulties in the group level KPI measurement and reporting. The entities that have different ERP system will then communicate the KPI's and needed data to the group by separate excel reporting templates. It is hard to have up to date information about the group level values when there are no common tools in use. Additional challenge faced by the group reporting is that the finance department is monitoring the financial figures and taking those values from financial database using the data from last month. This causes a situation where the operational reporting and financial reporting are not matching exactly. Like stated in the literature, performance measurement should be clear and react dynamically to daily changes and it is supposed to show the improvement and unimprovement instantly. Evaluating of inventory management should be done in unified manner across the whole company. Managing and leading the inventories would be then way more consistent.

Regarding the current KPI's it has been recognized that the current KPI's are not sufficient enough and by only tracking the value of inventories is not effective management of inventories. Therefore, new KPI's have to be established.

4.3.6   Aging inventory & write-down policy

The case company has two main policies guiding the management of aging items in inventories. The case company's financial accounting manual is giving rules for write downs and making the excess reservations for different item types. Another key policy guiding the operations related to aging inventories is the aging inventory policy, where the brief introduction of purpose and process of managing aging inventory is presented. Also, the rules for scrapping are given in this operational policy.

The case company has a policy to conduct the write-downs and excess reservation calculations on monthly basis. The purpose of the write-downs is to reduce the value of slow-moving items from the balance sheet. Therefore, the write-downs have an affect to the valuation of stock value. Consequently, the write-downs have a negative effect to the profit and loss statement. The case company has divided the write-down

policy for slow-moving items into two main categories. The first category rules apply for the items consisting of materials and supplies and finished goods. For this category the case company has split the write-down rule on two stages:

1. If the latest consumption for raw material or finished goods is less than 2 years, the value of commodity is reduced by 0%
2. If the latest consumption for raw material or finished goods is older than 2 years, the value of the commodity is reduced by 100%

The second category rules are made for the spare parts. The rules that apply in this category are divided into three stages:

1. If the latest consumption for raw material or finished goods is less than 3 years, the value of the commodity is reduced by 0%
2. If the latest consumption for raw material or finished goods is older than 3 years, but less than 5 years, the value of the commodity is reduced by 50%
3. If the latest consumption for raw material or finished goods is older than 5 years, or if the item has no consumption, the value of the commodity is reduced by 100%

In the year 2020 write-downs were 4,5% of the total inventory value in the case company group. The amount of write-downs reflect a character of poorly managed inventories. Figure 18 below illustrates the differences of write downs in the main companies of the group. The figure is illustrating that especially the inventories that have a low level have faced more significant write-downs. It is important to notice that even though the percentages seem to be quite low for many companies being under five percentage, still the amounts add up and comprise to a total value of hundreds of thousands in the end.
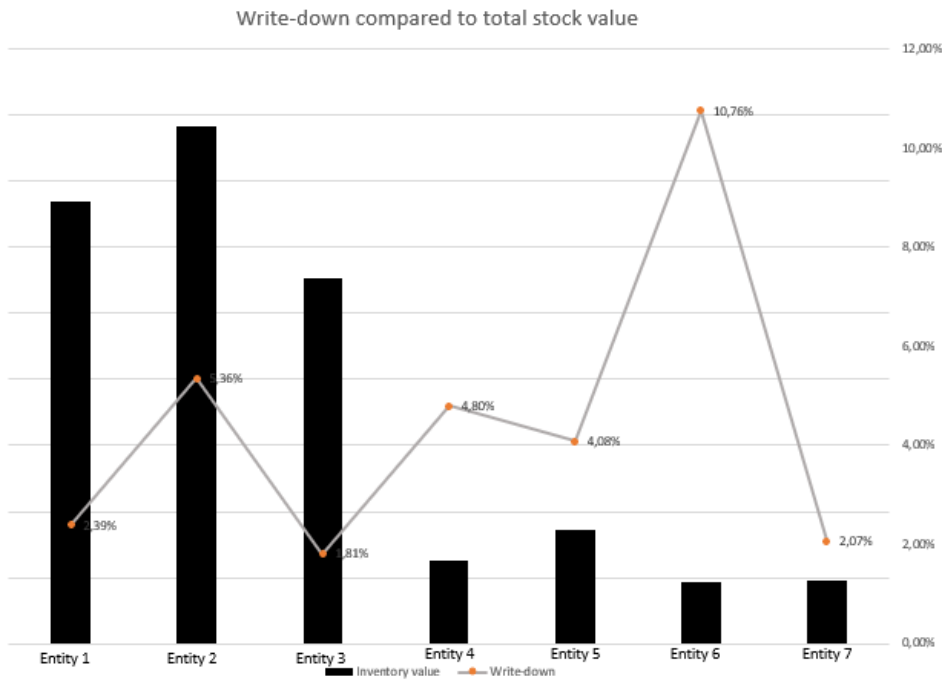
Figure 18. Write-downs compared to total stock value in 2020

The case company has a policy to complete write-downs and scrapping minimum twice a year. However, the actual group-wide rehearsal has been done only once a year. It has been identified that the lack of common rules, instructions and guidance are the main causes for not succeeding in following this policy. Additionally, poor management of the group-wide actions and the unawareness of the policy has also been a major factor. The research also indicated that the lack of sufficient tools in order to recognize the aging items has caused problems in order to effectively manage the write-downs and scrapping of aging inventory.

4.4   Current state: drivers and barriers of inventory management implementation

Implementing a group-wide inventory management will require the entities to give up on some of the autonomy and independence that they have had in the case company, since the renewed center-led approach that the global inventory management involves would require a lot more collaboration in order to succeed. When thinking of drivers and the success factors of inventory management implementation, there seems to be a quite strong understanding that a robust executive support as well as an organizational set-up enabling cross-functional working are needed (Monczka & Markham, 2007; O'Brien, 2015; Rozemeijer, 2000). Thus, it is important to recognize the difficulties in the current state before moving towards the new target state. Therefore, it is necessary to analyze the force field of the current situation so that the driving and restraining forces of the change can be identified. Without identifying the forces that are currently affecting, it is not possible to plan effectively how the target state of successful inventory management implementation could be achieved. The driving and restraining forces are summarized in figure 19 below.

DRIVERS	Internal drivers	Tools	21
		Ways of working + R&R	39
		Visibility in SC	12
		Measuring, planning, targeting (KPI's)	36
		Others	26
	External drivers	Others	2
		Customer expectations	11
		Supplier collaboration	12
RESTRAINING FORCES	Internal	Unclear current situation	12
		Change resistance	16
		Others	16
	External	Negative affects on suppliers	8
		Negative affects on customers	10
		Others	2
TOTAL		SUM	223

Figure 19. Table of the forcefield in the implementation of inventory management in case company

The interviews were conducted in the case company in same manner to each interviewee, and there could be in total 223 characteristics in the current force field. These characteristics were then divided to driving and restraining forces. The drivers and barriers were then further divided into external and internal factors. In total 159 drivers and 64 restraining forces were identified. This chapter of analyzing the current state of inventory management will define the groundwork for determining the actions that successful implementation would require.

4.4.1   Drivers of inventory management implementation

In general, it was rather easy for the interviewees to identify the drivers of inventory management and understanding the reasons behind the restricting forces was more challenging to identify. In fact, the interviewees described 159 driving factors for the global inventory management during the interviews. The drivers were divided into two categories based on the input source that was described to be either inside or outside the case organization. The drivers could then be further categorized into main topics, internal drivers consisting of five and external drivers consisting of three topics. Main topics of the drivers are summarized in figure 20 below. The interviewees identified the driving forces streaming more from inside the organization than from the external environment. When put in figures, the external drivers were mentioned 25 times in comparison to 159 mentions about internal drivers. Thus, it can be reasoned that the implementation of global inventory management is mostly driven and supported by organizational internal factors.
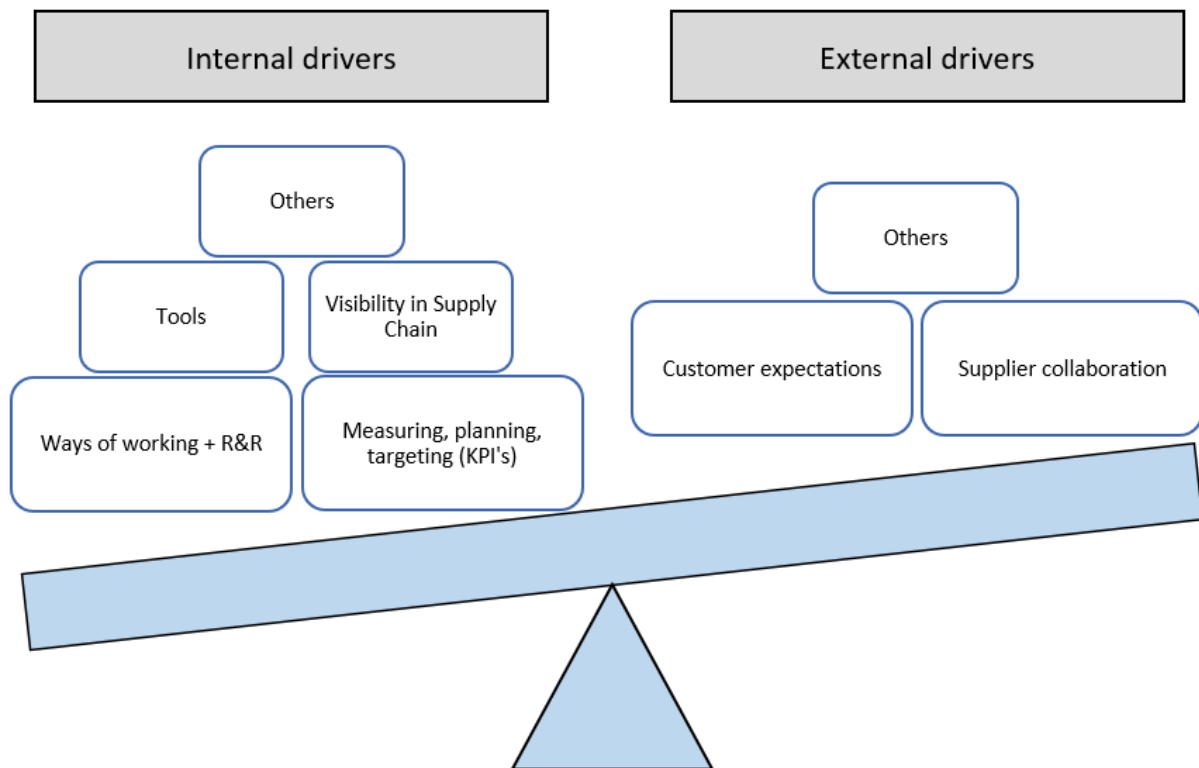

