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Contents

Chapter 1

An Approach Towards Inbound Logistics Efficiency: A Case Study at Schenker International AB[1]

Gouveia, Laura and Costa, Sérgio

Abstract

For many years, the focus of companies has been in the productive and postproductive operations of outbound logistics, the customer-oriented part, while the operations of the inbound logistics would be in the responsibility of the suppliers. Currently, the increased difficulty of obtaining outbound logistics benefits implies that the priority of retailers is to control entry operations in order to reduce costs, improve relationship with suppliers and establish partnerships. Thus, the problem under study is how to improve the efficiency and effectiveness of inbound logistics. Consequently, Lu Hai and Su Yirong (2002) explored a solution through the involvement of Schenker, one of the world's leading integrated logistics leaders, so that all parties involved in the value chain would gain additional benefits.

The contribution of this work to the public was the creation of a model hypothesis as a future-oriented response, giving companies the idea of adopting an integrated logistics solution, in order to establish a strategic alliance relationship with the suppliers and gain competitive advantage. Effectively, to emphasize the importance of the efficiency of inbound logistics in such a demanding market, Lu Hai and Su Yirong (2002) used an empirical approach with the use of interviews with Schenker's people to describe how organizations deal with question of logistics, as well as the study of documents, biographies, articles and newspapers.

Keywords: Inbound Logistics, Value Chain, Logistics Process, Partnership

[1]This paper is based on Su, Y., & Lu, H. (2003). An approach towards overall supply chain efficiency: A future oriented solution and analysis in inbound process (Master's thesis). Göteborg University

1 Introduction

Logistics is one of the main business issues today whose processes involve efficient planning, implementation and control of the flow of goods. It deals with activities from raw material acquisition, movement and storage of the product, to its distribution to the final client. More and more companies have contracted logistics services to reduce costs and lead times, making this activity a source of competitive advantage and a way to create strategic partnerships between the company and logistic providers.

Logistics has undergone an evolution in recent times, notably in terms of "warehousing and transportation management, total cost management, integrated logistics management and supply management" (Ross, 1997). At a time when society is becoming more unstable and dynamic, in order to adapt to this reality, the role of logistics has been expanding to 4PL or also called integrated logistic solution (Hieber, R., 2002, p. 35), in which the manufacturer outsources its logistical operations, as well as its management.

The key aspect of maintaining a high-quality service for customers and minimizing costs is the adoption of technological information to support logistics operations. The structured exchange of data via computer systems, better known as EDI - Electronic Data Interchange, is the essential technology for managing information flow and reducing lead time. Controlling the flow of information as efficiently as possible is one of the most competitive aspects that leads a company to differentiate itself from the other.

Schenker, "one of the leading international providers of integrated logistics and freight forwarding services" (as cited in Lu Hai and Su Yirong, 2002, p.5), is actively involved in this thesis in order to demonstrate that integrated logistics solutions are the best techniques to succeed in the business market. Schenker 4ROOMS is a network of logistics experts whose main goal is to help customers improve the value of their core business.

Thus, the goal of logistics management, driven by technological evolution, a growing demand and increasingly challenging distribution tasks, is to be able to satisfy customers' needs at higher service levels and at a lower cost by coordinating materials and information flows.

Therefore, the main purpose of the thesis is to explore a solution in the inbound logistics to find ways to improve the effectiveness and efficiency in this area of logistics by managing the physical flow and information flow in order to give quick responses to customer's requirements and where, in the future, there is a way that Schenker is more involved.

From the supply chain management's point of view, the scope of this work is to focus on the inbound logistics services of manufacturing industries in order to reduce overall cost with efficient information exchange (Lu Hai and Su Yirong, 2002). An ideal inbound

logistic information flow and physical flow will be mapped for key clients that will be studied.

Lastly, for a better understanding of the present article it is important to know how it is organized. In order to attain a deeper understanding of the theme in study some concepts with applicability in the thesis' problem area will be explained. Then, the research questions generated by the problem definition, purpose and limitations will be described followed by an explanation concerning the research methodology and research evaluation. After the methodology, it is important to analyse the results achieved from the empirical investigation, in order to cover the research questions and consequently to draw some conclusions.

2 Literature Review

With the objective of achieving a better understanding of the theme in study, it is crucial to have a notion of some theories that will be applicated for this thesis' problem area. This chapter provides relevant literature about the inbound logistics and introduces the research questions. The first part of this literature search is about logistics and its attributes with the aim to establish the framework that logistics will be studied.

First of all, logistics is a part of the value chain and it is about delivering the right product to the right place using the shortest possible time. Many small businesses are 1PL, that is, they make purchases and sales in the same place and the manufacturer doesn't outsource transport and logistics activities to third parties. Given that, in current days, many companies have expanded geographically and have adopted 2PL, which is mostly a carrier or warehouse manager contracted by the company that provides logistic and transport tasks. However, with the increasing demand, most of these 2PL have became 3PL or even 4PL, by integrating their operations and adding more value to the organization.

Furthermore, it is only through supply chain management and logistics that the goals of service improvement and cost reduction can be achieved. According to *Houlihan*, supply chain management tries to establish a balance between activities such as promotion, sales, distribution and production, since there is usually conflict with these areas. Integration of activities such as logistics, production and marketing between companies is one of SCM's main objectives, which indicates that logistics is a "sub-set" of the supply chain management, sustained by the *Council of Logistics Management*.

To obtain higher productivity and cost savings, minimizing the flow of raw materials and finished products it's necessary and also the main reason to establishing supply chains. Improving supplier relationships, increasing customer responsiveness, building a competitive advantage for the product-oriented channel and introducing supply chain management solutions and enabling information technology are vital aspects to improve effectively the performance of the supply chain and the company itself.

In order to guarantee sustained market strength, a price leadership or a differentiation strategy, even if necessary, aren't enough. It is imperative to manage an effective and efficient supply chain network, a complex group of systems and operations, by developing a common mission and objectives between the various business identities that belong to it, at the same time while they follow independent policies.

The supply chain management has the main goals to reduce cycle time, increase throughput, reduce inventory at different stages and to reduce overall capital tied up, objectives that are complementary to each other, which means, for example, that in order to rise throughput, the cycle time must be reduced. To support this manufacturing objectives, a few principles must be adopted in order to control processes in general, any kind of inefficiencies in the logistics and in the systems. Reducing the influence of lead time variability in the system and the inventory variability in the supply chain are serious challenges most companies must face.

The supply chain management also defends that it is important to build effective coordinated strategies that involves an interaction between marketing policies and production of raw materials and finished products, in the supply process.

In order to gain a deeper understanding of the supply chain for a single company, it is appropriate to divide its logistic system in two parts: inbound logistics, that is, material management and procurement and outbound logistics, customer service and channels of distribution (Coly. Bardi). The main focus of this work it is the part that deals with the suppliers and the delivery of goods into the company, in other words, inbound logistics. However, some may think that the inbound logistics is the opposite of outbound logistics, since there isn't a clear definition of what inbound logistics is (it is a matter of perspective).

From the supply chain management perspective, it follows that the network involved in the sequence for the material flow from origin to final consumption it is quite complex. Between the number of suppliers and distributors included in the process, this network is centralised in the manufacturer, also know as OEM (Original Equipment Manufacturer). The OEM is in the middle of the process: before it passes through the manufacturer, all the material is to be considered an unfinished product, and only after it can progress into the distribution process, because it is already a finished product. According to this, the inbound logistics is defined as "the flow from the raw material supplier to OEM" (Lu Hai and Su Yirong, 2002).

There are two areas in the inbound logistics: Purchasing and Logistics (Bowersox, D., Closs, D. 1996). The purchasing area consists in groups of products, since inbound logistics cares mainly for the purchasing and transaction of products. In each group, there is a responsible (purchaser) for the entire life cycle of all the products in this category. On the other hand, logistics area deals with coordinating the production planning. The main goal is to optimize the supply and production planning. So, "that means that the inbound logistics process is the part in the supply chain that has a complex procedure,

lower value added and higher capital tied up" (as cited in Lu Hai and Su Yirong, 2002, p.33), while the outbound logistics contains the biggest value created.

Nowadays, with such a demanding market, most manufacturers and retailers are busy trying to control efficiently the inbound logistics in order to reduce costs. Manufacturers and suppliers are joining forces into creating a strategic alliance so both can obtain benefits by increasing efficiently the processing flow. Seen from the logistics service provider's point of view, controlling the inbound logistics means bigger logistics capability. The logistic provider can also be called 3PL in the relationship between the supplier and the manufacturer.

Now it is time to emphasize the importance of channel relationship management. We use the term channel to interpret and understand logistics, functions of marketing and distribution. The channel concept in the inbound logistics begins with material supplier and ends in the OEM, which they are also known as the basic channel parties. Channel management has the main goal to communicate directly with customers in each channel.

Manufacturers and vendors are trying hard to improve the effectiveness and efficiency of their channels, as well as their partners are, such as 3PL company. This becomes a problem to the extent that VRM (Vendor Relationship Management) could turn out to be "the next big thing" (Lu Hai and Su Yirong, 2002).

This channel conflict depends of two things: the nature of the industry and the individual company (Lu Hai and Su Yirong, 2002). Companies must control their own channel risks in order to increase significantly their production and distribution channels, so they can avoid causing problems in their revenue streams.

Many organizations sell their products to their final customers through distributors, retailers, partners, intermediaries, and this a process that has been raising some important issues in trying to build an effective customer relationship process. In inbound channel, it is essential to know the lifecycle of the product and who owns the customer. Between this channel relation, the manufacturer has a key role and must evaluate partner involvement, competitive intensity, organizational capabilities and the strategic position for channel members in order do establish the right level of cooperation. It is necessary a proper analysis for the channel relation for the demand and supply chain, as well as a definition of the channel conflict, so it can be possible to balance the power in the channel and to reduce conflict by increasing cooperation.

Logistics embraces all the activities to help create customer value requiring the lowest cost, since the main goal for most businesses is to maximize profit. The main challenge here is "to balance service expectations and cost expenditure in a manner that achieve business profitability" (as cited in Bowersox. D. & Closs.D. 1996, p.8). Elements, such as service, cost and tied up capital, must be studied by companies in order to measure logistics effectiveness because they can affect its performance profitability. These three aspects are dependently of one another and interact among each other, so it is important to achieve a balance between them to optimize the result.

We are now able to discuss the SCOR (Supply Chain Operation Reference) model. The SCOR model it's applied to evaluate and measure the model hypothesis proposed. In 1996, the model in study was released with the main goal to analyse and describe all the dimensions of the supply chain process, in order to enable all industries to use it. SCOR model involves everything to do with the supply chain, which makes it a reference to most companies to improve their practices and associated technology. The five major management processes in SCOR model are: plan, source, make, deliver and return (Lu Hai and Su Yirong, 2002).

Furthermore, the SCOR model analyses a company's supply chain at four levels. In the first level (top level – process types) the scope and content for the model are established, as well as basic strategic decisions in areas determined by the company to improve the efficiency in their supply chain. The next level, configuration level (process categories), the implementation of the strategies previously mentioned is set. After, in the process element level (decompose processes), the capability of the company to compete with its chosen markets is defined. Lastly, the implementation level or level 4 of SCOR model, is about to being able to adapt efficiently to the changing conditions of the environment in order to gain competitive advantage.

SCOR has proven to be a helpful model to most companies, since by using it, organizations have reported significant progresses in their supply chain and manage to identify inefficiencies.

To understand better the model hypotheses, one must first understand how the traditional "demand to supply" model works. First, as mentioned before, a supply chain is "an association of customers and suppliers who, working together yet in their own interests, buy, convert, distribute, and sell goods, and services among themselves resulting in a certain specific end product" (as cited in National Research Council. 2000). Each company is a core part of a supply chain. All the chains in which a company is involved is defined as OEM and its suppliers, who work together to support and create the final product that is delivered to the final customer. Normally, for each product line, OEMs have a supply chain associated with, even though the same capabilities are used in multiple chains. Suppliers can participate in the supply chains of more than one OEM.

OEM is a fundamental part and serves as the dominant position between the supply and demand relation. Its job is to release the material order to its suppliers based upon the sales forecast and production planning (Lu Hai and Su Yirong, 2002).

In the traditional inventory management, the Bullwhip Effect is often led by the techniques practiced at each level of the supply chain. This phenomenon occurs in retailer's warehouse "where the inventory is much larger than the variability in customer demands" (as cited in Lu Hai and Su Yirong, 2002, p.54). That being said, the increased amount in variability will result in excessive inventory.

Thus, the traditional supply to demand model is composed by the supplier that deliveries material based on OEM requests and, in its turn, the OEM makes these

requirements based on sales forecast. This kind of activities have always been performed by 2PLs.

There are several consequences of increasing the variety of customers, the growing of inventories, larger and varied production batches, unacceptable services and inability to manage resources in an efficient way (MIT Tang Center, June 25-09-2001), however traditional 2LPs perform tasks in this relationship, the demand ends up being diverted which eventually can be improved.

With the constant change of business, more services and products are progressively integrating solutions in the market in a vertiginous way, which means some products can become quickly obsolete forcing the warehouses to be more ample and provoking longer supply chains that are the main problem of these rapid changes. As suppliers often produce forecasts based on their historical, small variations in demand can lead to major problems with the stock because it is highly difficult to anticipate the future. These changes could become a serious problem especially for large Store Keeping Units (SKU). VMI (Vendor Managed Inventory), when the manufacturer is responsible for preserving the levels of inventory and improvements of supply chain. Basically, the manufacturer receives information from its customers about their purchases and stocks, consecutively to assume responsibility for its refuelling. In order to avoid any occasional stockouts and reduce expenses, its crucial to exchange information with suppliers (Electronic Data Interchange - EDI). For this to become a successful strategy, there must be an ease of communication and the information must be critical and well detailed.

Furthermore, trusting the supplier is essential because there are often competitors who deal with the same supplier as they may have access to sensitive company knowledge. Also, information sharing it's extremely important since it allows the improvement of the forecast, which basically is an expectation of the future demand, thus makes the results much more precise.

Volvo in a pilot project that began in January 2002 gave its suppliers engines that needed a lot of space in the factory, keeping only safety stocks. Initially the project would begin with two national suppliers, Dayco and Horde, representing 80 percent of the total stock. As logistics partner Olsson Logistics, Volvo would be able to increase its deliveries from three times a week to three times a day, which would symbolize a large increase in internal efficiency. This integration led to the idea of wanting suppliers to be part of the company's own production line, so it would be much easier to reduce stocks and thereby reduce fixed costs.

OEM together with its suppliers associating mutual exchanges of information ends up requiring great logistics efficiency especially in the transport part, this serves as a key within the relationship. OEM was dedicated to the transformation of semi-finished products into finished products and having the final product ready to be worked according to their needs, meanwhile the supplier transfers the information to the logistics company to organize the delivery and 3PL generates the delivery schedules. In other words, the

supplier gets the replacement orders from the OEM side, they arrange the delivery schedule for 3PL, so both the supplier and the OEM maintain the stock.

The optimized model leads to the creation of a combination between OEM and suppliers, helping to achieve JIT (Just in Time) purchases, on the other side OEM helps with the production orders. They will send the material requirements in real time being received by 3PL in order to be able to deliver to the nearest warehouse, both parties maintain the production plan in addition to reduce the inventories, only maintaining the stocks of security. This flow of information between suppliers and OEMs seems to be able to make them work as an extension of the production line. Summarizing everything we said so far, in this model the supplier has access to the inventory information from its forecast and data promotions, it manages the inventory, generates its own planning orders and schedules in order to control the levels of 3PLS while acquires the information. For both supplier and OEM to be able to curtail fixed costs by reducing stocks, it is important to improve the flow of information as this will directly affect the total amount of fixed capital in the supply chain.