Figure 20. Summary of the global inventory management implementation drivers

Overall, the external drivers were mentioned far more infrequently than the internal drivers, but the topics when the external drivers were mentioned could be easily recognized and divided between two main categories and other topics. Customer expectations and Supplier collaboration were identified to be almost equally important drivers when comparing the frequency of the attention received during the interviews. Customer expectations were mentioned 11 times, while supplier collaboration was raised in total 12 times throughout the interviews. Other external drivers didn't receive as much attention and they mainly consisted of visibility for the stakeholders and the process clarity for external partners. Therefore, it is clear that interviewees from all operations considered the pressure and achievable benefits from customer as well as good collaboration with suppliers to enforce the implementation of global inventory management significantly. Global warehouses and management of stocks appropriately was noticed to have great benefit of filling customer expectations as that is also the reality that the customer have. Timely deliveries with good availability of goods. Also, scalability of the global inventories reacting to customer needs was seen as an important factor from the external point of view. Most important factors for the case company's suppliers that were recognized as external drivers consisted of decreasing the inventory levels of supplier's stocks through better forecasting and visibility in the supply chain. This also, applies to achieving better control in the demand and therefore preventing urgent delivery requests from the suppliers. Also, the implementation of global inventory management was considered to get external drivers through supplier collaboration by consolidating the business to the most appropriate suppliers and by increasing the agreement coverage. One interviewee consolidated the internal and external drivers together by mentioning that it is possible to reduce the inventory levels in the whole supply chain by implementing global inventory management.

Majority of the driving factors were related to the internal factors that also support the implementation of global inventory management further. In total the internal drivers were mentioned approximately 16 times during an interview. The recognized internal drivers can be divided into four main categories and other topics. Ways of working and roles & responsibilities gained the most attention from the internal drivers. The drivers under this category were mentioned 39 times during the interview. Which equals to

almost 25% of all of the internal drivers. The main topics under this category were a global inventory management process, common policies,
and trainings. It was generally seen that through the mentioned topics it is possible to gain clear ways of working and gain understanding as well as clarification in the roles & responsibilities. One interviewee mentioned the development of a global process and policies as an important aspect to give understanding in question "Why are we doing this?".

Secondly most important category identified from the interviews was measuring, planning, and targeting. In this category the most important topic was measuring, planning, and targeting through key point indicators (KPI's). Commonly it was noticed that the selection of correct KPI's will help to guide the implementation of global inventory management as well as managing inventories globally in future. The actual process of implementation and management of global inventories should be done by planning correct actions in order to meet the target KPI's in timely manner. The measurement should be computed by planning a standard cycle for reporting of the targeted KPI's. Few interviewees also recognized some important KPI's that should be measured. Three main KPI's that were recognized were inventory value, Days In Stock (DIS) and the amount of excess and obsolete inventory.

The third category of most recognizes topics comes as a natural continuum to the previous categories. Tools were mentioned 21 times as an internal driver. Sufficient tools are the enablers for efficient measurement and reporting. ERP was the most frequently identified factor in this category. A well performing ERP supports and guides the overall management of implementing and later on managing the global inventory management practice. Also, advanced tools related to such as, digitalization, inventory management reporting tools and for example taking bar code scanning into use received also attention during the interviews. One of the main tools that were recognized to drive the implementation of the global inventory management related to communication and the use of audio-visual conference programs for meetings globally. One interviewee mentioned that a well-functioning and same ERP system for all entities would drive and support the implementation of global inventory management. This comment leads perfectly to the fourth category.

Fourth main category in the interviews was recognized to be visibility in the supply chain. Gaining of visibility in the supply chain was recognized as one of the key factors in the driving of implementation of global inventory management. Transparency through supply chain would enable to control the global inventories better and have the correct goods with right amounts in correct inventories as well as avoid having the same item in too many places. The visibility would also help to gain synergies through the internal supply chain and inventories, by utilizing the stocks of other entities if needed. Lastly, 16% of the internal drivers were classified to the others category. The other internal drivers included for example such factors like, communication, better lead times, management commitment, and individual motivation. One interviewee also identified that positive results would drive the process even further. It is evident that the implementation of the global inventory management starts from inside of the company itself and the internal factors are driving the implementation as well as the management of the inventories globally in future. External factors have a clear link to the driving of the implementation and the external drivers are also important, as they will sort of give the push for improvement from the customer and suppliers side as well. In addition, it can be seen that the main categories in the internal drivers have also a supporting feature between one another. Therefore, the single category driver will also indirectly support the drivers of other categories.

4.4.2   Barriers of inventory management implementation

When considering the identifying of restraining forces of implementation of global inventory management, it seemed to be a lot more challenging for the interviewees than identifying the driving factors. While the interviewees identified a total of 159 driving factors, the restraining forces were identified over half a less with the total amount of 64 mentions during the interviews. This equals to approximately six restraining factors identified during one interview. The overview of the restraining factors is presented in the figure 21 below, that also illustrates the balance between the identified internal and external barriers. Like with the drivers, interviewees considered the barriers also to be streaming more from the internal factors than from

the external factors. To be more specific, internal barriers were mentioned 44 times during the interviews, whereas the external barriers were mentioned only 20 times. Therefore, it can be stated that the implementation of global inventory management faces more barriers from the company's internal factors than from the external streams and stakeholders.
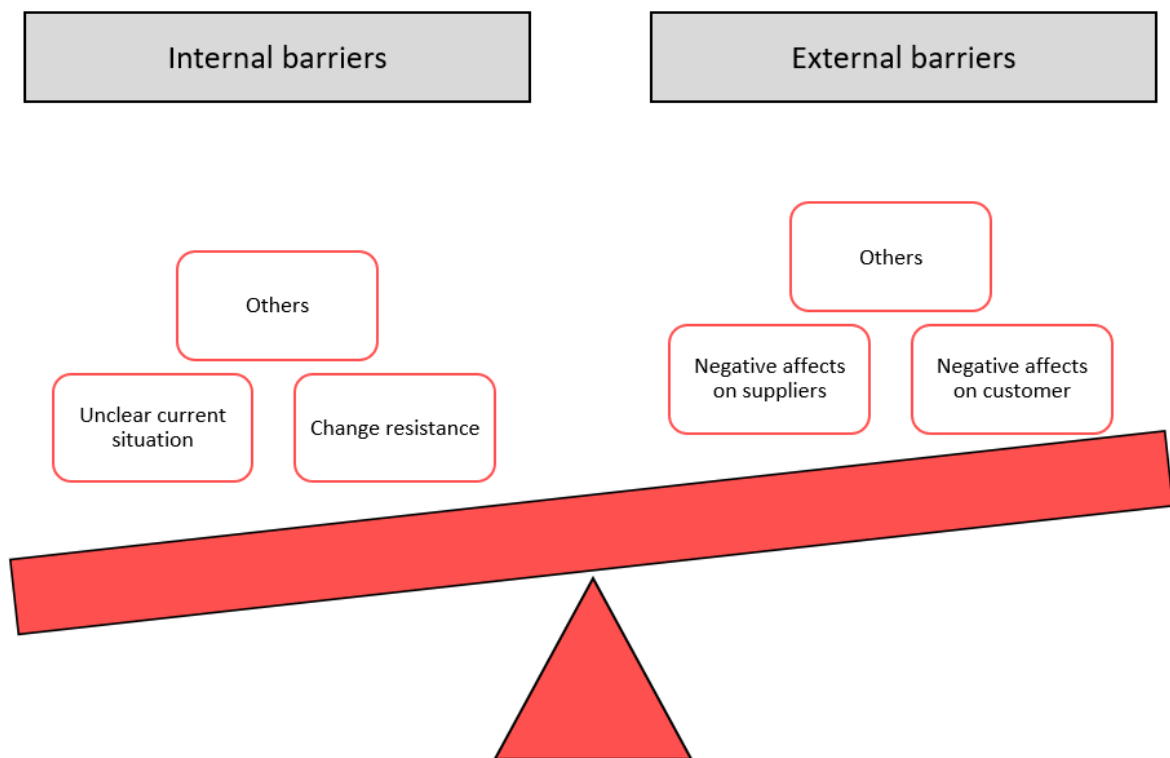
Figure 21. The barriers of global inventory management implementation.

Generally, the external barriers were mentioned not that often during the interviews. Two main themes in the external barriers clearly stand out. The two external aspects were discussed through the negative affects on the external stakeholders, more specifically suppliers and customers. Customers received the most attention from the interviewees when discussed about external barriers. Thus, the interviewees considered the possible negative affects to the customer service as the most important negative factor caused by the implementation of global inventory management. Some of the interviewees were concerned about the possible affects in product availability when taking the inventory management into tighter grip. Also, the lead times were discussed if the network of inventories shall be restructured due to new approach in the global inventory management. Finally, one interviewee commented that in order

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to succeed, we need to also consider the strategic customer goals in addition to the financial goals when driving the global inventory management. The second main topic within the external barriers was the potential negative effects on the suppliers due to the new approach. Most noted aspect was the risk of phasing out many suppliers and more specifically, wrong suppliers. The concern was that if wrong decisions are made during supplier selection, it can lead to increased costs in the long run. Also, the danger of seeking "quick wins" by stretching the limits of suppliers in for example the payment terms. A risk that was noted there that the company could lose some of the important factors like flexibility of demand and competitive pricing. Also, one interviewee mentioned that the suppliers inventories might also go up due to the company's new approach. This can also act as a restraining force between the collaboration of the case company and the supplier.

Internal barriers were overall more scattered when comparing to the external barriers. However, also from the internal barriers, two main themes could be pointed out. Change resistance received the most attention when discussing about the internal barriers. Interesting was that, while some interviewees mentioned the possible increase in the workload, at the same time some interviewees also mentioned the possible fear of job loss to restrain the implementation of global inventory management. Also, the individual motivation to comply in the global rehearsal instead of only taking into account the local perspective was seen as a barrier in some cases. The big question within this topic according to one interviewee is that how to get everyone on board. The other topic standing out from the internal barriers was unclearness of the current situation. Firstly, the unclarity of current processes and roles and responsibilities was mentioned by many interviewees. Secondly, the unclarity of the systems for managing inventories was described in few occasions. Also, the fact of missing clear targets and KPI's was noted as an internal barrier for implementation. Over a third of the internal barriers had to be categorized under the third category "Others". In this category aspects like ERP capabilities, reporting schedules and the concern of one fit for all problems were discussed. The interviewees were generally concerned about the possible negative impacts in the individual entities. Finally, the relation to other functions in the organization such as purchasing management was seen as and possible internal restraining force for the

implementation of global inventory management. It is evident that the affects on the external stakeholders were seen as important things to remember when determining the barriers, but the most change has to happen internally. Internal change management and the clarification of current situation have to be taken into account when planning the implementation of new way of working globally.

4.5 Transition to new approach: strengthening the drivers and reducing the barriers

There are two different ways for the case company to move towards the desired target state since they could either strive to add the driving forces that guide the company towards the future state, or another option is to reduce the counterforces that prevent the company from progressing as they could wish. The interviews revealed that the support of the driving forces during the implementation would be more needed when comparing to the restraining forces. However, base don the interviews, it seems that in the case company both tactics may well be needed to achieve the maximal progress due to the interviewees were able to describe the role of both actions in enforcing the change. Thus, it seems that both approaches have their own function in moving towards the desired future state in which the case company could enjoy the full benefits of successful inventory management.

4.5.1 Strengthening the drivers

When focusing on the drivers, there were clearly four themes: the ways of working and roles & responsibilities, measuring, planning and targeting, tools and lastly visibility in supply chain. From the external point of view the stakeholder's expectations and collaboration with them was seen as the most important aspects. Whereas measuring planning and targeting can be seen only as an internal driver, the ways of working and roles & responsibilities topic also can cover more widely the field of internal ways of working as well as collaboration with the stakeholders. Ways of working also is strongly connected into the tools used. Measuring, planning and targeting then again,

have a great influence with the category visibility in supply chain. Therefore, the two main themes within the drivers can be concluded to be the ways of working and roles & responsibilities and Measuring, planning and targeting. As those drivers play a major role in the current force field, it is reasonable to focus on them and their role when considering how to enforce the positive effects of the drivers. When thinking of strengthening the drivers in general, the interviewees saw the role of communication crucial in order to take the full advantage of the drivers. At the same time, the role of the two main themes can differ in the change process. Therefore, in order to utilize them as effectively as possible, it is crucial to identify in which stage of the change they are the most effective. Figure 22 illustrates the role of main driving themes and describes how they can be strengthened.
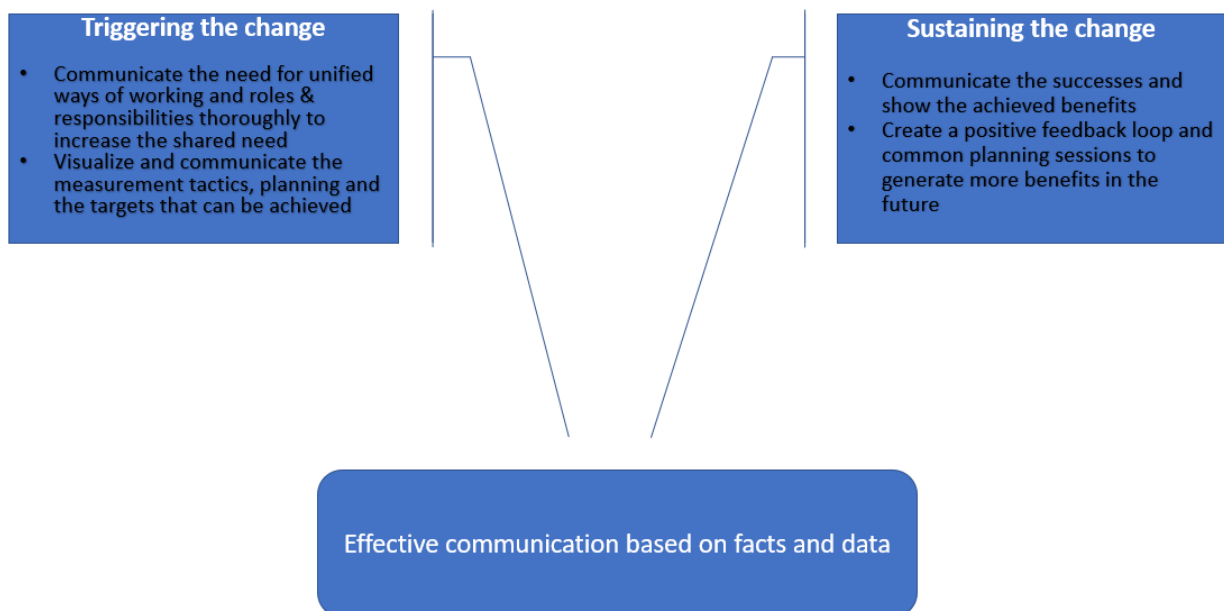
Figure 22. Strengthening the drivers in the stages of change

When starting the implementation, at first the current situation has to be unfreeze. This typically requires some kind of trigger in order to get the change started. In that respects, the recognition of the need for unified ways of working and roles & responsibilities can act as a great stimulating force since, all of the interviewees acknowledged the importance of that as a justification why global inventory management has to be implemented in the case company. Therefore, to utilize this force fully, the current situation and the increased need of unified ways of working needs to be communicated thoroughly inside the company so that the shared need

can spread even wider in the case company group. As discussed about the widespread communication, also the other main driver that was identified, the strategy related to measuring, planning and targeting should be communicated should be communicated well, as it may provide help in the implementation, since the performance management programs, also related to procurement and logistics have a significant role in the inventory management strategy. As the strategy is communicated thoroughly and frequently in the case company, the awareness can greatly increase the common need for developing the unified ways of working. One interviewee mentioned the role of early communication and giving the opportunity to participate in the change as a great tool for communicating the need for unified ways of working: "We could ensure that the stakeholders would act according to the global inventory management process and instructions included in the different phases by involving them early on in the decision-making and development of this process." This comment is a good example of message that could be used in the communication when starting to develop and expand the shared need and taking full advantage of it.

Whereas the need for unified ways of working and roles & responsibilities can be used to trigger the change, the role of strategy related to measuring, planning and targeting is twofold. Firstly, the visualizing the so-called benefits that can be achieved by reaching the targets that has been set for inventory management can be used in a similar way to trigger the change as most of the interviewees identified that showing and communicating the targets and achievable benefits would be very important to get the operations on-board in the implementation of global inventory management and to get the trust in the selected new approach. On the other hand, some interviewees saw the increased workload in the early steps of implementation and therefore, when the case company as the initial results of inventory management, many interviewees noted that it is crucial to communicate the successes so that wider audience can see what has been achieved. As one interviewee stated, it can be easy to achieve positive results, as long as the features of new approach are chosen wisely. These positive results should drive the process even further. Therefore, when the future state with some of the targets has been achieved, it is still important to visualize and communicate the benefits that can be achieved through the planning, measuring and targeting so that the future state can be maintained, and the targets achieved also in

the future. Thus, the communication of measuring, planning and targeting can be utilized continuously in the change process, but to strengthen their effect, it is important to pay attention in the communication as it has to be effective. Multiple interviewees described the importance of reporting detailed KPI's and showing the facts and influences in for example the cash flow. One interviewee also mentioned that if everyone gets on-board and the tasks are done in same manner, efficiencies can be achieved. Thus, even though a small group can be easily motivated, it is important to communicate widespread when involving the whole group in the activity.

In the end, the key aspect in strengthening the drivers of inventory management implementation seems to be effective communication that in the case of driving forces should be widespread as the commitment and support from the business operations is needed to realize the benefits that can be gained by accomplishing the targets. Thus, the overlaying question left, is that how to make the communication the most effective. Many interviewees stressed that in order to be successful and effective the communication should be based on facts and data as much as possible. When the message has strong, clear and visualized evidence, it can be accepted easier. This will make the communication more effective and enables the change in the behaviors in the end. This highlights the importance of the role of communication and planning it carefully. It must not be underestimated when strengthening the drivers.