A new hypothesis was proposed considering that in many real cases the OEM occupies a dominant position and always ends up been benefited. In the VMI model if the supplier does not comply with the OEM is considered a bad supplier, so as the 3PL, if they fail to deliver JIT they are considered bad logistics providers, so the 3PLs try to find ways to improve their processing time within the terminals, they install electronic order management systems and tracking systems, all these integrated logistics solutions benefit the 3PL and its sender. Although there is always a top management that supervise all the information from replacement, production and logistics, the tendency has been for companies to define their core business and outsource the remaining functions in a way to reduce risk and tied capital. Theoretically to make the communications between all the members in a multi information exchange, following the same goal is vital, so they must work under the same instructions.

With the increasing of responsibilities from manufactures to suppliers, collaboration and interaction tools needed to be optimized, these require participation in cradle-to-grave decisions, so suppliers are chosen not only by the product they deliver, but also considering their abilities and capacities to innovate. By making the effort to reduce costs and market time, working with fewer OEM partners ends up giving more responsibility to their suppliers to produce the complete system from raw materials to delivery process, encouraging manufacturers to participate in product development. Most OEM expect the suppliers not to be just "suppliers", so the leaning is to gather large amounts of information and increase effective collaboration between customer, supplier and manufacturer such as 3PLs.

Finally, we have outsourced 3PL, this can be decomposed into 3 parts OEM, suppliers and 3PL terminals for consolidation. With the approach between OEM and supplier, it has become easier to remove some OEM inventories. The so-called 4PL is intended to create a relationship with the 3PL establishing an agile way to accelerate

coordination with the bounded costumers. With the purpose to stimulate the connection between the members, the internal supply chain was suggested that 3PL could obtain information directly from the OEM, creating automation stock replenishment directly from the 3PL terminal or inventory in order to improve overall performance. Essentially, 3PL directly receives the OEM information (Production plan and orders to suppliers), generates the majority of the inventory and prepare the planning of the stock levels, thus is able to make the stock replenishment automatically for the 3PL inventory and finally JIT do the delivery according to the OEM manufacturing plan thereby it is possible to get all elements involved. Nevertheless, 3PL does not depend unfavourably on its supplier but remain working in group with OEM in the management of the inventory, ordering correctly the just in time delivery. Since the responsibility of the supplier is reduced as result of its position more focused on the make-to-order replenishment part, it is necessary to trust others as our cooperation partners so they can get autonomous and 3PL can manage the supply chain to work in harmony.

Given the relevance of the study of entry logistics, it is pertinent to talk about Lindex. Lindex is a company based in Alingsås - Sweden, market leader in the area of children's and women's clothing as well as lingerie in which most of its stores are located in Asia. Schenker is a department attached to Lindex that performs logistics functions, so it is possible to verify that 3PL is still capable of managing logistics operations. Schenker as a logistics partner is fully responsible for inbound and outbound traffic, delivery control, sorting terminal, management and IT.

At the split-centre in Göteborg all orders are handled in order to be properly distributed always considering the cooperation with customers. However, Schenker when dealing with the delivery control of all suppliers, receives information about the purchase orders when they are ready to be sent and, consequently, controls the entire delivery process. It is critical to gauge the performance of the supply chain as well as to understand how it works.

To be able to do the different evaluations of the different models it is indispensable to create a standard method to be able to map them. According to the Supply Chain Council, to meet all requirements was adopted the SCOR model to support the research, in fact, the performance measures of the model are very close to strategic business objectives from a supply chain perspective. In fact, as the objective of study was input logistics, it was essential to adjust these parameters because of the inbound and special cases.

According to the theory "Logic mix of goals" (Lumsden, K.R., 1998), introduced in the theoretical framework instituted by Lumsden it was a great help to integrate the strategical SCOR metrics due to the similarity between these two models.

3 Methodology

This chapter will be divided in three parts. The first part will describe the research strategy and the case study, which is an approach used by the authors to the thesis in study. Next, they focus more in the methods used for collecting data, more concretely primary and secondary data. The third part is about the issue of reliability and validity. Thus, the most important methodological problems related to the main problem in study (improving the efficiency of inbound logistics) will be discussed.

There are two approaches for a research work: theoretical and empirical. The theoretical approach consists of a discussion, proof and foundation of the theory, requiring an intensive textual investigation. On the other hand, the empirical approach is more of a practical method since it involves an extensive interaction with people with the purpose of collecting data. The main focus of this thesis is the empirical approach, yet based on theoretical studies, which means that a decent theoretical foundation is imperative.

To manage a good theoretical background, the authors began by reviewing intensively the literature documents concerning logistics, supply chain management and information systems. Afterwards, in order to learn of how companies, operate with issues of information systems and manage the inbound logistics processes, the writers concentrate their efforts on the empirical approach to make a description of all this. At the same time, interviews with the Schenker's persons and key account customers were made.

The case study is a method of the research approach and it helps to convey the complexity of real events. "The philosophy behind the case study is that sometimes only by looking carefully at a practical real-life instance can a full picture be obtained of the actual interaction of variables or events" (as cited in Lu Hai and Su Yirong, 2002, p.11). The case study highlights two different characteristics in research. Firstly, the case study is a method that can be used in establishing valid and reliable evidence (Lu Hai and Su Yirong, 2002). Secondly, the case study can help to create a story or narrative descriptions of the situation being analysed and that particular story can turn out to be a research finding, in such a way that it is possible to add value to the body of knowledge (Remeny, et al, 1999).

In a general way, the thesis purpose is to explore the field of the inbound logistics system, which is an area that is relatively new since most companies were focusing on the outbound logistics. For this reason, a high number of organizations investigate their own solutions for the main issue of how to manage their inbound information flow in order to develop the efficiency of inbound logistics system. Instead, the authors decided to choose a case of inbound logistics in the manufacturing industry (Alps-Volvo-Schenker), highlighting the logistics provider in order to describe and explain the current inbound operations and identify inefficiencies in the system. The model hypothesis was then applied to the case study to demonstrate the merit of the findings of the authors.

When conducting a research, there is a wide variety of methods of data collection that can be considered. According to Yin, as far as sources of data are concerned, there are six important sources, that is documentation archival records, interviews, direct observation, participant-observation and physical artefacts (Yin,K.R 1994). Generally, we can divide the information available in two particular types: primary and secondary data. In this work, it will be present both types of data collection, considering that the major problem for the someone that is conducting a research is to find data that is relevant.

Firstly, primary data collects information through direct observation, personal interviews and conducting conversation, that is every data obtained directly from the authors using their own sources and experience. To this thesis, they have used personal interviews and their observations. The writers had an advantage when it came to obtain first hand information because they worked most of the time at Schenker 4ROOMS (the research and development centre), which meant that every time they had a doubt, they could just simply ask questions as they appear.

Because it is difficult to map all the processes of logistics and to obtain an accumulated information resource for all Schenker's operations, the authors chose doing personal interviews as they thought it will be better for their study area. In that way, they could talk face to face with the person from the company they were interested in and rapidly follow up the questions. This primary source of data also facilitates to obtain the just-in-point information, as well as it gives a clear notion of what and how the business works (Lu Hai and Su Yirong, 2002).

When using individual interviews there is the benefit of having the possibility to ask all types of questions. The two principles ways of doing interviews are: structured and unstructured interview. The structured interviews are the formal way of interviewing someone, there is preparation before the interview where a set of questions are organized, which meant that the authors could be flexible with regard to questions raised in relation to their research problems, according to Lu Hai and Su Yirong (2002). On the other hand, unstructured interviews are differentiated by the simplicity that they occur. They happened mostly in a relaxed environment, where people aren't stressed, with most of the R&D (research and development) specialists in Schenker 4ROOMS. Most of these interviews, such as structured or unstructured, were made along with site visits to help confirm exactly what people from Lindex and Schenker International AB were saying.

It is important to have in consideration that every person that was interviewed was a logistic professional or a field specialist that has been working in Schenker for a long time, which means they have experience in the area and can provide the authors with a deep knowledge that can bring value to the thesis.

When it comes to observations, they can be both quantitative and qualitative, and also "it is important to avoid taking part of the things observed" (Svenning, C., 1996). Most of observations made by the authors were qualitative because the main purpose was to understand the behaviour of inbound logistics system. Also, the sample was small, and the interviews contribute to explain the reasons behind the processes. Sometimes, it can

be useful to participate in the observations, which are unstructured and pass by looking, listening, asking questions and acting. (Lu Hai and Su Yirong, 2002).

Secondary data involves journals, textbooks, articles that can be obtained in libraries, internet and target companies. It is the study of documents, biographies, web-sites and other historical and documentary records relevant for the studied issue (Remeny, et al, 1999). These sources were used to classify the inbound logistics, as well as to identify evaluation parameters. All of this contributed to manage a logistics solution.

The authors wanted recent information so most of the literature they went searching was published during the late years. To achieve this, they explore the most recent documents at the library in Schenker 4ROOMS and the database from Economic Library in Gothenburg University (Lu Hai and Su Yirong, 2002).

Additionally, to prove to readers that all this information obtained from all the used sources is trustworthy, it is important to discuss the issue of validity and reliability. First, validity is responsible for describing how much the results correspond with the reality and is divided in two parts, internal and external part (Lu Hai and Su Yirong, 2002).

The internal validity connects directly the theoretical foundations with the empirical approaches and deals with the study itself. “That is, the interviews shall be performed with relevant people and the experiment shall have enough samples to answer the questions” (Svenning, C., 1996). That being said, the internal part of validity tries to make sure that, in this specific case, the persons who were interviewed were specialists that had enough experience of the field to add value to the work. The authors made a pre-study on many Schenker’s businesses in order to find the most relevant case for the models to gain a deeper knowledge of the theme.

The external validity, on the other hand, “concerns the study with all its contents in a wider perspective, that is, if it is possible to generalize from the study” (Svenning, C., 1996). The target group of this these thesis is the Schenker AB and the authors truly believe that the conclusion of their work could be helpful to Schenker in a more strategic point of view.

Whenever a future study follows the exacts same processes and techniques as used before by different researchers, as well as the same case study that results in the same conclusions, we can affirm that the investigation has reliability (Yin, K. R, 1994). On the other hand, a wrong sample and misunderstandings in interpretations can lead to low reliability. To avoid bad comprehensions of the interviews that were made, the authors decided to record them and classify the information obtained after re-listened to the tape. Before the interviews were made, an e-mail was sent to all the interviewees with the purpose to inform them about the meaning of the study and the expectations about the results of the questionnaire. This delivers a high reliability and lows the negative effect derived from wrongs interpretations in face-to-face conversations. All these procedures contribute to increase the effectiveness of the interviews, as well as attenuate misunderstood.

4 Result Analysis

In this chapter, the empirical investigation carried out in the thesis in analysis will be presented and analysed. As it was previously introduced in the methodology, the empirical data is based on interviews with Schenker's persons and key customers. With the aim to discuss the inbound logistics processes and its role in the supply chain, the interviews were followed by gathering and processing information and internal data. Additionally, a model hypothesis was created as future oriented solution to overall supply chain efficiency. Lastly, the findings will be analysed leading to a decision to try to implement an integrated logistics solution as a unique methodology for logistics companies, such as Schenker, for achieving success in a current competitive market. Furthermore, an analysis of a case study (Alps-Schenker-Volvo) will be conducted, including the SCOR model to facilitate the evaluation. This research result will help Schenker in improving their supply chain modeler simulation system and also contribute to its SCOR model development for its inbound research (Lu Hai and Su Yirong, 2002).

Nowadays, companies are using third-party service providers, since they find outsourcing a solution for the lack of competitiveness. Usually, the companies are outsourcing due to the following reasons: cost-related factors, lack of resources or expertise in the particular field, geographical issues, or the companies want to have the full focus on core competencies. (Sople 2007, 142-143).

Firstly, it is important to have in mind that the logistics system of the supply chain is divided in two parts: inbound and outbound logistics. According to Lu Hain and Su Yirong (2002, p.31), "we define our inbound process in the material transit flow between product manufacturer and its customer, that is to say, the inbound logistics process is the flow from the raw material supplier to OEM". The inbound logistics is the part in the supply chain that has a complex procedure, higher capital tied up and lower value added (compared to outbound logistics), therefore the focus of this research is to improve overall efficiency in the inbound process. Complementarily, Emmi Tuomola (2014, p.16) affirms that "inbound logistics is a very vital issue to consider because it affects to the firm's whole supply chain processes".

Additionally, a lot of studies have been made on the outbound logistics instead of inbound logistics, because only in current times companies have been focusing on inbound processes. Larbi et al. (2011) states that companies have "much less information and control on the inbound transportation than on the outbound transportation".

Getting more in depth into inbound logistics, categorizing all inbound operations is needed. Inbound logistics can be characterised in three models: traditional model, VMI model and a model hypothesis (Lu Hai and Su Yirong, 2002). The first two models always put the OEM in a dominant position, which results in only benefiting the OEM. In this sense, a model hypothesis, or also known as integrated logistics solution, occurs to emphasize the 3PL to ensure that it can provide efficient performance. As a result, all

members in the supply chain are actively involved and it has been proven that the 3PL is competent enough to takeover the inbound logistic operation from its clients.

In order to understand how the supply chain operates in different models, it is essential to measure how well it performs. According to the *Supply Chain Council*, measurement must link to business objectives, must be repeatable, must provide insight into how to manage the supply chain, and moreover, it must be appropriate for the process activity they are measuring (Sum up from SCOR Version 5.0 Handbook, Supply Chain Council, Inc. 2001).

The theory "Logic mix of goals" (Lumsden, K.R., 1998) defines parameters from the operational perspective, which turned out to be a helpful complement to the strategic SCOR metrics. The parameters in Lumsden's model are: lead time, delivery reliability, delivery accuracy, storage availability and flexibility, which demonstrate similarity with parameters in SCOR model: order fulfilment lead-time, delivery performance to commit date, perfect order fulfilment, fill rate and supply chain responsive time.

With the intention of demonstrate the merits of the model hypothesis, it was selected a VMI case (Alps-Schenker-Volvo) to map the current inbound logistics and increase its efficiency. Based on the previously identified parameters, weak points in the inbound logistics were described for future improvements. While studying it, we could verified that the parameter "perfect order fulfilment" has higher requirements than "delivery performance to commit date", quantitatively, "perfect order fulfilment" couldn't be higher than the "delivery performance to commit date", but it was (Lu Hai and Su Yirong, 2002). Also, for Alps, its stock at Schenker's warehouse was nineteen days, which should have been maximum fifteen days. This means that are four days of inventory gap among actual performance and their target. The main problem here is the fact that Schenker is playing a negative role when it comes to inventory management and logistics information management. Schenker gets the second hand information, which lead to a unbalance performance.

In the current situation, SCOR model was applied for the analyses of the inbound process. Then, model hypothesis was mapped with the SCOR model to show comparative advantages of the hypothesis proposed. As a result, some responsibilities from the OEM and the supplier were transferred to 3PL and this one will be able to contribute to the whole supply chain utilization. This solution was to eliminate the negative position of 3PL in the information flow (Lu Hai and Su Yirong, 2002). Having this in mind, one of the research questions have been answered ("What kind of improvement can be made on the inbound logistic system and how will it be after improvement?).