4.5.2   Reducing the barriers

Another key aspect when implementing inventory management is to think about the barriers and focus on reducing the restraining forces that prevent the successful implementation of inventory management. As the interviewees recognized quite large amount of barriers regarding the implementation, decreasing them must be taken seriously. When it comes to the main themes in the restraining forces of the implementation in the case company, three main themes could be identified. The main themes within the restraining forces included the change resistance, the unclear current situation as well as from the external point of view commonly the negative affects on external stakeholders. As those barriers conclude the majority in the current force field, the investigation should be focused on them and on their role when thinking of how to reduce the negative effects of the barriers. During the interviews the interviewees saw the communication, clear guidelines and roles & responsibilities and the good relationship with the external stakeholders as important factors in general when reducing the restraining forces. As with the drivers, the barriers can be also differ from another during the change process and therefore in order to utilize the reduction as effectively as possible, it is also important to recognize the stages of the change within the restraining forces. Figure 23 presents the role of the main themes around the restraining forces and structures how they can be reduced.
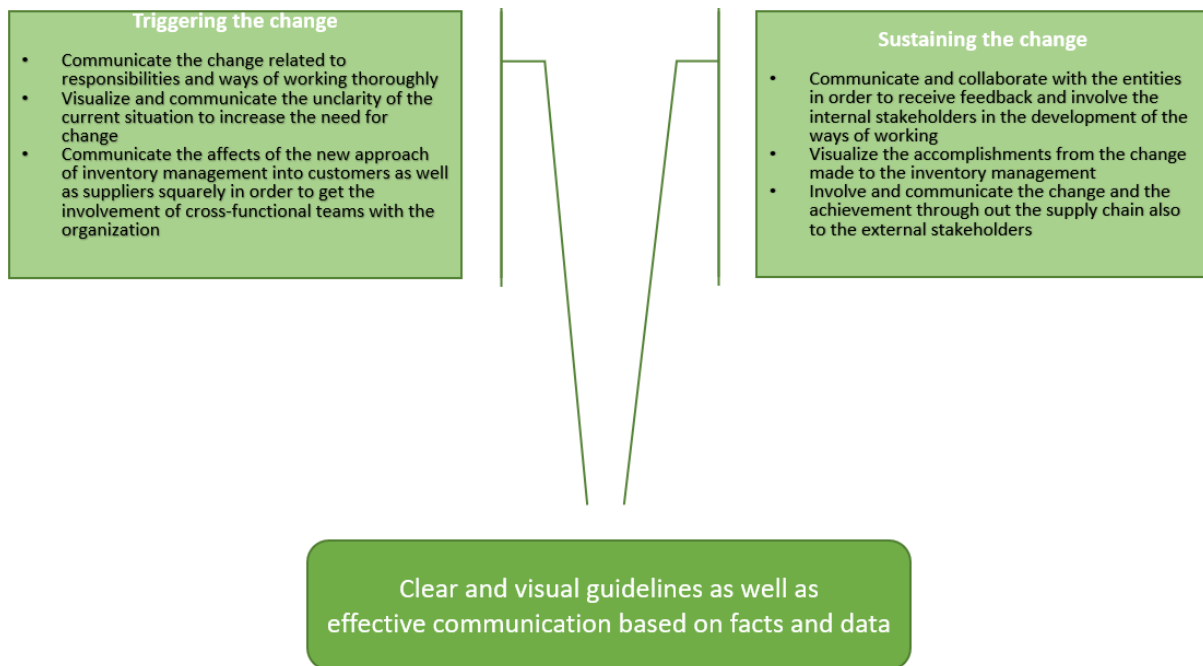
Triggering the change

- Communicate the change related to responsibilities and ways of working thoroughly
- Visualize and communicate the unclarity of the current situation to increase the need for change
- Communicate the affects of the new approach of inventory management into customers as well as suppliers squarely in order to get the involvement of cross-functional teams with the organization

Sustaining the change

- Communicate and collaborate with the entities in order to receive feedback and involve the internal stakeholders in the development of the ways of working
- Visualize the accomplishments from the change made to the inventory management
- Involve and communicate the change and the achievement through out the supply chain also to the external stakeholders

Clear and visual guidelines as well as effective communication based on facts and data

Figure 23. Reducing the barriers in the stages of change

From the internal point of view the most notable theme was the change resistance. Change resistance included such aspects like the increasing workload, the fear of job loss and the danger of employees getting a feeling of excessive authority and the lost possibility to be involved in the decision making. One interviewee tied up the key question under this theme to be: "How to get everyone on-board?" Thus, to answer the question, change has to be triggered effectively from the barriers point of view also. It is important for the involved employee to know their role and their responsibilities when the implementation takes place. That doesn't only give clarity in the expectations for the employee, but also trust and integrity. Knowing your role and responsibilities during the change helps to release the strains caused by the uncertainty and change resistance. The communication about the change in the roles and responsibilities has to be done both on the employee level as well as on a general level more widely. The role and responsibility change should be discussed always between the manager and employee in order to gain mutual understanding in the expectations as well as to minimize the feeling of dictation. The widespread discussion and visualizing of the new roles and responsibilities in the new global approach also builds up the cohesion internally and releases the fears related to the change. In order to reduce the change resistance gradually as much as possible, it is important to remember to present the achievements that has been accomplished with the new

approach in inventory management. By so, the stakeholders can empower from the accomplishments and feel proud of the work done.

The second most important theme within the internal restraining forces was the unclarity of the current situation. The main topics under this theme consisted of the unawareness of the process, unclearness in the roles and responsibilities and the different ways of working in different entities. In order to trigger the change withing the current situation towards a new approach and ways of working, the unclarity of the current situation should be communicated to the stakeholders as the common acknowledgement may well act as a good stimulating force as several interviewees recognized the unclear situation as the main barrier as well as the need for common ways of working as one of the key drivers. Thus, in order to minimize the restraining forces around the current situation, ways of working and roles & responsibilities, the change to the current situation has to be communicated widely internally so that the need for change will spread around the organization. Regarding the communication of the current situation, many interviewees identified the challenge with the different kinds of ways of working in the entities. This aspect can be reduced by communicating and collaborating with the entities continuously and widely as well as giving the opportunity to give feedback and get involved in the development activities. Involving the internal stakeholders in the development of new ways of working will give a clear picture on the questions: What, why, and how.

Whereas the internal themes can be used to trigger the change, the role of the external barriers with the negative effects on the stakeholders is two-edged. The negative effects on external stakeholders consist of the effects in suppliers as well as the customers. The two-edged nature of this barrier is due to the fact that some of the external stakeholders might suffer from negative changes and on the other hand some will gain benefits. The strategy of global inventory management is tightly connected with other areas such as procurement and sales. Therefore, the changes made in the inventory management will affect in the strategy of sourcing for example in the means of preferred suppliers. Therefore, some of the suppliers might gain more volume and due to that the selected suppliers inventory levels might go up a bit as one interviewee identified. Then again some of the suppliers may lose the competitiveness and then

be phased out due to the change. That said, the streamlining of the material flows will also increase the visibility and predictability of the supply chain, which is not necessarily a negative thing. What comes to the customers side, it is evident that by taking an aggressive approach in the inventory management by reducing the inventory levels, there is a clear risk of having too low stock levels for serving the customer. Therefore, it is extremely important to be aware of the changes that are made to the stock parameters, such as the safety stock and order points. The communication of these restraining forces within the organization is very important in order to gain the involvement and the knowledge of the specific aspects about the customers and suppliers from the area experts internally. By doing so, it will be easier to identify the possible drawbacks beforehand when making the decisions regarding inventory management. The communication of this is also a good way to trigger the change from the external barriers point of view. What comes to sustaining the change in this sense, the stakeholders both, internal as well as external should be kept informed about the change. Communication of the achievements throughout the supply chain is an important action in order to keep the restraining forces from rising as well as turning the involved stakeholders to support the change. It is easier to support the change, when the achievements can be recognized.

To sum up, as in the case of supporting the drivers, also reducing the barriers of inventory management implementation seems to be depended in honest and effective communication based on facts, that has to be distributed widely internally, as well as externally as the involvement and assistance from the stakeholders is needed to achieve the reductions in barriers as well as benefits of the change in total. The other key aspect in reducing the drivers is related to the guidelines in ways of working as well as roles and responsibilities. There seems to be a lot of ambiguity around the ways of working and that causes many restraining forces for the implementation. This needs to be controlled by creating the clear guidelines and then communicating it to the employee. This gives the employee comfort in the work, as they know the responsibilities and how to work within the new global approach.

5   RESULTS

As the current situation revealed the fundamental issues in the inventory management in the case company, it is necessary to focus in answering the three basic questions: What, why and how. When it comes to answering those questions regarding the future state that is targeted by implementing the group level inventory management in the case organization, it is clear that the efficiencies that can be achieved through the global inventory management approach act as the main describing characteristic. Knowing the benefits that can be gained is important as they provide a direction for the change, while at the same time describe the state that should be reached in the future. The unclear situation and the confusion in ways of working has to be unified globally and therefore a truly global process has to be created to guide the management of global inventories. The global inventory management process will define clearly what is supposed to be done and by who. In order to have structure and a goal to go for, KPI's have to be defined in order to know why the company wants to manage the inventories in the way they are managed. KPI's will give a target on what to work towards. Lastly, in order to be able to efficiently manage the local activities in a global level, an global inventory policy has to be created in order to have sort of a guidebook on what to look for when certain inventory management related practices need to be done and especially how to complete the tasks. As noted in the analysis, best way to answer the question why is to perform widespread and affective communication based on facts and data.

5.1   Inventory policy

In order to tackle the issues with unclarity in ways of working the need for one global and common guidebook was recognized. The inventory policy should tie up all necessary information regarding the general inventory management. A way to find information regarding the annual tasks related to inventory management under "one covers". Currently the group has many ways of working and different policies all over the entities and therefore the management of the group wide inventory management is difficult. The target is to give a format for all entities to organize their inventory management in a manner that is easy to maintain and measure.

In order to the guidebook to support the business as best as possible it is important that the policy includes all the key functions and principles regarding the inventory management. The identified main features to be covered in this common policy are: The global inventory management process, a general warehouse guideline including the purpose of different warehouses, stocking & item policy, stock taking, excess and obsolete policies, and the performance management. The following sub-chapters will define the key elements for the global inventory policy.

5.1.1   Multi-criteria classification

The case company controls their items currently with ABC classification model where they have five classes, and the classification is done by calculating a percentage of the yearly spend and multiplying it with average cost and quantity of sold items. This thesis project suggests to include a supplementary classification method in order to control the items globally more efficiently. XYZ analysis reveals items frequency of transaction and describes better how usually items are needed. By adding the XYZ analysis in the item classification criteria it is also possible to tell the consumption pattern of each item. The suggested criteria adding in the XYZ analysis is the pick ups from stock over the period of time equal to the one used in the ABC analysis. These criteria can be checked from the sales transactions of each item. Figure 24 below illustrates the suggested classification matrix for the combined ABC – XYZ analysis.

Pick ups can be also referred to as annual sales transactions. It also presents the suggested range to be used for amount of pickups during one year period.

Pick ups	ABC XYZ	Percentage of the annual cost of goods sold (COGS)				
		A 50%	B 30%	C 10%	D 8%	E 2%
≥30	X	AX	BX	CZ	DX	EX
11-29	xx	Axx	Bxx	Cxx	Dxx	Exx
5-10	Y	AY	BY	CY	DY	EY
3-4	yy	Ayy	Byy	Cyy	Dyy	Eyy
1-2	Z	AZ	BZ	CZ	DZ	EZ
0	zz	Azz	Bzz	Czz	Dzz	Ezz

Figure 24. New ABC-XYZ item classification model

The new classification The new classification model makes it possible to monitor and manage better the slow-moving items in the classes AZ, BZ, CZ, DZ, and EZ. In the previous model, the case company used ABC classification that had five classes for the stock items and that generated a management problem with the middle classes where the company had many items that compounded a major portion of the total stock value. In the new model the items can be classified into more specific categories in order to manage and plan them more accurately and efficiently. Additionally, it is far more easy to identify the specific needs and features of the classes and then make inventory analyses more focused as well as making policies and guidelines for managing the different classes. For example, the multi-criteria classification matrix also enables a better opportunity to set more appropriate targets for the service level of each category. It is then easier to indicate the highest service level targets for the high moving classes and a low service level target for the items below the yy category. This helps also to maintain low stock levels and drive for better inventory cycle in the slow-moving categories. Regarding the stocking policy, this thesis suggests to keep it the same way as used to be in the case company. If an item is sold over 2 times during the last 12 months, it will be stocked item and if under three pick ups during the last year, the items shall be classified as non-stockable.

5.1.2   Excess and obsolete policy and process

Another key subject in the inventory management policy is the excess and obsolete inventory management. It is extremely important to actively monitor and manage the excess inventory in order to keep the inventories healthy, with optimal inventory levels and good inventory turnover rates, as well as low DIS for the stock item assortment. There are two main approaches that have to be considered in the case company, when determining the excess and obsolete policies and process. The main inventories comprise of spare part inventories and project inventories and naturally they will have to be managed differently, since the spare parts inventory is controlled by forecasts and safety stock. Spare parts are thereby mainly consisting of inventory controlled (STOCK) items. The Spareparts are also sourced according to the MRP suggestions. Project specific inventories and items are then again almost entirely managed by the Buy-to-Order (BTO) rule and therefore the management approach in the excess and obsolete inventory is different than with the spare parts inventory.

Previously described ABC-XYZ analysis in the item policy is giving guidelines and direction to start the excess and obsolete management. Items under the Z and zz classes should be handled under excess and obsolete inventory process. The excess and obsolete inventory management process is done periodically on monthly basis and it is done for the items that are determined belong in the slow- or non-moving category. Figure 25 below is describing the process for managing the excess and obsolete inventory.
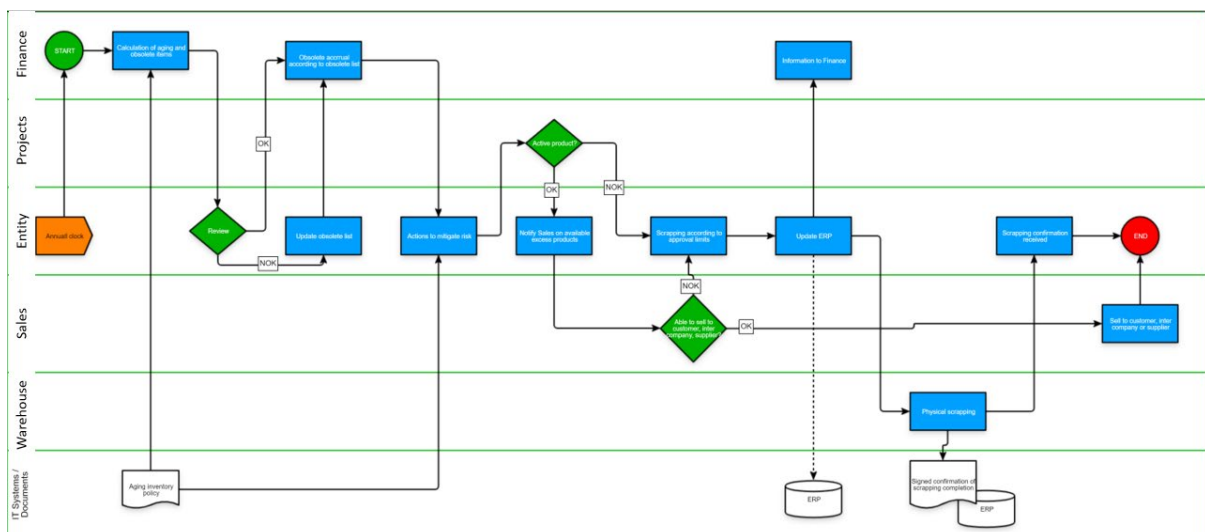

Figure 25. New process for excess and obsolete inventory management in the cases company.

The process has the initial input from the annual clock which acts as an scheduler for various inventory management tasks. The annual clock is also described in the global inventory policy. The finance starts the process by making the calculations of aging and obsolete items. The classified group of items from the inventory is then reviewed by the operational inventory responsible of the entity who then updates the list or approves as is for the obsolete reservations. The mitigation actions take then place. The actions include decreasing the value of commodity, seeking to sell it for a lower price or using the item elsewhere internally. Ultimately the goods will be scrapped according to the policy rules. The aim of this process is to minimize the extra costs caused by holding in current material in the inventories and by doing so also improving the performance of the inventories in terms of the KPI's.

One of the key drivers for implementation of the new inventory management approach was defined to be well functioning tools. Therefore, it is important to enable efficient management by providing effective tools. As one of the key drivers for maintaining low inventory levels as well as low days in stock is to have the right materials in correct place at the right time, the need for a tool in this area was recognized. The case company already has a reporting program with inventory information included, and thus the same program shall be used to generate this report. The report includes few main aspects, which are the current on-hand stock, demand, supply and safety stock (SST). The formula for unallocated liabilities is as follows:

$$Unallocated\ liabilities = Onhand\ inventory + Supply - Demand - SST$$

In one grasp it is possible to see the situation of stock, whether the company has stock against the demand or not. For project specific inventories the tool is specifically important when determining the unallocated inventory of project warehouses. The project warehouses should not have any unallocated stock, meaning that all of the items in the project warehouse needs to have an open demand. The tool reveals directly the unallocated stock and therefore it is easier to manage and cut down the excess stock in that sense as well as maintain the correct items in right inventories in the right time.

5.2　　Performance management and key performance indicators

Like mentioned previously the case company does not have process-based performance management for the inventory management. Currently there is no clear process model on how to set targets for each inventory or entity and how to achieve the given targets by the actions. Additionally, there are no key performance indicators that could be monitored and followed up regularly. Consistent target setting is a base for achieving objectives efficiently. Therefore, one result of thesis is a proposal for performance management model and key performance indicators for the case company.

In order to lead and develop inventory management, a systematic process for target setting and target achieving is computed on annual basis. The annual clock, which is setting the schedule for all inventory management activates on the global level will guide the performance management and targeting schedule as well. The new model includes responsibilities for each executing function, which in this matter are the entity management and the group management. The first stage evaluation and budgeting done in the entity will help the group management to have a good vision of the situation and possibilities within each individual entity. Figure 26 below illustrates the new performance management and target setting model for the case company.
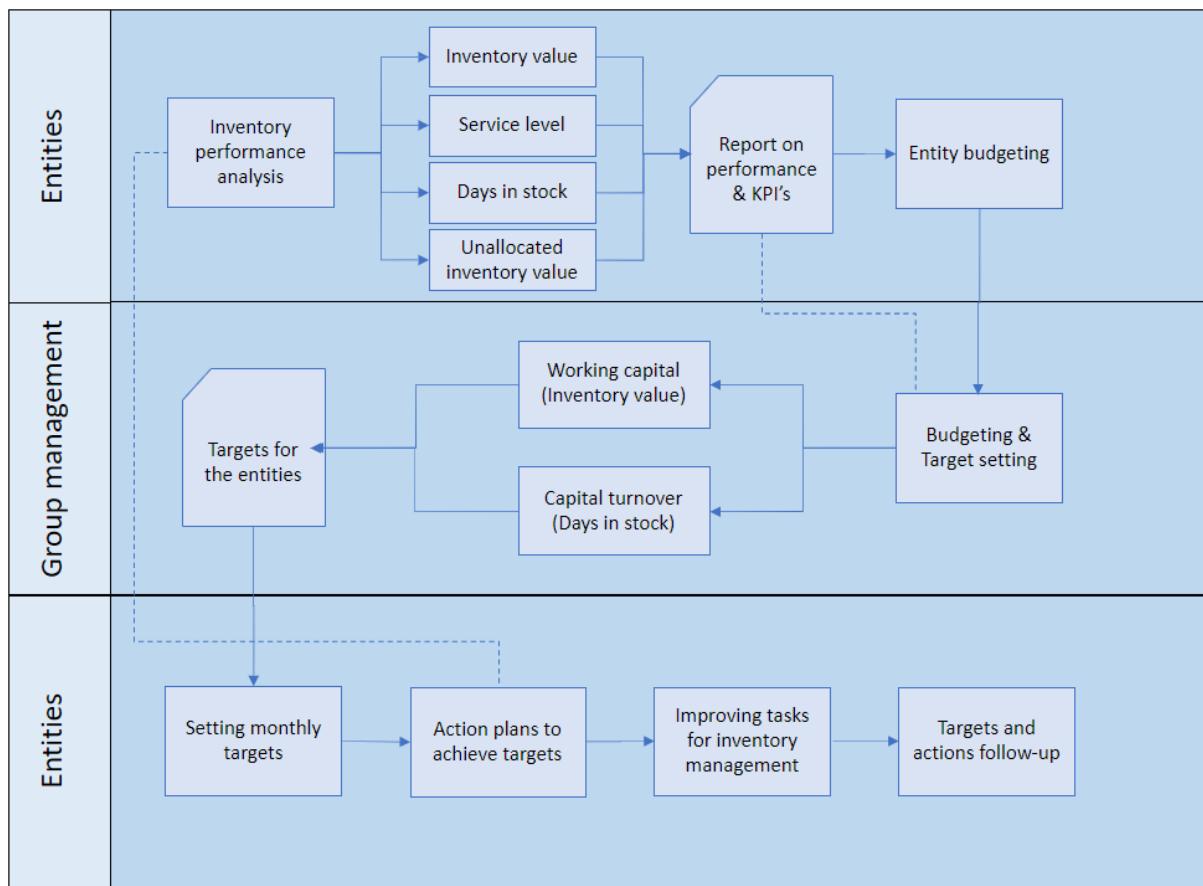
Figure 26. New target setting model based on budget for the case company.