Furthermore, with the information obtained through the interviews of Schenker's persons and key customers, the authors manage as well to find a solution that Schenker, as a logistic provider, is more involved in the inbound logistic relationship so it's performance can me optimized. Complementarily, " to overcome the local minimization of costs for either the vendor or the buyer, and to move toward the global minimization of all costs for the two parties, it is essential to optimize the logistic process as an

integrated system and to exchange information about production, demand and shipments data" (Persona and al., 2005) (cited in G. Neubert, P. Bartoli, 2009).

It is also required to manage properly inventories because its maintenance is important to take care of needs between the time of demand and time of supply. The main objective of inventory management "involves decisions concerning to provide uninterrupted production, sales and customer-services at the minimum cost and since for many organizations inventory is the largest assets category, inventory problem can cause business failure" (Waters, 2009) (as cited in Muhammad, 2016).

When it comes to the case study of Alps-Schenker-Volvo, Volvo logistics if focused on the wide scale of contracts; different haulers of different companies in order to get the best prices, and an easy way for administration (Lu Hai and Su Yirong, 2002).

Volvo decided to hire another hauler company to pick up inbound materials. From the suppliers, such as Alps, the hire a forwarder such as Maersk Logistics to transport materials from worldwide to seaports in Europe, "and then Schenker will arrange haulers to pick up and make storage in the warehouse, waiting for sequence delivery from Volvo car" (Lu Hai and Su Yirong, 2002, p. 94). Due to the fact that there are too many middlemen involved in the logistics process, many delays of information occur and everyone only cares about its neighbouring partners working performance. A solution for this was Schenker taking over the function of Volvo logistics and conducting a direct delivery to Volvo car, since Schenker possesses all the technology to conduct the overall inbound systems.

Now it is time to put the model hypothesis in practice. In order to do that, it was selected a case of inbound logistics with the purpose of identify weak points and illustrate the value of the model proposed by the authors of the thesis. Schenker International AB was the company selected for this purpose.

Schenker International AB is a global logistics service provider and it has been building close relationships with suppliers in the car manufacturer industry. Schenker is responsible for warehousing, sequence deliveries, quality controls and making sure that every component used in the car making are in the right place, at the right time. Some suppliers of Volvo and Saab made Schenker responsible for its logistics services in restoring spare parts committed for car manufacturers.

In this case, the authors studied a logistics solution about of the case Alps-Schenker-Volvo where suppliers are in the middle of the exchange of all communication and information, since suppliers are the Schenker's contracted customers. This means that Schenker does not have a direct connection with the manufacturers and it`s serving them indirectly. A problem that occurs with this system is that the operational flow is very fragmented. A goal to achieve in this inbound communication is to reduce the players between suppliers and the OEM, since the more they are, the more complicated the communication system is and the possibility of surging errors is higher, which can decrease the efficiency of the entire supply chain.

For a better understanding of the complexity of the inbound flow among Alps, Schenker and Volvo, the authors applied the SCOR model already mentioned in the thesis. The purpose of this was to clarify the contribution of each activity in the whole flow. The inbound process, according to different performing entities, was divided into four companies: Alps, Schenker International AB, Volvo Logistic and Volvo Car and each of their operations was categorized into Source-Make-Deliver (Lu Hai and Su Yirong, 2002). Then, to help analyse the process, the authors used the parameters defined previously, such as perfect order fulfilment and delivery performance, by linking them together. The point is to identify and describe weaknesses in this inbound process in order to improve them in the future.

The SCOR model, an international standard that explains operation processes, was mapped with the model hypothesis in order to emphasize the advantages of the last one. They concluded that 3PL was performing activities mixed up with the responsibilities of others and carrying just the simple ones, such as transform and storage, while the major decisions were being made by its upstream consigners, which is definitely not an efficient inbound solution (Lu Hai and Su Yirong, 2002).

The major reason to the proposal of "Hypothesis inbound model" was to "transfer some duties from supplier and OEM to 3PL; the 3PL will then have enough space to do more in contributing to the whole inbound supply chain utilization" (as cited in Lu Hai and Su Yirong, 2002, p. 94). 3PL had a negative position in the information flow, so with this hypothesis, that could change (with, of course, the 3PL managing the supplier inventory). The result of this was Schenker replacing the duties of the Volvo Logistics so it could delivery directly to Volvo Car. The other way (Volvo Logistics replacing Schenker) didn't happen because Schenker had the main resources to support inbound operations. Thus, in the re-engineered system, Schenker was assumed as the only 3PL.

In conclusion, with the study of this inbound logistics case of Alps, Schenker and Volvo, some ideas were proposed in order to turn the logistic operator more actively involved in the supply chain management. It started by emphasizing the importance of an efficient information system and how 3PL should start communicating directly with the OEM, in order to receive first-hand and real-time data. This would transform 3PL into a real inventory controller. Next, it has been suggested an expansion of the trend to the upper stream of the value chain, which means to outsource inbound logistics and, in that way, 3PL gets to manage all the information and demand from the suppliers or the OEM. Thus, "in the case of any failure or schedule changes from any party in the supply chain, it is the logistic provider who harmonizes the delivery of all suppliers to postpone or fasten the delivery to the best result" (as cited in Lu Hai and Su Yirong, 2002, p. 98). Finally, it was considered, after the analyse of the study case, that 3PL should be responsible for the inventory control and improve its management.

5 Conclusion

When analysing the course along the problematic in study and combining all the factors approached (literature review, applied methodology and results analysis), it is now possible to draw some conclusions.

Firstly, in order to answer the first sub-problem introduced in this thesis work ("How is the process of current inbound logistic system?"), the authors categorized all the inbound operations into three models: tradition model, VMI (Vendor Managed Inventory) model and a model hypothesis (Lu Hai and Su Yirong, 2002). We could verify some differences between the models, but the most problematic consisted in information flow related to business relationships.

It is important to have in mind that information has become the most essential part of the logistics system and has the ability to determine the position of logistic provider in the logistic scheme. The authors sustained that there isn't one logistic system that couldn't be included at least at one of the models previously mentioned. The last one, model hypothesis, stands out from the others since it is more related with answering the third sub-question ("What kind of improvement can be made on the inbound logistic system and how will it be after improvement?).

Secondly, the parameters, that are acting actively in inbound process, were defined by the authors in order to assist the logistic corporation to discover ways for better severing the inbound process. From the logistic operational perspective, the parameters are chosen with the purpose of measuring quantitively the logistic performance, while from the supply chain perspective they were selected to evaluate the final result of the entire chain. Thus, these parameters were introduced to evaluate the effectiveness and efficiency of inbound process.

With the aim to find the answer to the final sub-problem, the authors made a strict analysis of the current inbound logistic system and came to the conclusion that "a logistic company has the capability to be an extension of the supplier or OEM" (as cited in Lu Hai and Su Yirong, 2002, p. 99). The main goal is to fully integrate all channel members in order to increase efficiency and reduce costs.

The supply chain operation reference (SCOR) model facilitated the analysis and evaluation of existing cases. With this help, it was able to verify that there were many obstacles between the OEM and logistic provider and not even the VMI model could avoid these issues, so balancing the responsibilities within the supply chain was required. All these ideas were summarized in the model hypothesis and then a case study (Alps-Schenker-Volvo) was used to illustrate the merits of the model.

For many years, integration of the supply chain has been a dominant and compelling facilitator across a wide range of industries and, consequently, a lot of the main supply chain concepts and principles have been put into practice in a much more effective way. This concept includes: information sharing, multi-party collaboration, design for supply chain management, postponement for mass customization, outsourcing and partnerships,

and extended or joint performance measures (Lu Hai and Su Yirong, 2002). Companies are solving problems in a high innovative way due to the information technology, which accelerated the adoption of these core supply chain principles.

After the many interviews that were made to suppliers and OEMs, it was possible to conclude that there are challenges between channel members when it comes to managing supply chain relationships. The biggest obstacle is often initiated by the OEM because they refuse to be in contact with many people, they rather find a company responsible for its logistics and supply affairs so they can talk to just this person in order to simplify its working procedures and focus more on its core competences (Lu Hai and Su Yirong, 2002). To guarantee the success of inbound logistics, it is implied that developing a trusting relationship with supply chain partners is required.

In order to implement a supply chain strategy, one must evaluate how the links in a supply chain fit together. According do Lu Hai and Su Yirong, "Supply Chain Management (SCM) does not so much require the employment of a specific technology or solution as it demands an understanding of the business processes that must work together" (as cited in Lu Hai and Su Yirong, 2002, p. 101).

Information technology has provided new possibilities for most companies, namely e-business or the internet computing model (simulation tools which have been developed in Schenker 4 rooms). These components have emerged as the most enabling supply chain integration tools (Lu Hai and Su Yirong, 2002). This helps businesses gain global visibility beyond their prolonged network of trading partners and, also, allows them to respond quickly to changing business conditions. Also, the scoring model is very helpful to the companies since it can locate problems in their supply chain and provide them with more effective solutions to improve their business process.

Supply chain management solutions will typically include for example, material sourcing, forecasting, warehousing, inventory planning, transportation, purchasing, and financials (Lu Hai and Su Yirong, 2002). Enterprises, its customers and suppliers must accomplish supply chain integration and processes within all these corporations must be evaluated and updated in order to meet efficiency and logistical expectations. Most organizations can include more dynamic, collaborative communication networks in their offerings through information visibility.

Ultimately, a model hypothesis was proposed to improve overall efficiency and reduce the cost through centralization of through centralization for inbound supply integration, while it still needs both OEMs and 3PL industries to work hard to improve confidence in their ability to cooperate (Lu Hai and Su Yirong, 2002).

Since the research questions have been answered, solutions have been investigated and formulated to improve the efficiency of inbound logistics processes and even a model has been proposed to accomplish this, it can be considered that the purpose of this thesis has been fulfilled.

References

Fisher, M.L., Hammond, J.H, Obermeyer, W.R, Raman, A.,1994, "*Making supply meet demand in an uncertain world*", Harvard Business Review.

Francett, B, 1996, "*The synchronized supply chain: from connectivity to commerce*", Software Magazine, 113-16.

Fraser, J, 1998, "*Demand management works even if the forecast is wrong*", Midrange ERP, 58-60.

Fraser, J, 1997, "*Synchronization: more than a buzzword*", APICS – The Performance Advantage, 76.

Gaffron, M., 2001 *"Redefining.logistics.com- A true paradigm shift"* Schenker AG, Presentation on Oct. 09, 2001

Gophal, C., Tyndall, G., Partsch, W., & Kamauff, J. 1998 *Supercharging Supply Chians: New ways to increase value through Global Operational excellence*, New York, Johon Wiley & Sons, Inc.

Harlend, D., Scharlacken, J.W, 1997, "*Global supply chain planning: synchronizing operations and logistics with the pulse of the international marketplace*", 1997 Conference Proceedings, American Production and Control Society.

Harrington, L. 1995 *"The Best Offense is a Good Defense*," Inbound Logistics, January1995

Henrik Anden, Klas Eliasson, 2001, *"Vendor Managed Inventory", Siminar Project of Logistics Concepts,* Mop, Chalmers University, Autumn 2001. Siminariearbete: 2001:11

Hieber Ralf.,2002, *Supply Chain Management*, Zurich, vdf Hochschulverlag AG. Hoffman, K. C, August 2000, "Just what is a 4PL Anyway?" Global logistic & supply chain strategies.

Impact of Inbound Logistics on Design of Production System. (2009, June 3-5). *Proceedings of the 13th IFAC Symposium on Information Control Problems in Manufacturing*. Retrieved from https://www.sciencedirect.com/science/article/pii/S1474667016340617

Introducing an effective inbound logistics concept to the automotive industry. (2014, November 18). *Preparing a Milk-Run – transportation plan for Valmet Automotive Ltd.* Retrieved from https://www.theseus.fi/bitstream/handle/10024/85435/Tuomola_Emmi.pdf?sequence=1

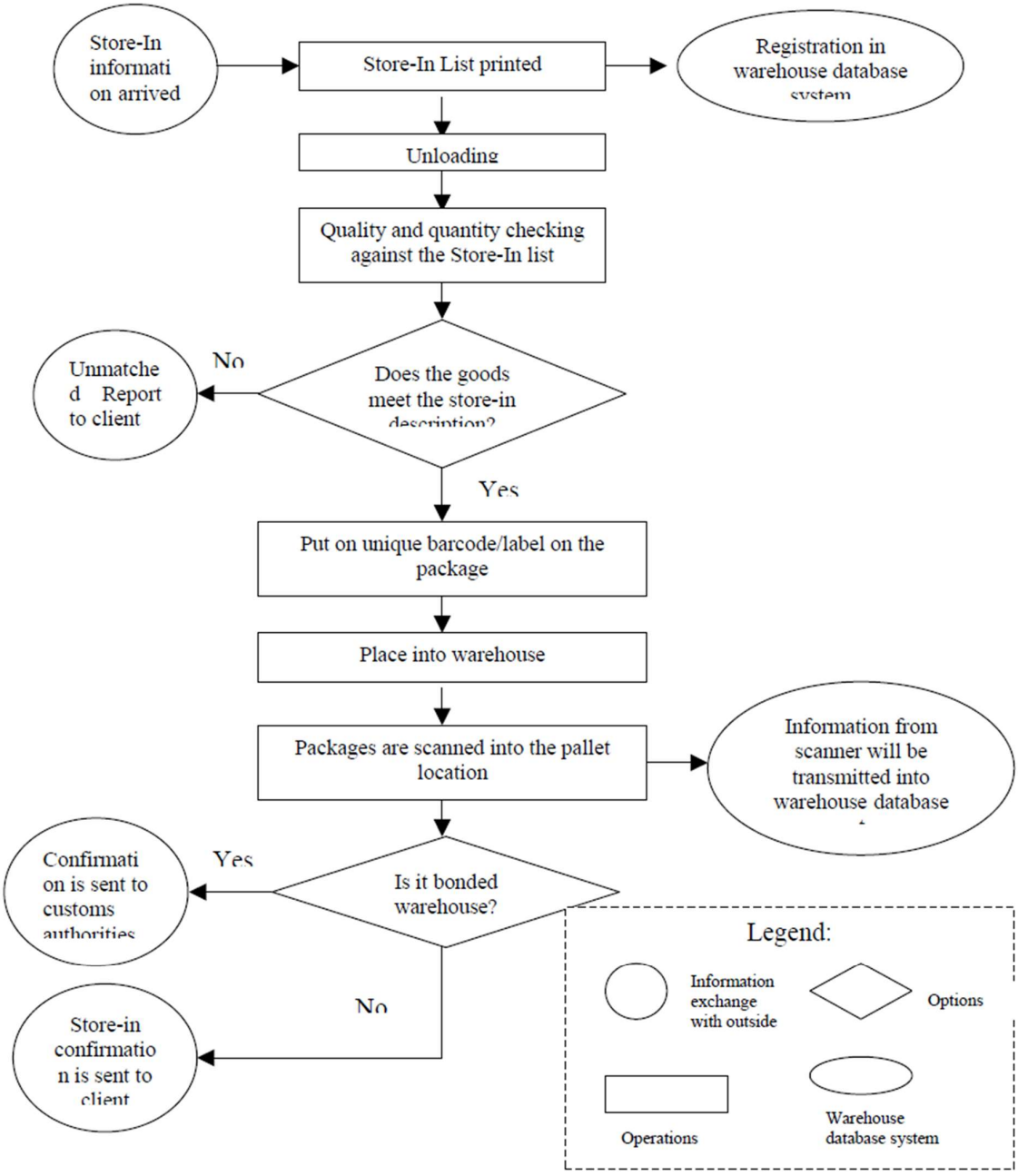
Lambert, D.M., Stock, J.R. and Ellram, L.M., 1998, "*Fundamentals of Logistics Management"*, Boston, MA: Irwin/McGraw-Hill, Chapter 14