The new target setting model process starts with inventory performance analysis. The purpose of the first step is to get clear picture of the current state by doing data analyses. The inventory performance analyses include service level, days in stock, unallocated stock, as well as the inventory value. Based on these analyses the entity shall create a report about the inventory performance and KPI's to support the target setting. The report will support group management in decision-making and setting new targets. As a result, the management will give two targets for each entity's inventories. The targets are total inventory value and days in stock for the whole entity. It has been challenging for the entities in the case organization to achieve the set targets. In the new approach, the process guides the management to set targets based on facts given by the entities as well as set the operational objectives on how to manage the different inventories to reach entity's targets. The action plans will be created based on entity's lead and support will be given from the performance analysis as well as group management and the global inventory management team.

The current state analysis discovered that the key performance indicators for inventory management were not specified. Key performance indicators (KPI's) make it easier to monitor performance. Therefore, KPI's that can be monitored regularly should be created. As a result of this thesis a KPI framework for the global inventory management will be created. The framework includes KPI's and follow-up process and practices for inventory management.

5.2.1   KPI framework for inventory management

The case company has not been used for managing inventories globally and the key performance indicators have not been in place for the inventory management. The importance of KPI's has to be highlighted when managing a global inventory network. This chapter presents some of the recognized and most important KPI's for the case company. As discussed earlier in the literature, KPI's should be reviewed wide enough and in this subject, it means that its crucial to evaluate the overall performance of the case company's inventories. As commonly noted, inventory level affects directly to service level. Therefore, these areas are considered when defining KPI's for the case company. It is also very important to remember that when setting new targets for the Inventory's performance, too high target for one KPI can influence to another KPI unfavorably. Figure 27 below illustrates the four most important KPI's for the inventory management in the case company.

Inventory value	Cycle time	Service level	Project inventory
Actual stock value	**Days in stock**	**Order fill rate**	**Unallocated stock value**
Sum (Qty. of items in stock * item value)	Cost of average inventory / cost of goods sold * 365 days	Orders delivered as complete / total number of orders shipped * 100 %	Sum (Qty. of items in stock * item value) – (Qty. of items on open sales orders * item value)

Figure 27. New Inventory management KPI scorecard for the case company

Scorecard's KPIs are especially used for the entity level inventory management. The scorecard increases information about the entity's performance and give a direction for the management. The scorecard is determined according to the current needs and the scorecard has to be maintained when the needs will develop in the future.

There are many elements that have an affect in the efficiency of inventory management. The fundamental performance indicator is total inventory value, which must be measured continuously. The actual stock value indicates simply the amount of tied capital in inventory. Actual stock value describes the current stock value. Actual stock value is also good to be monitored from the past to be able to make trend of the value development. The trend of the inventory value can then be analyzed to identify some development points.

The second KPI for the case company is related to inventory cycle. This is suggested to be done by measuring the days in stock, which is used for indicating the number of days in a year that the case company holds its stock in inventory before selling it forward to generate revenue. Days in stock is calculated as follows:

$$Days\ in\ stock\ (DIS) = \frac{Cost\ of\ average\ inventory}{Cost\ of\ goods\ sold\ (COGS)} * 365$$

This inventory metric of DIS is meant to be measured in the entity level as well as for the individual inventories. It tells very simply the overall situation and performance of the inventory at one glance. The target is to aim for as low DIS as possible, without missing out sales.

To bring in the customer point of view in the KPI scorecard, it is suggested to measure the service level. Service level indicates how many items of the customers needed were available at the time of demand. Service level is best to be measured based on total value and for each item class separately. This KPI is specifically useful in the spare parts inventory management of the case company. Service level is formulated like below:

$$Service\ level = \frac{Ordered\ goods\ delivered\ at\ once\ from\ stock}{Total\ ordered\ items} from\ last\ 12\ months * 100\%$$

And lastly in the inventory management KPI scorecard the specifically tailored KPI for the needs of case organizations project-oriented business is given the KPI for managing the project inventories specifically. The case company has some warehouses for project materials specifically and the management of those can is different from the general spare parts inventory as for example there are no safety stocks for the BTO project material. However, it is important to know where the material belongs and avoid cumulation of excess and obsolete in the project inventories. The allocation of the goods in warehouse should be measured from project inventories in order to make sure that all items in the warehouse have a demand. The value of unallocated inventory is calculated as follows:

$$Unallocated\ stock\ value$$
$$= (Qty.\ of\ items\ in\ stock$$
$$* item\ value) - (Qty.\ of\ items\ on\ open\ sales\ orders\ *\ item\ value)$$

As mentioned previously, the seeking for the ultimate low inventory can be dangerous as it increases the possibility for stock out situation which causes higher cost for example in logistics as well as loss of sales. So, to make sure not to go too low in the inventory it is essential to also recognize the changes in the other related cost areas. Key performance indicators act as a guidebook for the company management and therefore the KPI's should be systematically reviewed by the management board. This allows better grip on global inventory management as well as provides deeper understanding about it.

5.2.2 Performance management follow-up process

Its is crucial to follow-up on targets of the performance management of inventory management. There has to be a systematic way on ensuring target achieving as well as continuous monitoring. The previous sub-chapters presented the target setting model as well as KPI framework for inventory management, this section describes a process for performance follow-up in the case company.

Follow-up meetings should be organized periodically. This thesis suggests to hold a meeting between the entity and group management quarterly, where the follow-up process is started and planned. The purpose of this follow-up process is to get information about entities achieved or non-achieved targets as well as follow up in reporting and analyzing the challenges and reasons if the targets are not met. The entity will also have a possibility to affect in the setting of new targets during the review as well as gain the launch and advice for attacking the new targets. The new process for follow-up practices is illustrated in figure 28 below.
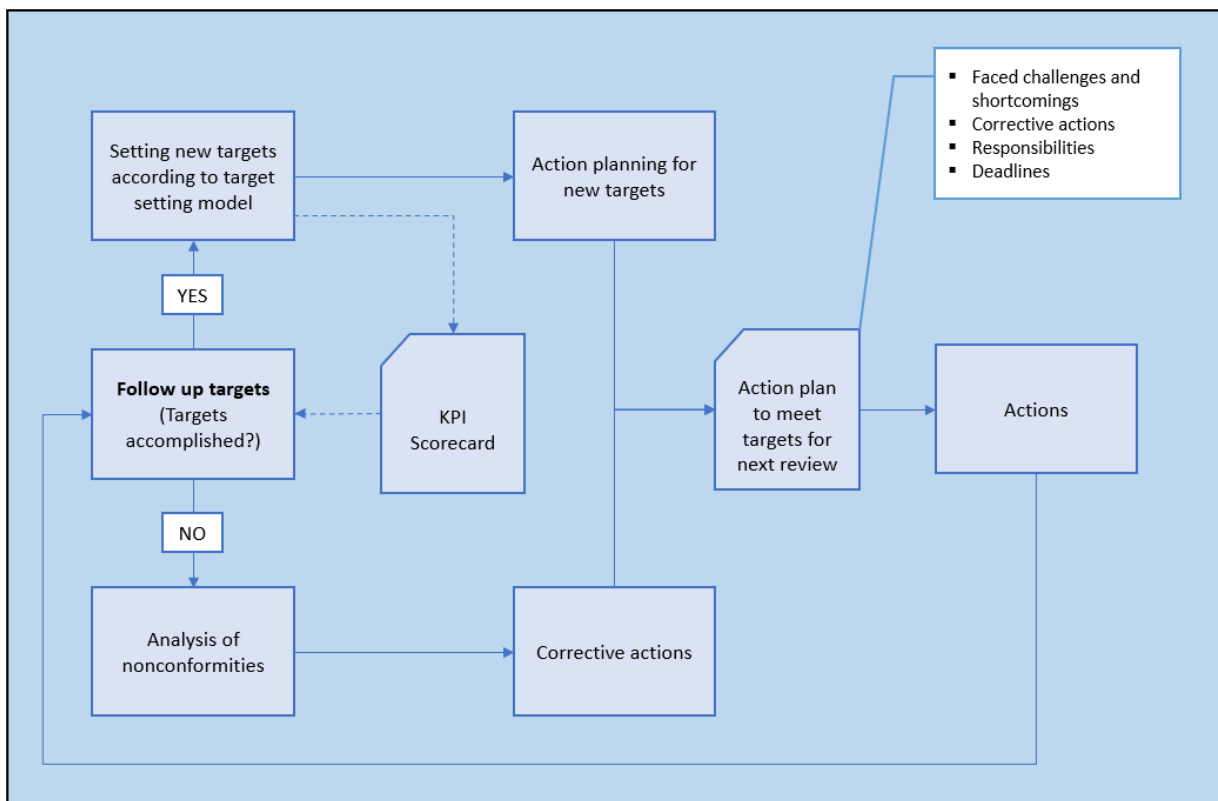

Figure 28. Performance follow-up model for the case company

When creating action plan, it is crucial to also list in the responsible as well as deadline for completing the action. The action plan shall be reviewed in each review meeting until the targets have been reached. After the targets have been reached, new goals can be determined for the next period. Even though targets are normally set annually, it is important not to let go of the achieved results if the targets are met before the end of period. Essential thing in total in the follow-up process is reporting on how the targets will be achieved in the entity as well as, what was done in order to achieve them. The above presented process-based follow-up model will make the management and systematical achievement of the targets possible in the global picture of the case company.