Optimization of the inbound process at Wavin NL. (2016, June 30). *Dealing with variability from dock to stock.* Retrieved from https://essay.utwente.nl/70400/1/Boeve_MA_BMS.pdf

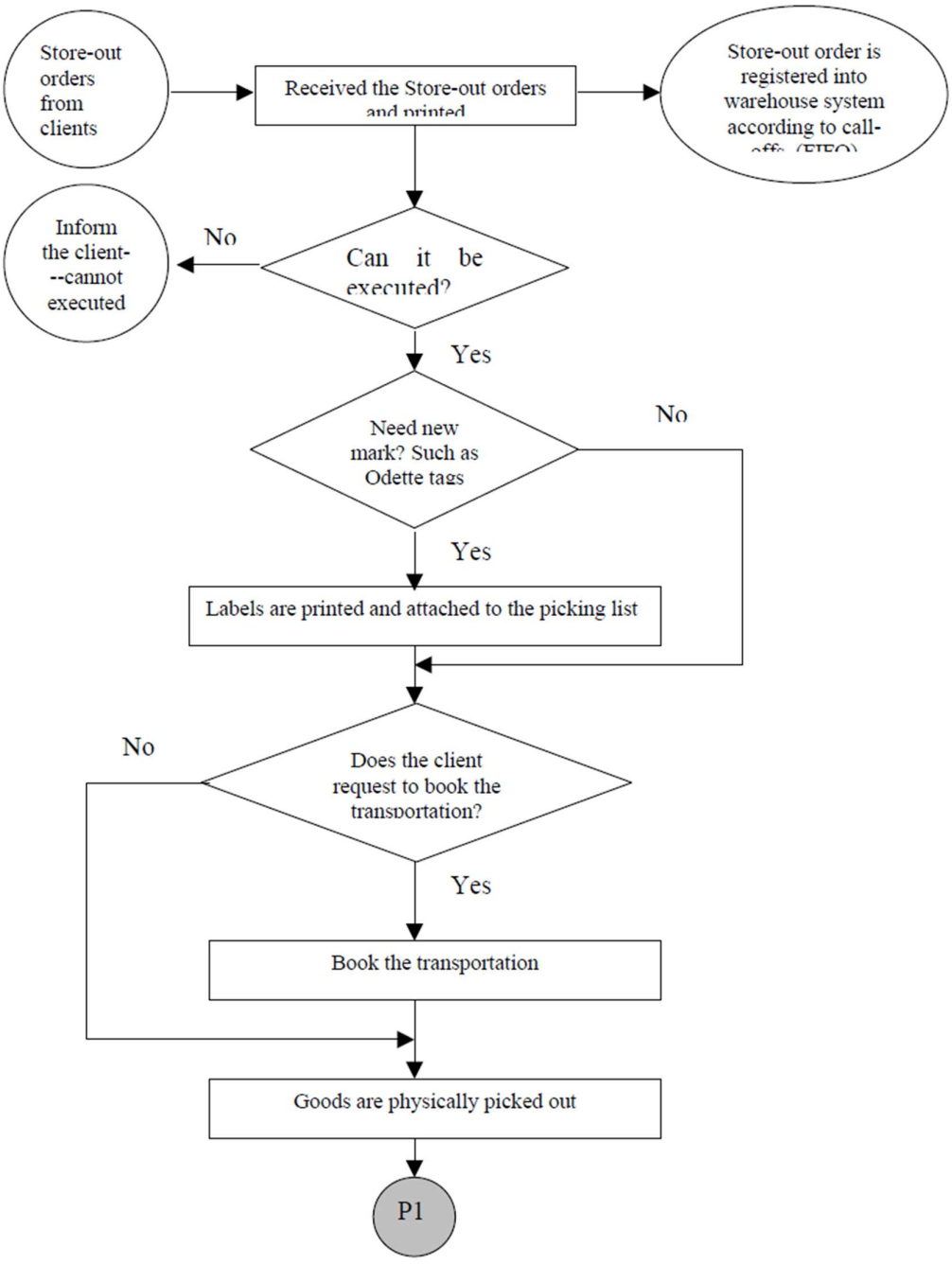
Supply Chain Management (2016, May 4). *Importing Footballs from Pakistan*. Retrieved from https://www.theseus.fi/bitstream/handle/10024/111218/Bilal%20Hafiz%20Muhammad.pdf?sequence=1&isAllowed=y

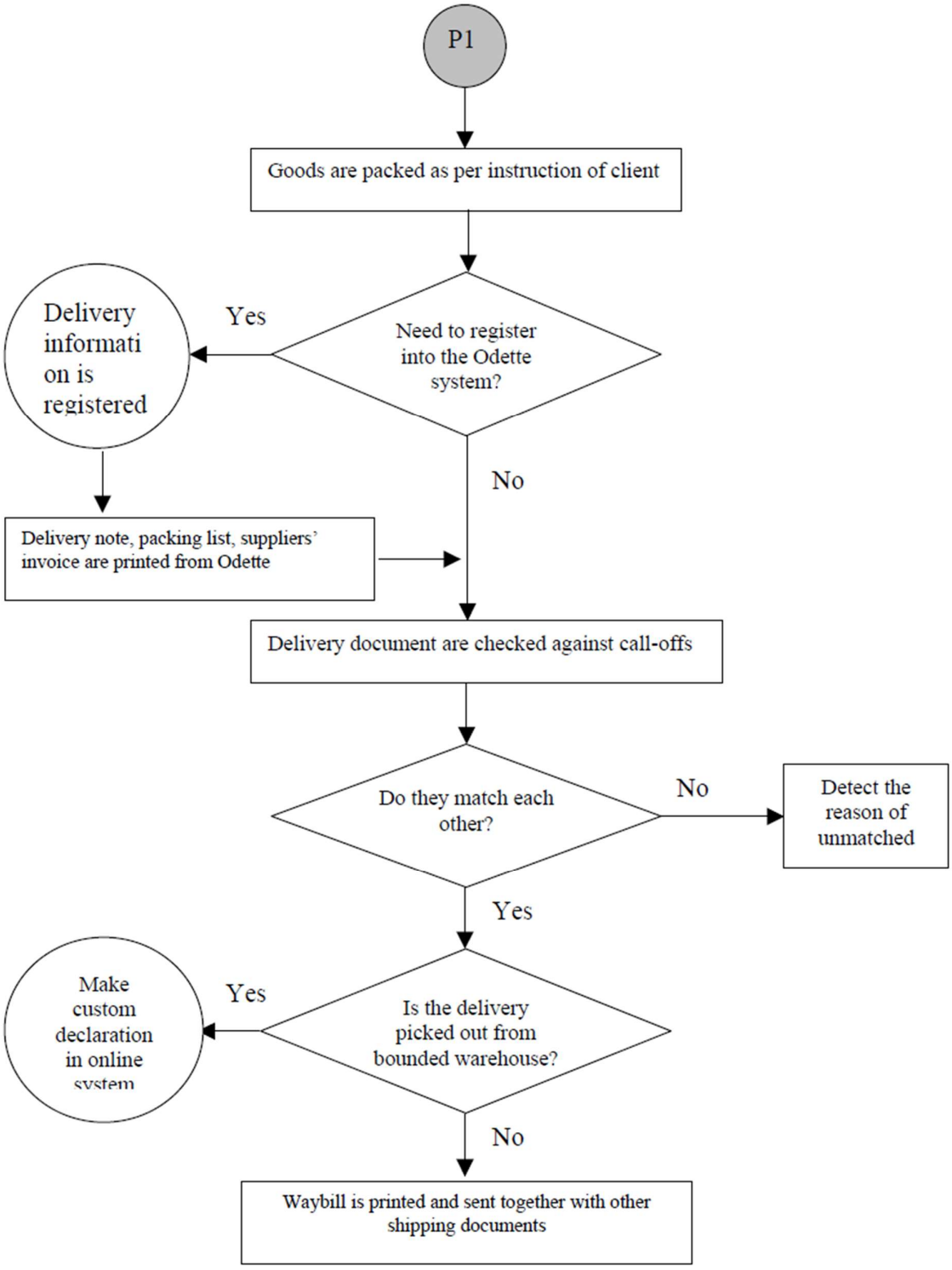
Appendixes

Appendix II A: The Store-in Process of Schenker International Warehouse

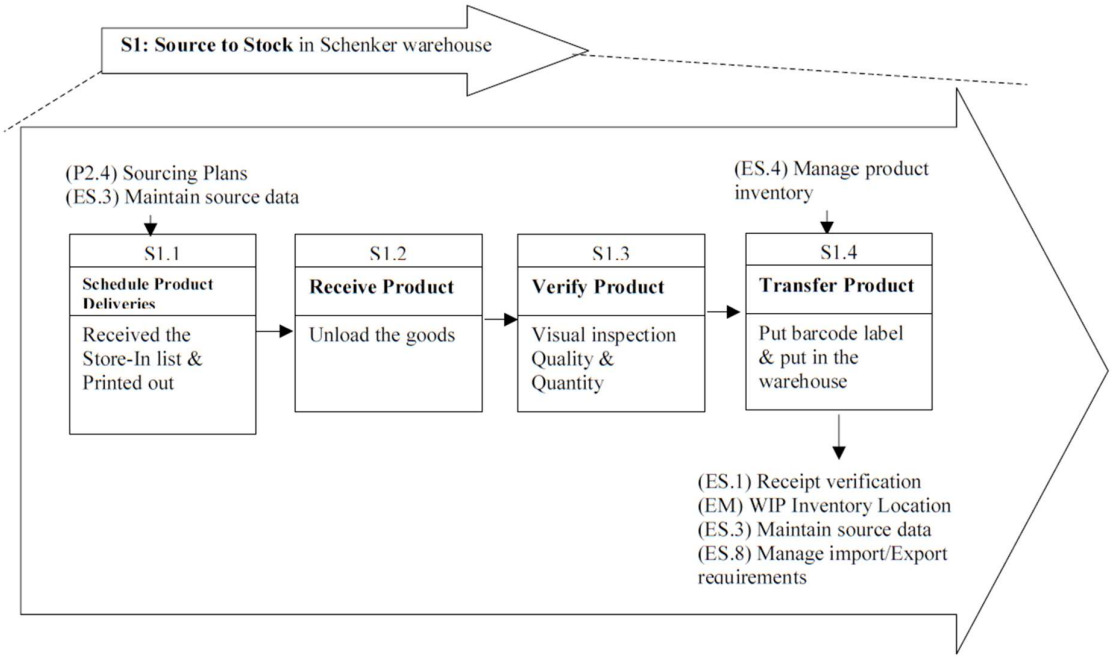


Appendix II B: The Store-out Process of Schenker

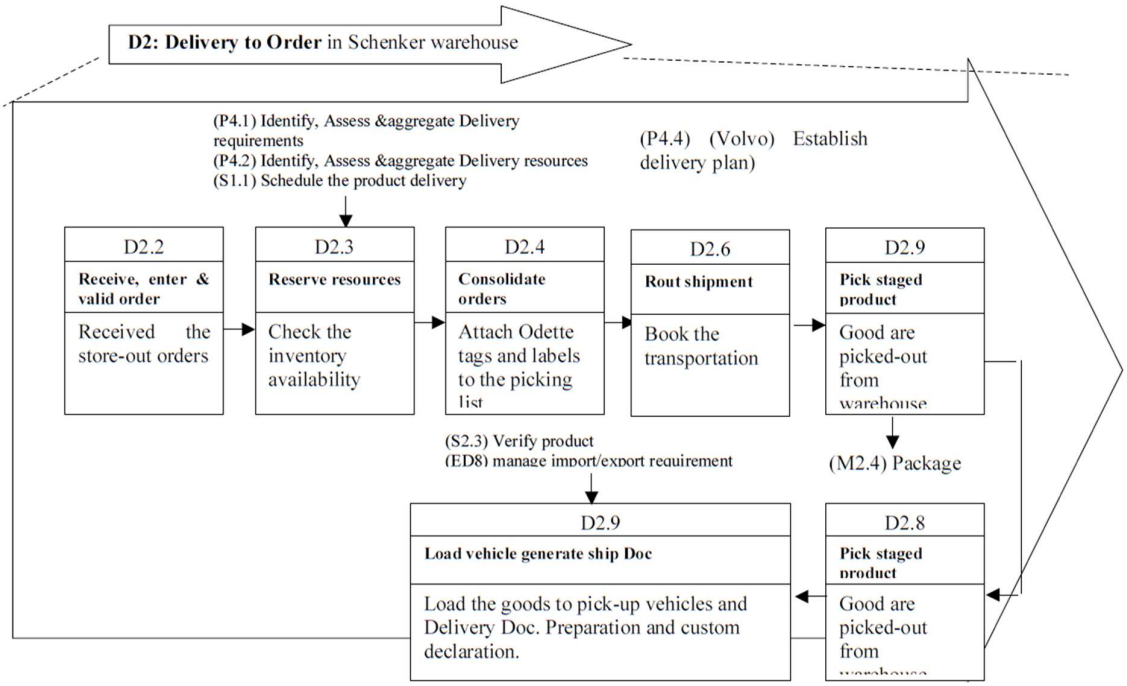



P1
Goods are packed as per instruction of client
Need to register into the Odette system?
Yes
Delivery informati on is registered
No
Delivery note, packing list, suppliers' invoice are printed from Odette
Delivery document are checked against call-offs
Do they match each other?
No
Detect the reason of unmatched
Yes
Is the delivery picked out from bounded warehouse?
Yes
Make custom declaration in online system
No
Waybill is printed and sent together with other shipping documents

Appendix IIIA: Decompose the "Source to Stock" Activities in Schenker W/H



Appendix IIIB: Decompose the "Delivery to Order" Activities in Schenker W/H



Chapter 2

The role of design management methods and styles in increase of the productivity[2]

Cravo, Marco

Abstract

The present article will manifest the original study concerning a new approach to the optimization of business productivity in a short-term returning range through specific internal and external analysis, flexible work processes and design management implementations. Therefore, the focus on this study will be about the maximization of the outputs enabled by the business's human capital. Given the particularities needed throughout the system implementation, the swot matrix analysis will be company specific and therefore, although generical descriptions for styles and methods will be provided, those selected will concern specific corporation needs. The synergic optimization will furthermore show a productivity surplus and advance the communication processes within the company as well as the individuals and groups autonomy, enabling cross-functional teams to mid-manage business processes and projects. The investment to productivity ratio regarding the actual market and economical situations should uncover useful management tools. Concluding this article, my authorship's statistic control of processes insertion on human capital operations will be presented, therefore aiming to change the way operational management is done.

Keywords: Audit process, maximizing the utility of clients and auditors, preventive measures, minimization of errors

[2]This paper is based on Hantsuk, N. (2018). The role of design management methods and styles in increase of the productivity (Master's thesis). European University of Lisbon.