5.3   Global inventory management process

The purpose of this thesis is to create a common way to organize the case company's inventory management in the global network. The ideology behind this is to get better grip in the group's inventories; to enhance information transparency, optimize the total inventory value, to have goods in stock in correct places and increase the inventory turnover while securing the appropriate service level for the end customers. Based on the interviews and observations there are a lot of excess and obsolete as well as overlapping stocks scattered in the case groups inventories around the world. This phenomenon can be linked to the problem that there is no way to handle the inventories efficiently via streamlined and common inventory management approach. The inventories globally do not perform as the group would like it to be and furthermore, the group has close to none control in some of the inventories from the recently acquired entities. Therefore, one of the key elements in the aim of this study was to create a managing model for the global inventory management in the case company.

Especially when managing the global inventory network, a high level of transparency as well as target-oriented management model is compulsory. Also, the other necessary thing is that the management model has to be visual and easy to understand, with fixed points of action. Therefore, the process for global inventory management was created. The process for global inventory management is illustrated in the figure 29 below.
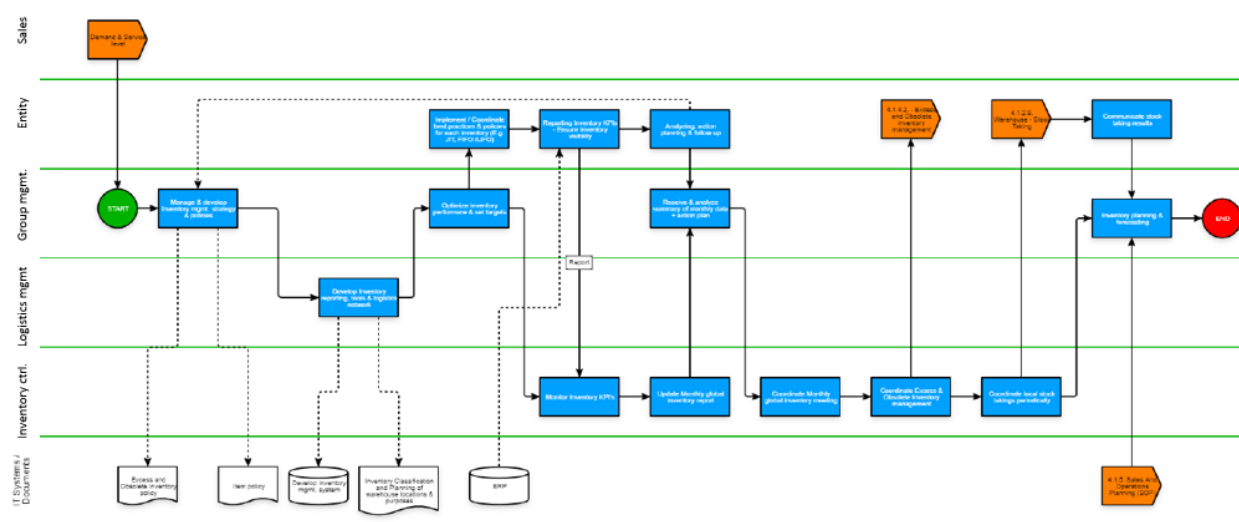

Figure 299. Global inventory management process for the case company

The global inventory management process includes key responsibilities divided into 5 roles consisting of sales, responsible of the inventory, the group management in the inventory management and logistics areas, and the coordinator for global inventories. The process has the input from the sales team's indication on demand and service level. The process is constantly on going with development projects and follow-up practices included. To start off, the group management will have a responsibility to manage and develop the inventory management strategy and policies, also development of reporting, tools and logistics network is group managements duty. Moving on to the inventory performance, the targets will be set according to the new target setting model by the group management. Then the action planning and reporting the KPIs while ensuring the visibility will be on responsibility oof the entity level inventory responsibles. The global data will be gathered and monitored by the global coordinator. Then the analyses from entities as well as the performance data will be reviewed by the group management and further analysis will be done according to the situation in regard to the targets, whether achieved or not. To create a solid continuous

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transparency as well as discussion in the global inventories a monthly meeting is organized by the global coordinator, where a summary of the current state is reviewed. Additional meetings about the details of single inventories are arranged between the entity and the group level coordination when needed. The performance follow-up model presented earlier in this study is used for this purpose. The periodical tasks of excess and obsolete inventory management, as well as stock takings are coordinated by the global coordinator. Finally, the group management will be making future planning of inventories and forecasts based on results from the stock takings and sales and operations planning.

The purpose of the global inventory management is to not only involve the global group management but particularly the entity level operations management as well. The plan is to expand target-oriented working and follow-up practices to the operational levels in the group's entities. The process it-self basically summarizes multiple different tasks and development actions within the inventory management globally. It also provides way of working for the global inventory management including relevant roles and responsibilities.

6   CONCLUSIONS AND DISCUSSION

The main target of this study was to create a effective global inventory management process for the case company. This process was created and the supporting features such as inventory policies and performance management around the global actions were developed and streamlined in order for the case company to be able to optimize their invested capital in inventories while having a great service level and customer satisfaction. Firstly, the relevant literature related to inventory management, process management, their implementation as well as change management features were reviewed in order to generate a comprehensive view on the current state of the research that acts as a basis for further contributions. Secondly a general overview of the current state of the case company's supply chain, the network and inventory management was presented based on authors observations as well as insight gathered during interviews. Also, empirical evidence about the driving and restraining forces around the implementation of inventory management were provided, as well as the practices that could be used to apply the existing forces to the company's advantage when going to the desired direction and to realize the change that is required. Finally, the empirical study also contributed on the actual results that need to be managed in order to have a solid ground for working towards the global new approach by providing suggestions for solutions in the inventory policy, performance management as well as for the global process. These actions have made it possible to answer the research questions, which are provided next starting from the sub-questions that are needed to provide the answer for the main research question.

What are the enablers of successful global inventory management?

The evidence provided in the empirical phase of this study tells a clear story that a new inventory management process cannot be implemented into the case company group without proper planning and preparations. Therefore, this study is supporting the fact that introducing the inventory management process successfully it requires that certain preconditions are in place as they enable the process to operate smoothly. Thus, they can be called as enablers of inventory management process. The enablers

can be easily linked to both drivers and barriers of the implementation in this research. Nevertheless, the situation sill requires to identify the factors that need to be in place before starting to operate the inventory management process itself. Those factors include top management support, fit with the overall company strategy, shared need for implementing global inventory management as a new way of working and correct timing. The role of top management support has been also emphasized by several authors (Lee & Dale, 1998; Rozemeijer, 2000; Monczka & Markham, 2007; O'Brien, 2015). It can be seen that the top management has therefore a great role in the enablers. The main elements of the enablers of successful global inventory management that were identified during the empirical research are: clear ways of working and roles & responsibilities, effective tools, and structured performance management including target setting, measurement and follow-up practices.

What are the driving and restraining factors that either enable or decelerate the implementation of inventory management?

What comes to answering this question it is good to start from taking a look about the forcefield that was analyzed in the empirical part of this study. It can be seen that the driving and restraining forces can be classified to arise either from outside of the company being external factors or from inside the company being internal factors. The external forces that drive the implementation are mainly consisting of features related to the external stakeholders, such as customer's expectations and collaboration with the suppliers. However, the study revealed that the internal drivers from inside the company play clearly a more significant role in the driving the change towards successful implementation. The most notable internal drivers consisted of ways of working and roles & responsibilities, measurement, planning and targeting, and efficient tools. When considering the restraining forces, the setup was the same as with the drivers. Internal barriers gained most of the attention and the most notable factors were change resistance and unclarity of the current situation. External barriers got the least of mentions from all of the categories. Similarly, as with the drivers also the external barriers were related to the external stakeholders of the case company and negative affects on the customers and suppliers were seen as a decelerating force.

Which methods can be used to strengthen the driving factors and reduce the restraining factors?

The change management within the forcefield when implementing global inventory management has to be considered thoroughly and planned in advance. It was noticed that the basic principles for both, strengthening the drivers as well as reducing the barriers consists of same phases. Firstly, there is a need to unfreeze the current situation, which means that the baseline must be defined and made public within the organization. Secondly, its time to move forward and trigger the change. The change can be triggered in the research context by communicating the need for unified ways of working and roles and responsibilities, as well as communicating the measurement tactics, planning and targets that can be achieved, as well as the effects in the external stakeholders. After the change has been triggered, it is important to keep going. Thus, the second phase is to sustain the change. The sustaining should be done by having a common way of working with the planning sessions where feedback is provided and the successes and achieved benefits are communicated. From the external point of view it is worth mention that also the external stakeholders will get confidence in the changes, if the successes are communicated also externally. The analysis showcased that there is one common nominator that helps to strengthen the drivers and to reduce the barriers of global inventory management implementation and shift the organization towards the desired target state. The results indicated that effective communication based on facts and data is the best approach to take the full advantage of the drivers as well as barriers.

What are the benefits of successful implementation of inventory management?