1 Introduction

Modern business managers have increasingly higher concerns facing the crowded supply markets and rigorous benefit demands to provide superior value notwithstanding a lower production cost. Such contingences have led several corporations to close the doors. Competitive advantage through productivity has been a long-wanted attribute for companies in general, nevertheless, achieving that may actually be a very defying, complex, costly proposition. The maximization of the output to input ratio may lead to several forms of restructure and technological obsolescence guides productivity through capital demanding maintenance, additionally, settlements for productivity are usually mid/long-term attainable. Allow my freehand approach towards up-to-date economical context to thrive upon the virtualization impacts within the supply chain and consumer value delivery, may those foundations also unveil productivity as core economical differentiation and therefore advantage, meaning that margins are being pressurized and work rate improvement is subdued to inflammable relations between investments, production, sales... leading us back to conclude that capital acquisitions, equipment discontinuance, market speculations, provide mechanical productivity with the weights mentioned earlier. Marketing developments within the firms expand profit margins for the well succeeded and increase sales, therefore can easily solve corporation's needs, right? Well... marketing sees itself as company’s blood, so whether we are hiring, investing, producing, rationalizing processes, marketing claims to claim the profits, for that reason let us consider marketing as brand reputation, product promotion and synthesize its existence to advertisement, therefore, sums up the conclusion for defying, complex, costly, mid/long term returnable productivity as well.

This article will not debate restructure, technological investments nor any aspects of the actual equipment productivity concepts for that matter. This study suggests an increasement of productivity by way of design management styles and methods application. Such implications urge to satisfy global company crisis needs for significant, uncostly, short-term attainable productivity. Throughout the article practical application evidences will be hand to hand with the theoretical foundations for this type of productivity optimization.

Human capital resources expenses are usually the first discarded variable addressing the under crisis need for higher productivity, unfortunately, such management decisions may incur work teams to feel stressed, demotivated, and result in an overall per man hour productivity decrease, plus the loss of quality constrained, therefor, the study’s explanation for human resources to actually be maintained and productivity and quality levels increased using proper design management styles and methods is worthy of reflection. Furthermore, economical deductions show us that marginal productivity graphs are downwards parables and companies should operate between the maximal marginal productivity and maximal average/production (fig.A), may we conclude then, that decreasing labor capacity will, at a certain point, prejudice business's capability for optimal productivity, meaning that those expenses cuts although may release some tax and operational costs will, in sum, lead to poorer performance, poorer quality,

poorer competitive supply, poorer revenue... (adapted from Microeconomy I) On the other hand, applying design management styles and methods will combine optimal production capability and productivity outputs without, and for the contrary, restrain or diminish corporative goals, missions, nor raise business's weaknesses nor treats.

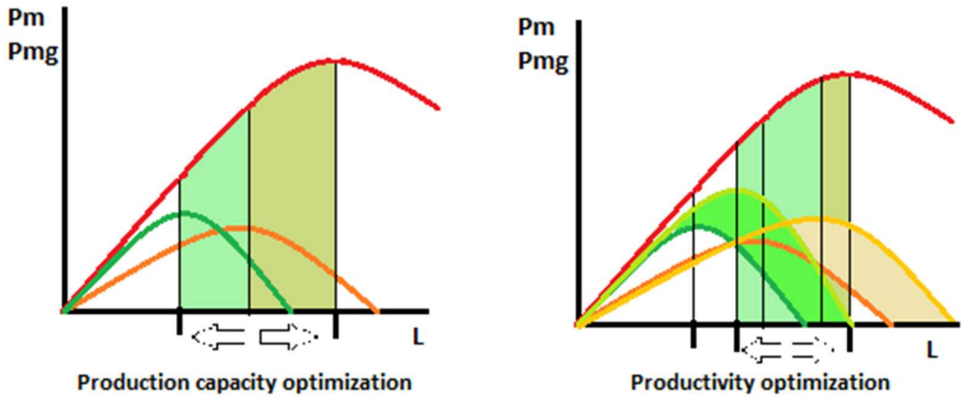


Fig. A – beneficial areas for business operation for the same production and optimized productivity.

An agency of marketing services will be subdued to the authors study so that the theoretical system may be analyzed and conclusions may be taken, nevertheless, more subjective and wide characteristics for design management methods and styles will be explained in order to analogically proceed towards other circumstances presented and effectively increase productivity, service quality and therefore business growth.

The comprehension of this article will require some kind of management theoretical reflection background towards better understanding of the contemporary importance since no authors are being referred for this introduction, nevertheless, logical reasoning is always constrained to the observations being made and clear definitions inhibit otherwise controversy topics. On my knowledge so far, objectives and significance upon this theme were described, therefore further structural content will incise within the parameters of the application of management methods and styles with special control implementations for conclusion.

2 Literature review

The master's thesis will devout arguments and observations quite often around the company's individual characteristics, however, although the implications adjacent to marketing services study may form a narrow field of sight, analogy through equal departmental segmentation will insight for further operational needs for improvement. That being said, the author's literature (Hantsuk) will be reviewed along a wider scope without concealing any necessary information for the understanding of the conclusions being taken. The inferences of obtaining results from a service company in order to draw generic operational productivity conclusions may seem insufficiently relevant, yet, may we observe that the results will not be

altered by equipment volatilities nor process delays, therefore the results of proper usage for design management styles and methods will incise only upon human capital usage towards output maximization.

Since some theoretical authors used in the study are russian, unpronounceable therefore, and some others theories are now a days, let's say, management common sense, those will be omissive, nevertheless, renown names such as Hay-Macber, Peter Drucker, Tom Peters, Robert H., Aeker, Lewin and Ruch will be referred for their impacts in the following study. Marketing principles, Microeconomy references, Management foundations and Production Management characteristics will be approached in order to deliver productivity-based knowledge within all processes of design management methods and styles for the purposes intended and furthermore conclusions.

Such endeavors towards obtaining human capital performance increasements have been, so far, individually dealt with, meaning that there’s no extended step-methodology previsions for the sector optimization and the focus for those implementations have been surrounding the concepts of organizational efficiency and/or effectiveness, and after all, all company's departments conclude to one single agglomerate, the firm, nevertheless, the maximization of human processes should include more than making a firm sustainable or provided with delivery capability for objectives, so, quantifying human resources as for their productivity will not only optimize the human labor within, but also boost the competitive advantage as individual units or as a whole. The existing compartmentalization of the theories involving managing human capitals inhibit proper measurement of the added value of the premise's implementations and so for, it’s an important aspect to unify.

The step-methodology will be decisive for gathering the so searched productivity surplus as for instance, there won’t be any significant increasement in productivity if the required implementation parameters are discarded or if such implementation parameters are not required for the specific firm, nevertheless, attention to details will definitely payoff in the business run, considering that 1% productivity gain in every human department can result in an overall productivity maximization of 25%, for the sake of a 25 units firm.

Concluding these aspects, it’s important to announce that the implications of controlling such achievements will allow the management of human stocks to further evolve along our chronological progression and grant a continuous delivery of the attained results or improvements for that matter, synthesizing such evolution in matters of unifying the theoretical principles towards empowerment of results, quantifying the results in more concrete terms, using human productivity as to accentuate competitive advantage and metamorphosing into attaining controlled, or at minimum, controllable parameters concerning our initial focal intuit for human operational management.

3 Approach

In order to efficiently approach design management styles and methods it’s required to understand firstly how the company is positioned in the market, how the structural dynamics

apply to personnel, what's the brand positioning, value... what are the objectives of the firm, in other words, the author suggests a primary marketing analysis. Well, and whether we are consulting or managing a specific firm, its crucial to know what is the company valuing and how is the company solving (past, present and future) internal or external problems.

On the subdued firm, PRkvadrat, primary marketing analysis revealed good prospects for future markets, philanthropical beliefs, sense of community, overall holistic processes, and structural functioning was noted. On this stage, tracing employees' profiles will be important for subsequently defining which design management strategies will be used, for those will differentiate accordingly to the type of psychological and functional profiles of the assigned work teams. In comparison to non-service-based companies, staff teams are equally assigned multiple different tasks and labor groups that can also improve correspondent productivities based on their leader's or manager's profile as well as their own through the implementation of the same design management styles and methods discussed by the author.

Perceived data may be further rooted through an internal process analysis since the reasons may vary along a wide cause spectrum, and since design management methods affect improvable human capital units it is needed for effective operational improvement to consider all business's weaknesses and strengths and further correlations to define which incision points will actually strengthen operational processes by the authors management methods application through swot matrix analysis. Therefore, inner cultural research will show if the definitions for objectives is properly set, value review enables the understanding of the in/existing interrelationships promoting, through inspection of targeted client efficient production direction can be judge, main competitors preview will bring up subdued market influences, pricing policies provide operational range and, analyzing profitability allows conclusions about the company growth throughout.

Strengths:	**Weaknesses:**
- Good current position on the market.	- Tax debt
- Well-known international clients.	- Low trust of clients
- Price positioning is competitive.	- Low trust of employees
- Experienced business units.	- Inefficient international team communication
- Existing distribution and sales network.	

Fig.B - Conclusions for swot matrix analysis on strengths and weaknesses for the subdued business.

Analysis through swot matrix will proceed gathering motives for further design management system application. External factors examination will provide intel towards macro traits that may be affecting or promoting previous perceived data, needless to say, extensive considerations and afterwards correlations will be crucial to define the previous mentioned incision points on which operational processes will be strengthened. Accordingly, policy view determines activity restrictions, economical context manifests market status, social approach uncovers consumer behaviors, technological observation shows progress levels, legal

parameters acknowledge taxations, competition notes allow placement considerations, market insertion provides growth predictions and, segment analysis will infer particular constrains.

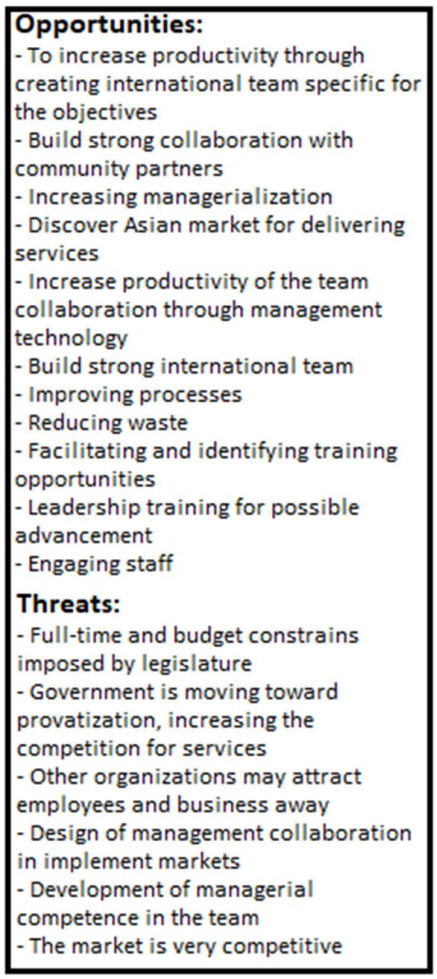


Fig. C - Conclusions for swot matrix analysis on opportunities and threats for the subdued business.

4 Methodology

Corporative contemporary pandemical needs for productivity require interdisciplinary associations with operational management towards resolution regardless of what the term operational may mean in means of processes for conclusions. Therefore, the early on microeconomy approach enabled an understanding of how inefficient, unsustainable, human capital reductions can be, leading us to marketing observations towards the specificity of the businesses engaged, lather on, a more psychology field of analysis made possible profile tracing for work teams, and then, the usage of marketing management swot matrix analysis led us to obtain incision points for improvement action. For that reason, nothing more should be expected than requiring another branch of knowledge towards operational productivity increasement goal. Introducing, design thinking characterizes an innovative, human-centered field of action, through consideration, design management applies “project management,

design, strategy and supply chain techniques (Definition, 2010)" through tactical and strategical levels, centralizing businesses strategy processes and interrelating departments, as reported by Hantsuk's literature, therefore providing functions, styles and methods which will improve operational productivity, quality, and communication as the ones presented by Hantsuk's study.

Styles:	Efective when:	Styles:	Efective when:
Directive	Unexperienced team Close deadline Deviations are risky	**Paceseting**	Manager is expert Close deadline Highly professional team People are highly motivated Litlle direction required
Auturitative	Established client Long-term project Clear directions and standerds Leader is credible	**Coaching**	Skill development Motivated imployees Medium deadline project Creative project Multitasking team members
Affiliative	New company Mixed with others styles Routine tasks Managing conflict Low work load	**Hybrid**	Long-term team Complicated projects Long-term projects Motivated employees Multitasking team members Skilled manager
Democratic	Employees working togheter Staff have experience and credebility Steady working enviornment As part of team building		

Fig. D – Hay-Mcber's key leadership or management styles

Hay-Mcber's pallet for management styles will allow us to partially perceive which implications the previously obtained employees' profiles have and will be having on current human capital operations if not corrected, and allows us to robotize human recourses that should not be hired for position filling but as a multifunctional, improvable "equipment", therefore making us able to proceed accordingly to firm's goals and values and optimize living variant beings' productivity through the "specifications manual template" (editable) provided by Hantsuk's study.

Operational management characteristics are now subliminally appearing as we begin the qualifying procedure and thus important, walk towards influencing through decisions the outcomes for an input otherwise characterized as "soft" data. There are huge implications for the ways planning, organizing, leading and controlling human operational recourses will be made acknowledging these processes, not to mention the competitive advantage that can be brought up through such management. Nevertheless, design management is not yet fully perceived, therefore, may we approach management methods for they will be another important part of design management.

Workflow characteristics	Management Style Name						
	Directive style	Auturitative style	Affiliative style	Democratic style	Pacesetting style	Coaching style	Hybrid style
Comfort of the office team	-	+	+	+	-	+	+
Comfort of the international team	-	+	+	+	-	+	+
Effective of distance	+	-	-	+	+	+	+
For Short-term project	+	-	-	-	+	-	+
For Long-term project	-	+	+	+	-	+	+
For Extreme Deadline situation	+	-	-	-	+	-	-
Conflict resolution	-	+	+	+	-	+	+
Effective for young team	+	+	+	-	+	+	+
Effective for professional team	-	-	+/-	+	+	-	+
Multitasking members of the team	-	+	+/-	+	+	+	+
Narrow-focused team	+	-	+/-	-	-	+	+
Problematic team	+	+	+	-	+	+	+
Strong Moderation of Manager	+	+	+	-	+	+	+
Low Moderation of Manager	-	-	-	+	-	-	+
New client	+	-	-	+	+	-	+
Established client	-	+	+	+	-	+	+
Increase professionalism of the team	-	+	+/-	+/-	+	+	+
Increse productivity	+/-	+	+/-	+	+	+/-	+
Increase motivation	-	+	+	+	+/-	+	+
Improve emloyee vision of the company	-	+	+	+	+	+	+
Reduce cultural difference	-	-	+	+	-	+	+
Steady to external changes	-	-	+	-	+	-	+

Fig. E – Effectiveness of the management styles for the studied firm.

Peter Drucker's management by objective method implies direction through previously set objectives between all managers and afterwards managers/employees, giving each member the power to evaluate the ongoing processes and therefore improve under manager's coordination. Tom Peters and Robert H. Waterman's walking around method allows short-time problem solving, focus improvement, relationship building, efficiency, guidance through processes and therefore creates a positive environment that grants the manager up-to-date information.

Method:	Effective When:	Method:	Effective When:
By objective method (MBO)	All members include in the objective process Employees are not motivated Multitasking team members Skilled manager	**Total quality method (TQM)**	Strengthened competitive position Adaptability to external changes Higher productivity Enhanced market image Elimination of defects and waste Increased client loyalty and retention
By walking around method (MBWA)	Complicated project International team Members don't follow deadline Problematic team New team High proficient and friendly manager Need to improve efficiency	**Scrum method**	Respectfull team Commitment to work as a team Long-term / short-term projects Client colaboration Daily plan/ sprint planning meetings Transparent work process Responsive to changes

Fig. F – Management methods and effectiveness (compiled).

Aaker's total quality method pivots around continual improvement procedures therefore increasing motivation and objectives maintenance through costumer-focus, total members involvement, process-centralization, systems integration, systematic approach, communication and fact-based actions. Scrum method enables meetings for self-organized teams to manage priorities through sprint procedures, demanding therefore, commitment, courage, openness and

focus as the author sugests. Hantsuk's study also provided another "specifications manual template" (editable).

Lewin's change management model will be an important procedure since, as refers, unfreeze stage will demand communicating why change is needed and addressing concerns/plans, change stage will require members empowerment towards embracing application, and finally, refreeze stage will provide changed company culture that can always be analyzed for further improvements.

Workflow characteristics	Management Method Name			
	Management by Objective Method	Management by Walking Around Method	Total Quality management Method	Scrum Method
Comfort of the office team	+	+	+	+
Comfort of the international team	+	-	+	+
Effective of distance	+	-	+/-	+
For Short-term project	-	+	-	+
For Long-term project	-	+	+	+
For Extreme Deadline situation	-	+/-	-	+
Conflict resolution	+	+	+	+
Effective for young team	+/-	+	+	+
Effective for professional team	+	+	+	+
Multitasking members of the team	+	+	+	+
Narrow-focused team	-	+	+	+
Problematic team	+/-	+	+	+
Strong Moderation of Manager	+/-	+	+	+
Low Moderation of Manager	-	-	-	+/-
New client	-	+	+	+
Established client	+/-	+	+	+
Increase professionalism of the team	+	+/-	+	+
Increse productivity	+	+	+	+
Increase motivation	+	+	+	+
Improve emloyee vision of the company	-	+	+	+/-
Reduce cultural difference	-	-	+	+
Steady to external changes	-	+	+	+

Fig. G – Effectiveness of the management methods for the studied firm.

5 Results analysis

Towards analogical procedures we need to understand that design management will be the linking point between the previous possibilities for improvement and the actual implementation settings, therefore, results and further controls will vary accordingly to design configurations.

		Office team	Compound distance team
Normal timeline Workflow	Management Style	Hybrid Style	Hybrid Style
	Management Method	Total Quality Management	Scrum
Extreme Deadline situation	Management Style	Directive/Pacesetting styles	Directive/Pacesetting styles
	Management Method	Total Quality Management	Scrum

Fig. H – Design management styles and methods results for the study's corporation.

In order to analyze results, we need to establish a measurement and the field of analysis, otherwise it could be “an overall positive result”, therefore, concluding our operational management concern, we will measure productivity. Such implication urges us to quantify and understand how productivity can be obtained, so, Ruch’s literature insights for the importance of the controllability of parameters, mentioned earlier, and specifies further possibilities to control productivity, such as, task capacity, individual capacity and individual efforts, furthermore, insights about productivity correlations throughout the business’ operations. Let us be aware that through design management styles and methods we will be improving the departure point of productivity, meaning that all sectors of productivity attaining will be proportionally improved through such proper applications.

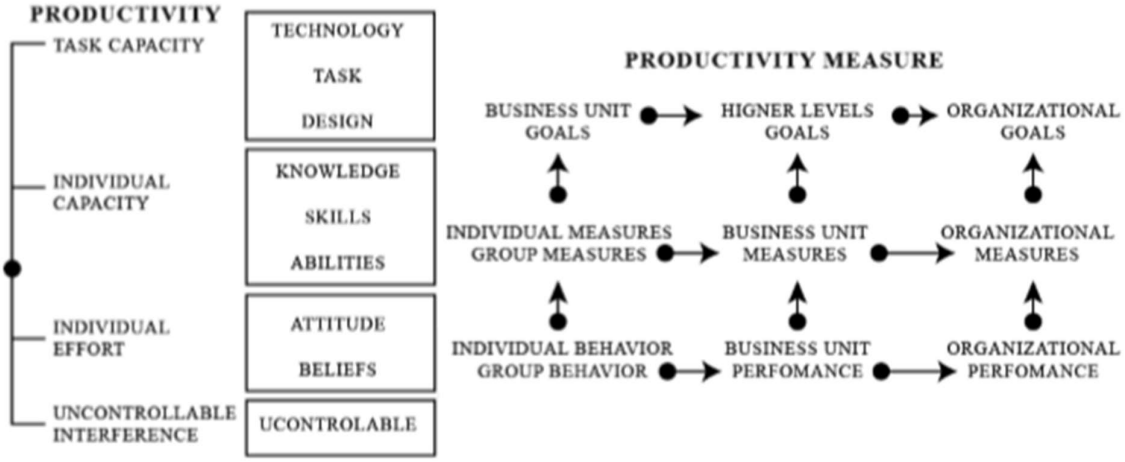


Fig. I – Productivity measurement system and components (Ruch 1994, adapted).

The hantsuk’s study suggests, for this specific company and circumstances, quantifying the outputs on a scale from 1 to 5 and the performance inputs accordingly to objectives assigned to sectors.

A	Account service	Weight	Evaluation	Weighted Score	Comments
1	Account manager's service level (i.e. Speed of service provided, Operational excellence)	10%	5	0,50	
2	Understanding of work scope requested by Client (project planning)	5%	5	0,25	
3	Professional capability of Agency's team members	10%	5	0,50	
4	Documentation Flow (i.e. budgets, approvals) & Ease of Communication	5%	5	0,25	
5	Accuracy of documentation & invoicing in accordance with Client process and procedures	5%	4	0,20	
	Total	35%		1,70	
				-	
B	Strategic planning	Weight	Evaluation	Weighted Score	Comments
1	Understanding of Client	5%	5	0,25	
2	Understanding of Client's business	5%	5	0,25	
3	Able to propose integrated communication strategy delivering great effectiveness	10%	5	0,50	
4	Able to propose effective strategy to support Business growth	10%	5	0,50	
	Total	30%		1,50	
C	Creative	Weight	Evaluation	Weighted Score	Comments
1	Ability to bring new programs to build positive corporate image of Client	5%	5	0,25	
2	Demonstrate "Out of Box" thinking in all forms	5%	5	0,25	
3	Demonstrate great understanding of available communication channels as well as upcoming trends	10%	5	0,50	
4	Demonstrate creative proposal to address business growth	5%	5	0,25	
	Total	25%		1,25	
D	Design	Weight	Evaluation	Weighted Score	Comments
1	Ability to understand the Brand Language of the client	5%	5	0,25	
2	Demonstrate creative design proposal	5%	5	0,25	
	Total	10%		0,50	
	Final Score	100%		4,95	

Fig. J – The study's subdued firm's team results.

Team: Office team

Management style: Hybrid

Management method: Total Quality Method

Implementation of design management styles and methods allowed this team to increase productivity to an evaluation of 4.95 (scale per objective), let us consider previous results with average evaluation of 4.25, then calculating the improvement ratio we can conclude that productivity for this team as increased 16,5%. Unfortunately, for the present case, teams work with budgets, therefore, it's not appropriate to consider monetary outputs for they will change accordingly to the size of the job or complexity requested by the client, knowing that such parameters do not depend on the team's productivity there is no logical correlation with such measurement and through the same reasoning may we conclude that time outputs will not be appropriate as well, for the tasks performed are always different and as we all know, unequal things require unequal time consideration throughout. As for the inputs, for the exact same reasons mentioned, time and money cannot be considered on this case.

A	Account service	Weight	Evaluation	Weighted Score	Comments
1	Account manager's service level (i.e. Speed of service provided, Operational excellence)	10%	5	0,50	
2	Understanding of work scope requested by Client (project planning)	5%	5	0,25	
3	Professional capability of Agency's team members	10%	5	0,50	
4	Documentation Flow (i.e. budgets, approvals) & Ease of Communication	5%	5	0,25	
5	Accuracy of documentation & invoicing in accordance with Client process and procedures	5%	4	0,20	
	Total	35%		1,70	
				-	
B	Strategic planning	Weight	Evaluation	Weighted Score	Comments
1	Understanding of Client	5%	5	0,25	
2	Understanding of Client's business	5%	5	0,25	
3	Able to propose integrated communication strategy delivering great effectiveness	10%	5	0,50	
4	Able to propose effective strategy to support Business growth	10%	5	0,50	
	Total	30%		1,50	
C	Creative	Weight	Evaluation	Weighted Score	Comments
1	Ability to bring new programs to build positive corporate image of Client	5%	5	0,25	
2	Demonstrate "Out of Box" thinking in all forms	5%	5	0,25	
3	Demonstrate great understanding of available communication channels as well as upcoming trends	10%	5	0,50	
4	Demonstrate creative proposal to address business growth	5%	5	0,25	
	Total	25%		1,25	
D	Design	Weight	Evaluation	Weighted Score	Comments
1	Ability to understand the Brand Language of the client	5%	5	0,25	
2	Demonstrate creative design proposal	5%	5	0,25	
	Total	10%		0,50	
	Final Score	100%		4,95	

Fig. K - The study's subdued firm's team results.

Team: Compound international team

Management style: Hybrid

Management method: Scrum method

Design management styles and methods, when properly applied, are in fact a competitive advantage in productivity matter as we may tell, the compound international team's productivity was improved to 4.90 (scale per objective) which means there was a, significant, 15.3% improvement. This measurement may downsize its importance to some, but if there were, for the sake of an example, gathering potatoes teams, cleaning fields teams, mechanical services, sheet archiving teams, productivity measures could be €/objective, €/time, €/unit, time/objective, units/time, so on so forward... nevertheless, productivity index for this company was improved from 0.11 in 2015 to 0.31 on the present year, which means there was 181,2% productivity index improvement, although this article, through having a wider scope, may not have mentioned it concretely, this company is well placed in the market and was great client fidelization, to exemplify magnitude, they provide marketing services to Coca-Cola.

6 Conclusions

Managing human capital recourses properly is one off the most difficult achievements one can have, strategically we need to consider macro and micro correlations for improvement, tactically we should figure out how can our strategy be followed, operationally we must

consider our human recourses towards improving corporative operational units together with firm's goals, values and beliefs, furthermore, we are required to organize how, where and when are our living recourses being applied, even further, living equipment demands leadership through refinement and, not least, we need to be able to control. Control has not yet been approached even though it is an essential part of operational management, and for that reason we better figure out a way to control... To Control human operations, mathematically that is, may we consider the fact that we already have quantifiable data that can be analyzed, well, if we have a quantifiable, manageable output/input relation and we can use it across multiple operational sectors, well, we have nothing less than human machinery that allow us to know, through statistical control of processes, how controlled or capable our human operations really are. With that being said, after all this study's implications, we are able to apply control by variables and specifications control to our company's human capital.

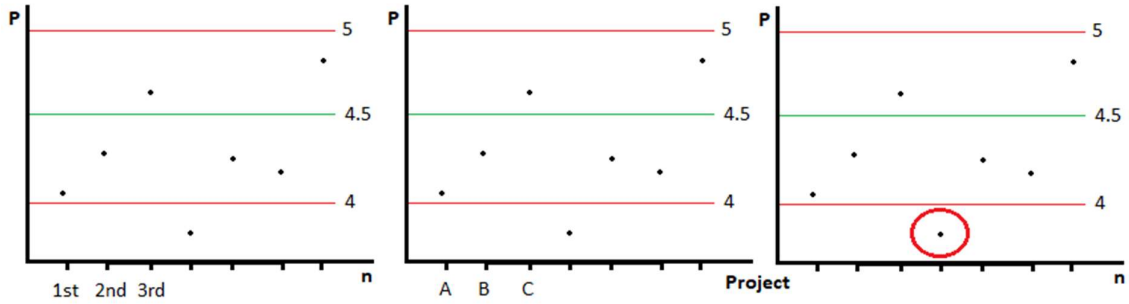


Fig. L – Productivity control by variables.

Control by variables method will let us know if our processes are controlled, we can apply it through overall operations for operational homogenization or we can use it to specific group's projects as in a more individual management style, therefore letting us know which teams are underdelivering or which projects/services were underdelivered and further address those problems. Furthermore, other implications can be observed, if a new labor group is being formed, through comparison we can deduct whether or not it is performing well or if we need to make adjustments in order to increase the group's productivity.

Specifications control method enables us to know if our processes are capable and, similarly to the application of control by variables method, we can subdue singular work group's projects or we can apply it through the overall services, therefore, we will be able to know if one group is consistently capable of the productivity levels expected or if the overall performance of the company's labor teams are consistent in productivity deliver. New labor teams being formed should not be included in the overall statistics, for they will be underperforming in early forming stages, group processes' capability will also be inconclusive, for there is expected statistical deformities throughout team building.

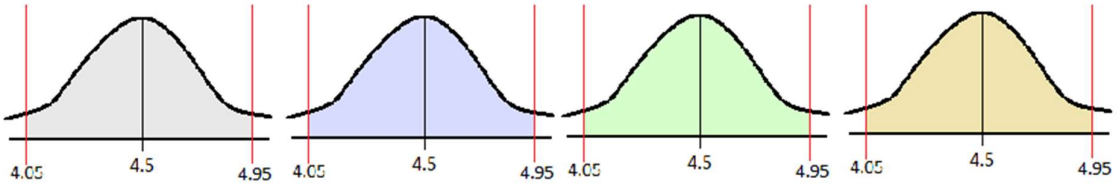


Fig. M- Productivity control by specifications method.

This type of control will allow us to keep track of our human operations productivity as company's human recourses, as company's human units and even as company's individual's productivity, therefore enabling acknowledging whether overall human processes result as competitive advantage or whether labor teams need improvements, and which teams need improvement and, within the teams, which members need empowering, furthermore, we are able to deduct how controlled are our human capital operations and how productivity expectations are being complied within all variants' dimensions.

This article showed how design management styles and methods will be inflating productivity, nevertheless there are multiple other ways task capacity, individual capacity and individual efforts can be, through incentives, increased, as for example, Herzberg's principles of vertical job loading implementation, as Argyris' double loop learning execution, as administrating philanthropical principles as formation, therefore, human operational management should be a particular field; with the introduction of human capital operations control, human outputs are no longer "soft" uncontrollable data, rather, living machinery.

Chapter 3

Nederman & Company: Progress Of Inventory Control[3]

Caires, Micaela and Morais, Patrícia

Abstract

Nederman wants to increase their supply chain efficiency through a clearable method that may improve their inventory control. The goal is to maintain the service level while the stock level decreases by predicting the future demand. Therefore, the mixed theory of different authors about inventory control is essential to support the whole thematic, as is the data provided for the enterprise. Due to the amount of data, the analysis has more quantitatively character complemented with qualitative information of the interviews that can relate with the theory presented. The solution suggested was the enhancement of the existing SS-bas matrices installed in the inventory systems the company possesses. Finally, it is concluded that the complexity of the range products can be enriched. It was also possible to identify four demand patterns and so the way the products were divided was capable to accomplish the goal of the firm in reducing the safety stock without affecting the service level. If the corporation intend to equally develop the service level is required an even more sophisticated system.

Keywords: inventory control, demand pattern, safety stock, service level, SS-bas matrices, inventory system.

[3]This paper is based on Arrelid, D., & Backman, S. (2012). How to manage and improve inventory control: A study at AB Ph Nederman & Co for products with different demand patterns (Master's thesis). Lund University.

1 Introduction

AB Ph Nederman & Co. is the stage for the application of some studies to improve inventory control. This enterprise focuses mainly on the safety systems that can improve the workplace environment and working conditions. Actually, it develops, produces and sells products, like air filtration systems and safety curtains, and offers full solutions (design, installation and servicing) to all facilities needing upgrade their workplace.