It is crucial to think of the benefits that the successful implementation of the global inventory management may bring in order to have a clear vision about the direction that is targeted. The benefits seem to fall into three categories, namely economic, operational and transparency. It is worth to mention that the results indicated that there were a significant importance in the operational and economic benefits, as those categories gathered the most attention during the data collection. On the other hand,

transparency factors can not be left out and the category has a crucial role in achieving the benefits. Basically, the three components have to be all in place in order to be able to efficiently and systematically work towards the achievable benefits. To start off with the transparency, enabling the visibility in the supply chain with appropriate tools the case company is able to gain a better grip in the group's inventories in total. The transparency will also give help to understand the current state in terms of global inventories. Secondly, the economic benefits are of course a big driver for the entirety of inventory management. The main economic benefits that are targeted with the new approach in inventory management are efficiency in the net working capital, equal to lower inventory levels. Consequently, following up on the lower inventory levels will come a faster inventory cycle, which shall be measured by KPI, namely Days in stock. Lastly, it is crucial to maintain the inventories in a manner that the customers face negative effects as minimal as possible and by managing and measuring the inventories efficiently the service level can be increased and therefore resulting in a better customer satisfaction.

How to facilitate the implementation of global inventory management process and the change management related to it successfully?

Finally, the main research question can be answered by combining the contributions of the sub-questions presented previously. To mention first, the research evidently emphasizes the role of enabling factors that can be considered as the preconditions which have to be in place in order to succeed in the inventory management implementation. Thus, like the results indicate the top management support, strategic alignment, shared need for change, right timing, clear resourcing, unified processes and tools are important requirements that need to be ensured in the early phase of the implementation. After the initial work has been done it is important to knowledge and handle the drivers and barriers appropriately by strengthening the drivers and reducing the barriers by triggering the change and sustaining the change via communicating the successes as well as providing the support for setting the targets and achieving the targets. Lastly, when the previous phases are done successfully it is possible to

reach the benefits for a clear future in terms of way of working and controlling of inventories as well as efficiencies economically.

All in all, it can be seen that by creating clear and effective ways of working as well as defining the roles and responsibilities at the same time is the best way to approach the implementation of global inventory management. The other main factor while defining the new way of global inventory management is to set effective KPI's to guide the ways of working. When these two main aspects are created well and communicated thoroughly, they can strengthen the drivers and minimize the restraining forces greatly.

Currently, the case company's inventory structure is scattered around the globe. Some of the inventories are replenished by ordering the stock from the main distribution center as well as at the same time replenishing the stock from the local suppliers. Entities have also locally typically one main warehouse as well as several smaller inventories that might be also located in the supplier's premises. The whole inventory system is based currently in local knowledge and expertise on the area specific features. Also a global exercise is in place to coordinate the activities related to inventory management from the group point of view. The case company has multiple ERP systems in use and different kind of material planning systems as well as different kind of policies for item planning and inventory replenishment methods.

Case company's inventory management for spare parts is based on ABC philosophy. There are five ABC classes where items are divided based on the sales volume. For these classes are set the parameters which are applied when calculating the re-order point, order quantity and stock level for each item. The calculations are done manually, when there is a need for re-calculation. There is no set timeline for performing the calculations periodically. The stocking decision is based on consumptions during the last 12 months. The current item policy gives guidelines for performing the material planning system as well as determining the classes and parameters for products as well as whether they should be kept in stock or not. Entities local purchasing teams can also deviate from the policy if seen as needed. The lack of strict way and timeline for performing the calculations for classification is definitely seen as one of the key

problems related to management of the stocks. Also, it was seen that five item classes are not enough for a company this size. For keeping appropriate stock levels, a guideline as well as more detailed specification for item classification is needed.

One of the largest problems in the case company is the performance management. There is no clear process-based performance management system, neither a measurement method for the performance of inventory management. Specifically, the lack of performance metrics for measuring specific inventories in the operational side is seen as the greatest challenge at the moment. The inventory value is only checked couple times a year, but a deep understating in the performance of the local inventories is missing. Like it has been described in the literature, if there are no performance measurement or targets, they will not be achieved (Waters 2003, p. 197; Richards 2011, p. 230). The current measures for inventory management are only based on budget targets for each entity, but a more specific target setting to the lower level for each inventory are not in place. Also, other measurement practices for inventory management in addition to just the value of inventory are missing. Corresponding to that, there needs to be detailed plans and actions hot to achieve the targets, and continuously follow up the actions and the way to the goal. Practically, the case company does not have proper key performance indicators, as performance score card as well as a process-based performance management in place.

As previously described in the literature, it is important to stock the goods where consumption is granted. In the case company there is close to none process for handling the unallocated goods, nor for the slow-moving inventory. Currently the calculation for slow moving inventory and scrapping is only done once a year and the input for starting the process is caused by the stock takings. When there is no clear understanding of how to handle the unallocated stock as well as the process for slow moving items those actions will cause confusion and unexpected increase in workload upon the stock takings take place. The proposals for scrapping are also done manually and that is causing a lot of work. Thus, the company has to develop clear ways of working and process for managing the inventories.

From the drivers and barriers point of view, it was recognized that the most important factors related to implementing of global inventory management are related to the internal aspects. Drivers covering the areas of creation of clear ways of working and roles and responsibilities. This was seen the most important driver overall in the implementation of global inventory management. Also measuring, planning and targeting as well as visibility throughout the supply chain were seen as key drivers from the internal point of view. The most notable internal barriers were related to the unclarity in the current situation and how to perform the activity as well as the change resistance related to the implementation. External drivers emphasized the importance of working together with the external stakeholders. The barriers were also seen to arise from the negative affects to the external stakeholders, such as suppliers and customers.

To conclude, the successful implementation of global inventory management can be facilitated through structured processes for managing the global ways of working with inventory policies, performance management as well as the global perspective of the inventory network. As the analysis and results indicated visualization is the key for making the data easily understandable and more tangible. To answer the main research question, two basic principles can be drawn together as a conclusion. Effective communication based on facts and data as well as clear and visual guidelines ensure the successful implementation of global inventory management process and the change management related to it.

6.1   Assessment of the study

This study is done based on broad current situation analysis and the change related forcefield withing the implementation of new approach. The results from the analysis were able to answer the research question and purpose of the study. Results are given by understanding the case company environment and they are created to fit the case company's operations. The suggested solutions consider the needs of the case organization and in the other hand the restraints in the business area. Therefore, the suitability and value of the results can be seen in the case company context.

The research is done by qualitative methods, with two different approaches, namely case study and action research. In addition, observations were used naturally by the means of action research. The primary data collection was done conducting 10 interviews widely around the case company group and withing different levels and business areas of the company. Extensive interviews with the different functions of the case organization create a reliable view of the current state and the challenges it confronts in the large image. Thus, this increases the validation of the results and give reliability for the solutions to solve the research question at the case company group level.

The objective of the thesis was to solve the research questions, which was accomplished. In addition to that, the research provided reliable information of the case company's current situation and challenges that are affecting to the global inventory management indirectly, as well as strengthened the knowledge overall about the inventory management in the case company group entities. Most importantly, the study provided the beginning of continuous improvement in the case company.

6.2   Limitations and further research

It is important to remember that this study focuses strictly on the perspective of the case company as the research is conducted in a holistic single-case design. Therefore, the results must be understood in their original context and should not be straight generalized to other contexts such as other companies or industries. However, selecting a different research design could provide interesting opportunities for the further research. For example, studying the successful implementation of inventory management in several contexts as well as different industries could reveal the potential differences and similarities as well as provide more detailed information about the effects of the company culture or industry on the implementation process and its complexities.

This study offers also possibilities for further research in the case company. One interesting topic could be to study on how inventory management, demand forecasting and item management could be integrated into the case company's sales and operations planning (SOP) model as well as what would be the achievable benefits from that. Successful SOP model including the aspects from inventory management would provide a better starting point for strategic planning and specifically better opportunities in network planning in the future. It would also enable the case company an increasingly efficient and profitable business.

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APPENDIX I. Interview questions

Role of inventory management

1. What is currently the role of inventory management in your division?
2. How the current system works? How satisfied are you with it?
3. How would you change the role of inventory management in your division if needed?

Inventory management

4. It is widely discussed that the company should start to act in a more unified manner globally, to utilize the full benefits of the global network. How well you think global inventory management serves that purpose?
5. What are the benefits that can be achieved through global inventory management in your opinion?
6. How would you develop the current inventory management?
7. What kind of features should a global inventory management process include in your opinion?
8. How would you organize the global inventory management? For example, roles and responsibilities?
9. What are the possible affects of global inventory management to our suppliers? Customers? Positive / negative?
10. What are the best benefits (driving forces) in current way of performing inventory management?
11. What are the most negative factors (restricting forces) in current way of performing inventory management?
12. Please comment the global inventory management process draft from your point of view. (Last page)

Implementation

13. How the implementation of global inventory management affects your daily work?
14. How you have to change your ways of working in order to ensure that benefits of global inventory management are utilized?
15. What are the main challenges in implementing global inventory management from your perspective?
16. What kind of tools and practices could be used to mitigate the challenges you identified?
17. Which factors support and drive the implementation of global inventory management?
a. How could these supporting forces be strengthened and taken full advantage?

18. Involving of stakeholders has been identified as one key factor in successful implementation of new processes. How should the stakeholders be involved?
    a. How should the stakeholders be selected / who are the ones to involve?
    b. What kind of steps should the involvement be enhanced?
19. How should the overall communication about global inventory management be constructed?
20. What would be the main reasons why someone would not be willing to comply with the global inventory management process?
21. How would you ensure that the stakeholders would act according to the global inventory management process and instructions included in the different phases?
22. How should the employees be trained in order to get familiar with the new common way of working?
    a. What kind of competencies are needed?
    b. Who needs the training?
    c. How to train them?

Global inventory management process draft

Confidential by request of the case company.