Nowadays the inventory control seems easier due to the fact of the creation of inventory systems installed in the warehouses. However, is always possible to make better results, bringing a competitive advantage coming with an expensive price once it needs to invest in their workforce capacity to operate with these complex systems to its full extent. Nederman believed in the unpredictability of demand, enlarging their stock storage into dangerous levels. Aware of this problem, they are searching for a more efficient solution analysing old sales data in order to discover a demand pattern.

Given that Nederman controls its stock level through SS-bas matrices, divided two matrices (the manufactured goods and the purchased goods), measuring the safety stock by frequency and product value. Therefore, it will be tried to generate a more precise tool based on the existing system adding new classifications through a demand pattern and a control of the different subclasses leading to decreased stock levels without affecting the service level as purposed (Blix E., 2012).

The study was conducted in two warehouses the one for the components and the other for the finished goods in Helsingborg considering the transitioned active products in two years without regarding the new products so the demand pattern can be studied. In addition, 20% of all products were randomly collected to serve as a test group being supervised when implementing the new method.

First, the article will present a theoretical framework giving a basic theory to understand the way the demand pattern is determined, its respective forecasting, the replenishment system and the mapping tools relevant simplify the inventory control. Second, comes the methodology where is reported the different methods strategically chosen by the authors and the way of making them more credible, as well as the reference of the data collected stating the Nederman situation. Then, specifies the analysis of the data combined with the theoretical framework describing and explaining the demand pattern using the new SS-bas matrices clarifying how it was implemented and updated in the system. Finally, there is a conclusion of the results and some recommendations to apply the better methods.

2 Theoretical Framework

In general, companies retain part of their capital invested in raw materials, work in progress and finish goods, which in fact can have improvements (Axsäter S., 2006). This capital, through some techniques and knowledge, may be controlled. Although it has some barriers due to the

massive amount of data it creates, it is easier today since inventory control is apply to programmed systems being controlled automatically. As a matter of fact, inventory control is a monitorization of the stock in an enterprise. This tool is not restricted to only one function or unit in the firm. Therefore, conflicts occur because different units have different objectives. As a result, this becomes a complex process since there is so many human factors affecting the system (Axsäter S., 2006).

The most important steps in inventory control systems is mapping the flow of goods, materials and information as well as determining the demand pattern to adopt the proper forecast model and the respective replenishment system. Primarily, mapping is an illustration to simplify the supply chain. The globalization and the intense competitiveness present among supply chains and value chains brand them as complex. Consequently, to work logistics more efficiently the development of a visual language composes a straightforward understanding (Gardner, John T. & Cooper, Martha C., 2003) in the connection existing between the value adding unit (●), the unit (■) and the warehouse (▼) and how they are affected by each other (Norman A., 2011). Then, determining the demand pattern delivers a good perception of the products in order to manage it. Thus, generates dissimilar patterns and deviations in the demand, identified and analysed by five tools.

First the regression analysis settles any trend prevailing in the demand of a product, by locating a linear equation that best describes the observations of the product (Axsäter S., 2006). Second the autocorrelation, using an autocorrelation coefficient (r_k) based on two years of data, reveals the seasonality in the demand pattern whenever $k>2$ the $r_k>0.5$-0.6 (Prof Perego A., 2010). Third, the frequency must be a starting point to establish the demand pattern, measuring the regularity in which the volumes are operated. The major deficiency in indicating volumes per time unit is to outcome the right time unit to describe the pattern and its reuse in further analysis. Next there is the standard deviation (σ) quantifies the number of observations that are deviating from each other, designating the predictability of something. However, it does not take in consideration the volume, thereby the high volume products that support a higher risk of standard deviation are not differentiated from the low volume product. Finally, there comes the coefficient of variance, more capable than de previous one, as it takes volume into consideration. As a result, this enables a better visualization and a comparability between all products in a warehouse. Additionally, this process allows a classification of products through a cross referencing between ABC-analysis on demand volume and xyz-analysis representing the stable, variable and lumpy demand. This form a matrix 3:3 where the left column is the "to stock products for central warehousing", the four cells in the right corner are "standard products that should be made to stock" and top right corner are "the very variable and should be produced to order" (Norman A., 2011). Another model use is a diagram with a logarithmic scale which is divided in four quadrants: Q_1 high volume low variability, Q_2 low volume low variability, Q_3 low volume high variability and Q_4 high volume high variability. The border splitting the quadrants is different in every business and for different types of products and is extracted by

the analysis of historical data on production and through the Pareto principal of 80/20 (D'Alessandro A. & Baveja A., 2000).

Furthermore, there are three forecasting models. The moving average that focus to estimate the demand presumed it variability is slow, centred on the averaged value of N previous periods to forecast every month. In this context, the demand structure defines usage of the value in N depending the flexibility of the changing demand (Axsäter S., 2006). The exponential smoothing is an updating procedure of the moving average that practise a linear combination giving a weightiness to recent data (Axsäter S., 2006). The exponential smoothing with trend is an alternative method to regression analysis that add another parameter, the trend, which gives a value affected over time to forecast that can be either positive or negative (Axsäter S., 2006).

Moreover, the replenishment systems allocate the right quantity of products at the right hour and place to enhance the cost of treatment, ordering and selecting volume for transport. There are three replenishment systems that aids to elect the most suitable one. The reordering systems require continuous or periodical inspections. Continuous inspections imply ordering the same amount of stock (Q) whenever this reach the reordering point level (R). The (R, Q) system fixes a stock position between the levels of R – R+Q even though it can go under the R level pondering the multiple units (Axsäter S., 1991). In contrast, the periodical inspections infer altered orders (S) in different occasions but at predeterminated times (s). The (s, S) system setups a stock position that refills each time it falls below the safety stock level (s) (Axsäter S., 1991). Additionally, the Economic Order Quantity (EOQ) or Wilson formula clarifies, based on the carrying cost (r) and the fixed cost for replenishment (A), the order quantities (Axsäter S., 1991). In fact, the system assumes that the demand is continuous and constant as the carrying cost and the fixed cost for replenishment. Besides that, the order quantity is not necessarily an integer and it is entirely delivered at the same time not tolerating shortages. This approach exposes a total relevant cost (TRC) determining the optimal and cheaper order quantity. Nevertheless, defining an accurate carrying charge is the major problem (Silver E. A., Pyke D. F. & Peterson R., 1998). Furthermore, the safety stock must be established. In other words, is essential to uncover the reordering point that during the lead time will certainly cover the demand. Meanwhile in the lead time, surge an uncertainty in demand caused by deviations in the lead time and demand itself. In the case of high demand normal distribution is chosen. Nonetheless it has the disadvantage of turning it in a continuous function that is, the demand does not need to be an integer throughout lead time, triggering a drawback fundamentally when the demand is very low since it can turn out to be negative. Ideally when the demand is low the Poisson distribution is the one (Axsäter S., 1991). In addition, a service specification or a shortage cost can fix the safety stock. Despite the simple usage of the "probability not to have a shortage during an order cycle" ($SERV_1$), it does not take into concern the order quantity which can transmit a low service. In spite of being more complex the practice of "the fraction of the demand that can be collected directly from the warehouse" ($SERV_2$), it shows a precise

image of the real service level. The downside is to obtain the quantity to prevent that the shortage occur every time a fraction is taken (Axsäter S., 1991).

3 Methodology

In order to develop a project, it is necessary to consider the research choices and the methodical approach, as these can affect the project result in numerous ways. In fact, the scientists have created a specific type of language to detail the relationship between fundamental assumptions and methodology by bridging both through the concept of "paradigm". However, the existence of an imminent relationship between paradigm and methodology becomes evident, subsequently it is possible to find several paradigms in a methodological approach. Thus, there are three different approaches to research regarding the area of methodology in business economics, which can be analytical approach, systems approach and actors' approach (Arbnor I., & Bjerke, 1994).

Moreover, these three approaches can be related through a line, in which on the far-left side is the positivist tradition, which is deeply linked to natural science and quantitative methods (Bryman A., 1997) and the extreme opposite the hermeneutics tradition, which can be seen as an universal science comprehension and communication, (Wallén G., 1996). Thereby, the analytic approach parallels the positivist tradition and, in contrast, the actors approach are in parallel with the hermeneutics tradition. In this framework, the systems approach acts as a link between the two.

First, the analytical approach "describes the world as an objective reality where causal relations can be identified". Its object of study is observed by completeness as being analogous to the sum of the parts (Arbnor I., & Bjerke, 1994). This means that, reality can be divided into small-sized plots and thus studied separately, taking deductions based on developed cause-and-effect relationships, which separately may represent reality (Grammelgaard B., 2004).

Second, the systems approach recognizes that the totality is isolated based on the sum of the parts and, in turn, the relationship of the various parts can result in negative and positive effects for the totality. Thus, from the attributes of totality we can explain the parts (Arbnor I., & Bjerke, 1994).

Finally, the actors approach is directed to the apprehension of the social totality from the conception of the individual actor and, in this way, the reality assumes itself as a social construction. The reason why this happens is just because it maps the implication as well as the definition of distinct actions and the environment, which contributes to the creation of this social construction through structural classes of meaning (Arbnor I., & Bjerke, 1994).

About the level of knowledge presented in a certain area, it is possible to consider four approaches. First the explorative approach, in which its purpose is to create a basic knowledge in specified subject, since the knowledge in the area is very low. Second the descriptive approach, which is characterized by describing without clarifying relationships, as there is a

common knowledge and understanding about the thematic. The next is explanative approach, which is used when there is knowledge in the area and where its main purpose is to achieve a deep conception mutually for description and for explanation. Lastly the normative approach, where the knowledge and understanding are high and the objective of this is to provide guiding data and, consequently, recommend actions (Björklund M. & Paulsson U., 2003). Having referred the different approaches, it became clear to the authors that the systemic approach would be ideal in the context of the problem, since many different parts and activities are analysed both separately and as a system. Therefore, in order to better understand and detail the stock control in Nederman, the entire system must be considered, and later find improvements. Likewise, the totality of the selected inventory control is reasoned on the entire system and not on the best separate parts. On the other hand, the normative approach is also appropriate for this context, since the inventory control research area needs a high level of knowledge in order to use the existing information to find the best way to control the safety stock in Nederman.

Knowing how to choose the research method as well as the research approach is important as it becomes crucial to adapt the methods used to the problems. Moreover, it is necessary to consider the concepts of induction, deduction and abduction to balance the theory with the empirical data. Accordingly, induction is how to create theory based on empirical data, (Björklund M. & Paulsson U., 2003), without predictions, which has a starting point in the empirical data in order to make new general and theoretical conclusions (Kovács G. & Spens K., 2005); deduction has the purpose of explaining empirical data by using existing theory (Kovács G. & Spens K., 2005), although it may also be developed (Holme I. & Solvang B., 1997) and lastly, abduction has a combination of both, in other words, the authors intercalated theory with empirical study, beginning this process with the treatment of some theoretical knowledge, combined with the empirical data which the purpose it to compare and validate theories ending, eventually, to apply the results evaluated.

It is important to note that there are two general scientific research methods, namely qualitative and quantitative methods. The first consider all methods that can be measured and analysed through information and data. This is more used by the social sciences through unstructured interviews where the aspiration is to express events, actions and norms of the object under study (Bryman A., 1997). The second is used when the goal is to gain a deep understanding on a specific subject (Björklund M. & Paulsson U., 2003). This is very analogous to the approach of natural science that are studied through research, structured observations, subject analysis, and all of which can obtain a large amount of data for the study. In this context, this method is a way of creating models based on the science of nature (Bryman A., 1997). In addition, both share the goal of creating an enhanced understanding of civilization (Holme I. & Solvang B., 1997).

In this perspective, to find ideal solution for Nederman, based on their specific data, it will be used theory being later compared to empirical data that can be executed according to the theory. In this way, the most appropriate approach to resolve the problem in question will be the abduction approach. In addition, this study is centred on a combination of quantitative and

qualitative research, however, there is a resort through qualitative methods to achieve a deeper cognition in the desired fields.

Both data collection and other information can be searched and found in various ways and methods. These can be divided into two groups: primary data and secondary data. The primary, are those that are exclusively collected for the study in question (Björklund M. & Paulsson U., 2012). On the contrary, the secondary ones are those that are based on historical data that have already been divulged (Björklund M. & Paulsson U., 2012).

So, in order to obtain the necessary information, it is possible to use methods such as: interviews, observation, database, literature and data studies supported by existing projects and tests. Interviews are a simple genre of collecting data, typically primary (Björklund M. & Paulsson U., 2012), for a specific project having the ability to adjust to different people to obtain a deeper understanding. These can be divided into three distinct categories: structured, semi-structured and unstructured. In the structured interview, the interviewer reveals having control over the questions and the format of the answers. In a semi-structured interview, the interviewer demonstrates the flexibility to change the order of questions, allowing more detail in the answers, besides what would be planned even though there is a list of topics and issues that should be discussed and answered. The unstructured interviews are like conversations where the interviewer initiates allowing reasoned answers (Denscombe, M.,1998). Regarding observations method, also a primary data, it is performed when original information is collected by technical equipment or the sense itself. As for the databases, these are just as primary data, since the information is extracted from the database for the project. As far as literature is concerned, typically secondary data, it is identified by its speed and simplicity in the way information is obtained in a given subject. Note that it is critical to realize and ensure that the information obtained through it is explained and written by an objective person (Björklund M. & Paulsson U., 2012). Finally, the data from existing projects and tests, are also classified as secondary data, which may be pre-existing tests, measurements of performance quantities or others that other researchers may have performed. In short, several methods of data collection were used, however one of the methods used was the database that was taken from the company under study. Another method widely used was the interviews, having no preference in one of the three structures. These were crucial to understand the current situation of Nederman and its methods of work, for example the interviews with the supervisor, Fredrik Arborelius, permitted information about how the enterprise operates and supplied analysis of its current state. Throughout this study the focus of data collection changed to a combination of experiments and observations.

An extremely important step in developing this project is to choose a model of analysis that can meet the goal of the project. In this way, the previously collected information can be analysed through statistical processing in order to obtain new information. This is done by statistical tables, measures or graphics according to the purpose of the study. Nowadays, due to the new technologies, these processes have been facilitated using advanced computers that make a most efficient statistical result (Björklund M. & Paulsson U., 2012). Furthermore, the

information collected can likewise be simulated in several ways. Through the modelling and simulation method, several scenarios can be simulated and possible results can be seen and predicted. The purpose of this is to verify, in practice, the functionality of implementing a theory. In this connection, the analysis model used was a combination of statistical processing and modelling. Thus, in order to confirm that the statistical process was giving the exact results, modelling and real simulations were used. All in all, in the sequence of this analysis and with the objective of selecting the most pertinent methods for the data and validating the results, it was decided an alternation between theory and practice, more precisely, firstly defined the problem and the objective, secondly choosing the methodology (research approach, methods and data collection), in third use the existing knowledge in the subject, next do an empirical study in order to collect data, then select the most pertinent methods, after perform an analysis of the empirical data, posteriorly validate the results and finally implement them.

In order to carry out a study, it is important to maintain a certain degree of credibility: validity, reliability and objectivity which have often been used throughout. In this perspective, validity is taken as the ability to measure exactly what one intends to measure, being essential to transpose for a specific project. Regarding reliability, this is considered a measure of the degree of accuracy in instruments where the person or test data are chosen randomly (Höst M., Regnell, B. & Runesson P., 2006). Additionally, validity is regularly evaluated alongside with reliability when verifying whether a measurement provides rigid results. Concerning objectivity, the authors must: keep all the facts accurate, visualize from different angles all aspects and be careful with the use of words to not harm the results (Björklund M. & Paulsson U., 2012). Besides, to increase the credibility of a study, it is plausible to use several methods to obtain several perspectives, this phenomenon is designated as triangulation, that is, when two or more methods are used in the same study to reach the same goal (Björklund M. & Paulsson U., 2012).

In conclusion, several methods were used to expand credibility as well as to improve the accuracy of the results. In this context, to spread the reliability of the data collection, analyses and tests were carried out several times. The data was collected from the databases as the analysis and the statistical processing were performed twice. The test was carried out uninterruptedly over the ten weeks. Therefore, to have a strong validity, the answers were crosschecked among all. As illustrated by the interviews, during the data collection were elaborated from different units of the company, with the objective of obtaining a wide range of opinions; and, by constant meetings with the company proving common purposes. In order to obtain a wide variety of approaches and thoughts to ensure the credibility of the report, the theory chosen needed an alternation between old classic research and new reality actualized theory.

Regarding the analysis of the current state of Nederman, has been gathered all sort of information through interviews and conversations with the employees, especially with Fredrik Aborelius, Maria Waidele and Erik Blix, but also with others in order to verify and consolidate the reliability of themselves.

In this framework, Nederman contains two warehouses and a combined assembly station that supplies Europe and the Middle East as well as two distribution centers in North America and China. In particular, the distribution channel in Helsingborg dominates approximately 26 000 active products. The company's products end in a structure with a high degree of complexity and a colossal of multiple heterogenous products, which means that this process needs an overly sophisticated control system.

In this company, products that are considered as stock are controlled by a software, MySigma, which in turn is linked to the IFS, that is an ERP system operated by Nederman, where a forecast is made every month through a suitable software named Demand Planning. In this process the values are sent to MySigma, via IFS, and thereby, the levels of safety stock and reordering are estimated. That said, the new calculated safety stock and the respective reorder point is transferred to the IFS. This process is considered a reorder point system that every month is updated. In this way, the place where the reorder point is determined by the safety stock and the demand along with the lead time which is defined by SS-bas, controlled by a matrix system based on two parameters, the value of the product and frequency, culminating with groups of different amounts of safety days (Arborelius F., 2012).

As far as Nederman's forecast is concerned, it has two purposes: the first is to determine the demand for the next period in order to define the safety stock and, consequently, the reorder point, and the second is to make information available to suppliers in advance so in the future they use it as an indicator. The forecasting process is based on the previous six months of historical data where no future information is considered (Arborelius F. & Holmkvist C., 2012). However, the forecasting process initially needs to have some manual adjustments to new products and other special products so afterwards all products are transferred from the IFS to the demand planning and then sent via IFS to the MySigma, where the new reorder points will be calculated. With all this, products that have obtained an oscillation at this point higher than 15% are recommended to be changed. In these circumstances, after deciding which products, the newly calculated reorder points are transferred to the IFS and sent to suppliers and material planners.

As far as the replenishment system is concerned, the company uses a system of reordering points for all stock products, all of which are controlled by identical methods regardless of their specificities. The order quantities are usually determined once a year and can be updated in the event of changes that have a significant impact or the appearance of a new business. When the reorder point is raised, a new order for manual or automatic creation is advised, depending on the inherent product. This point is defined by demand over the development of lead time, by the safety stock that is monitored by the security days previously set and by the SS-bas based on frequency and value, a lead time adjustment factor and expected demand. These points should be updated once a month after the forecast, but this is not what really happens, so it makes the system more flexible, but also more vulnerable and subject to employee behaviour.

In respect to the stock level of replenishment system, this together with the replenishment sizes are determined by the enterprise through different combinations of methods, being

therefore a factor with greater difficulty in controlling which products that have a request size defined by one specific method. In connection to this, other methods for establishing order sizes may also be used, for example, batch sizes that are allowed by suppliers, discounts obtained from buyers, experience, among others. As for the size of the orders, these are established once a year and subsequently used during the period, with some exceptions, for example: project requests or adversities pointed out by the supplier.

In reference to the reordering point of replenishment system, this should be updated monthly and centred on the safety stock and the demand forecast during the lead time. Consequently, it is necessary that after calculating these new points, the employees decide on the updates that should be made. Generally in case of differences of more than 15% compared to the previous month, possible changes are recommended, if it is feasible to select specific product groups as well as families of products, products at specific assembly stations among others, and from this to determine whether or not the updates should be performed.

About the safety stock, this topic that has been previously mentioned is based on an expected number of days of security that works as a factor of adjustment for the delivery time and the demand. With all of this, MySigma has been created and programmed with the existing lead time, but it is also possible to adjust it, if required, according to the delivery precision of the supplier.

As far as SS-bas is concerned, it is a fact that this is an original factor in Nederman's stock control, since it categorizes products with an ABC analysis, making it possible to divide products into two categories: manufactured and purchase goods designing two SS-bas matrices. In these matrices there are two parameters: the value and the frequency, in which it turns out that the difference between these is the number of days of security. In the matrices, the low value and the low frequency are presented with greater number of days, giving a rise to a larger safety stock. Both have several days of decreasing security with increasing value and frequency, resulting in lower stock levels relative to the safety stock.

Lastly, the level of service is estimated on all stock items and relates to the goods that must be delivered within the delivery period with allowable delays. The service level objective is a global goal for all products, that each cell in the SS-bas matrix can evidence different destinations. Therefore, products with low value and high frequency are monitored in the sense of service level. With all this, one reason why it is relevant to study this variable is the fact that in 2011 the objective service level was not reached.

At the present time, Nederman uses three different systems in the transactions records which are: IFS, MySigma and QlickView, to cover the total of the activities of the warehouse assisting and optimizing also their supply chain. In this context and in relation to the use of databases, the IFS correspond to an ERP system that keeps the entire warehouse registered and from this the products reorder points are updated. In this system can be found all transactions, purchases, statistical information and concerning the lead time, cost, reordering points and other information that can be connected to a specific product of Nederman. MySigma corresponds to a calculation program that generates monthly a detailed report of each product being this active

or inactive. This program also calculates the new reordering points for products using the Demand Planner data. However, upgrades are only changed in the IFS if the new order point is less than or greater than 15% than the current one and this must be approved by Fredrik Arborelius. QlickView is mainly used to evaluate the level of service, making it more accessible to view and monitor the service level in the warehouse and consequently, to visualize product performance. In consequence, the current and historical levels can be evaluated and controlled, but only the finished good's warehouse products can be evaluated.

During this study many data were imported from different databases to different analyses. As for the IFS data, the focus was on finding historical records of sales and transactions between the periods of 2010.01.01 - 2011.12.31. Since two warehouses were used in this company, one for components and another for finished products, the data obtained were separated for each one. The data was downloaded of this system to an Excel file and in this way each line contains detailed information about a line item for a product causing two large files to be created. As for MySigma, most of the information related to the products is received through a file created by the program that contains information about all the products. This information is used in addition to the IFS data in order to obtain more information on all products. Finally, QlickView was first used at the end of the analysis and after the implementation was performed. It provides a weekly report of all products that have been sold or used in production over a specific period in order to monitor easier and to see how the different products are executed.

4 Analysis

To understand the truly potential of improvements it is necessary to comprehend Nederman's working methods and processes along with their distinctive software. Therefore, it is created a map to simplify the structure of the product range and apprehend how they are controlled and linked together. It also identifies the data needed and the procedure to summarize it allowing an analyse of all products in the same way, informing the products which are more interesting for the analysis and the implementation. First, the division of the products into components and classifications as well as the way transaction data is separated. Second, the description of the supply chain unit and the flow of the products. Third, the classification of the products in the IFS, the connection to the warehouses and production between manufactured and purchased and the existence of both in the components and finished goods. Fourth, comes to pass the products from all directions into the two SS-bas matrices of purchased and manufactured.

The next approach is based on the handling of the stock products managed by the matrices along with the formulas and in how it is really used and performed. Thus, shows the order size but, it turns out lacking any sort of specific info about the method it is hinged on. As a result, it was not further analysed, being established that the size order was good enough. However, Nederman should educate their staff to use the economic order quantity so they would know want would have been the optimal quantity of the order. Since the organization of the products

in the two matrices seams that contain in one averaged line way too different demand patterns, it brought out that there were items with a too high stock levels while other got a lower safety stock. The advantage of using these matrices is in the simple way to manage the product range and the acceptable level of control of the warehouse with the possibility of improvements as Erik Blix, the project commissioner, suggested and confirmed. The special adapted formula of the safety stock to the software and situation of Nederman displayed little theorical ground which leads to a comparison between the theorical calculus of $SERV_1$ and the ones formed by Nederman. In result, $SERV_1$ discloses an in total higher value of safety stock but according to a higher service level. Once further investigations were made about the reordering point and forecasting method, it seems useless doing new analysis. Conclusively, the study determines that (R, Q) system, the one that Nerdeman already practices, was a good way to indicate the reordering point as it was not necessary to do any changes as (s, S) system requires. The limits of 15% in reordering point chances make up in a good way the blunt forecasting method. Similarly, the moving average was concluded as the most suitable as the exponential smoothing or exponential smoothing with trend resulted in no better improvements which reported that the 15% limits for chances make up the smoothing created in the forecasted demand (Arrelid D., Backman S., Grönlund M., Svanfeldt P., 2011).

After all the insight taken into the current situation at Nederman, it proceeds to the analysis of a massive amount of raw data to define the demand pattern and from there divide the products into the new matrices. Therefore, the focus was to develop the SS-bas matrices in order to verify a more accurate safety stock. Regarding that the company did not have a classification of the demand pattern of their products, the first stage was to identify all the demand patterns among the product range. The data collected from IFS are relocated to a pivot table, where y-axis represents the product numbers, the x-axis embodies the time in weeks and the demand is supported in the main frame of the table, offering an effortless view of the demand pattern for all products during 2010 to 2011. However, new products were removed once the test period was too short, products with at least one order were not. As a result, surged 8 000 lines which required a more quantitative method. Consequently, calculations based on weekly demand, standard deviation and frequency of use are added to every product line. The usage of standard deviation and average weekly demand also allowed the calculus of coefficient of variance. A plot is thereby created by all products with the weekly demand and the coefficient of variance showing that products with a high weekly demand have a low coefficient of variance (CV). The distribution in the matrix is according to the frequency in terms of orders symbolized by the weekly demand presented in the pivot table and the plot of coefficient of variance and weekly demand sets the different matrices. Due to the fact of the existence of a lot of data it is needed a cleaning and a restructuring. The first step is to delete the data from 2010 necessary for notice a demand pattern unsteady over the time but, unnecessary to discern peaks in demand. In fact, after comparing a plot for 2010-2011 to a plot for 2011 it is confirmed a similar demand pattern over time that not change fast followed by the deletion of data from 2010. The next step is to set limits for make to order and make to stock. As this warehouse pretended to eliminate

products with low frequency and a very high coefficient of variance, that is accomplished after testing limits and comparing the number of products in the two different groups with the current numbers. So, products with a CV>6 is a make or purchased to order. Likewise, a product to order with an average weekly demand frequency under 4 per year are for purchased products and under 13 per year are for manufactured products. The last step is to cross reference in the products in the on stock group with the ones that are current on stock in the warehouse. Containing the same products, it comes that the new solution limits offers an improvement of over 700 items that should be stock and over 500 that should be made to order instead of being on stock. The existence of products that were one time order in the last two years on stock and the ones ordered more and less every week are deleted due to lack of a certain reason. Therefore, 4 126 products are left for analysis. To acquire the demand pattern from the remaining products it was used, like before, the frequency, standard deviation and coefficient of variance in order to come across with stable, variable and lumpy demand patterns. Regression analysis and autocorrelation were used along with oral statements from the employees resulting in any substantial trends or seasonality. The presence of so many different demand patterns leads to potentials different ways of controlling the products. Stable demand patterns are the highest for improvements, as they are common among the product range of Nederman, their stock can be low while the service level is still high. Variable products are the most common and the most difficult to manage as the variation turns the products unpredictable requiring a very high stock level to have a good service level. Peak group is unexpected and hard to handle implying a stock level unnecessarily high. Lumpy products, common among Nederman's products and way affected negatively by the current methods of the warehouse, will always have a stock level based on the average demanded, but with a poor service level. About trends and seasonality patterns are too few and had a too short timeframe as so products with these demand patterns were classified with another pattern.

After the different demand patterns were all found for the product range, it is essential to determine values and parameters to set out their partition. Thus, will be crucial to disclose the optimal limits to distinguish the demand pattern groups. In spite of having always products waling near the limits with too similar proprieties, the borders must be settled where the least number of products ended up in the wrong group. Fist of all, the boundary between stable and variable demand is establish through an analysis of individual demand patterns at different coefficient of variance values. Then, the low frequency, representing make to order purchased products, form a line dissecting the lumpy demand from the normal variable. The last limit is to compartment the peak products from the rest. The visual and individual analysis also reveal frontiers among purchased and manufactured products as the purchased products generally had higher volumes. The matrices for the make to order products are then divided as peak product, lumpy product, stable product and the rest becomes variable, resulting in seven different matrices, four for the purchased and three for the manufactured regarding the unclear group for lumpy products. In this perspective, the matrix for stable purchased products (883 items, 26%) is defined for products with a CV=1.0 and a high frequency, giving an average weekly demand

of over one product per week with a low item value, representing 25% of the purchased products. The purchased variable products (1 388 items, 41%) are the largest group being more spread out in the matrix but with a largest concentration in the middle section, they are segmented by a value between $1.0 < CV < 6.0$. The peak purchased products (304 items, 9%) are classified as so when the forecast, based on the last six months of historical data, predict one, two or three peaks that are higher than a certain level above the average level and a minimum average level. After visual analysis and many tests, it was decided a level of six times the average level. Another factor was that the average demand should be higher than 5 products per week, which contains only significant peaks. Likewise, the peak products are spread out as the variable products. The lumpy purchased products (804 items, 24%) are few demanded, as analyse it is demanded 13 weeks per year, but when they are the volume can vary a lot make them punished heavily by the old method since the safety stock is quite low resulting in a low service level. These products occupy the top left corner of the matrix. Regarding the manufactured products, they were fewer to the number and generally with a lower weekly demand, but they have similar demand patterns as purchased products. For these products the ones with lumpy demand were consider rather make to order than make to stock because they were demanded of less than 13 weeks per year. Additionally, manufactured products tend to take more space and have shorter lead times if all components are in place which make them, as the old and new methods confirmed, products for make to order. The stable manufactured products (154 items, 21%) will have the same limits already chosen as well as the distribution in the matrix. The variable manufactured products (394 items, 53%) have a similar distribution I the matrix as the purchased products and the same limit of a value between $1.0<CV<6.0$ but, the coefficient of variance it achieved was lower than 4.0. The peak manufactured products (199 items, 26%) were the only group with different boundaries from the purchased ones having a decrease to a lower level of one product per week in average. However, the distribution is like the purchased items, these ones have a higher frequency.

Finally starts the process of creating the new values for the matrices being limited to the current way of calculus of the safety stock, based on the SS-bas, demand and lead time, and the ordering point. Consequently, the focus is to discover a different way of calculating SS-bas, using the standard deviation and a pre-set service level to calculate the safety stock according to $SERV_1$. Although $SERV_2$ could be another alternative, it is a method more complex with more parameters to take into consideration and impossible to use due to the fact of having uncertain order sizes since Nederman did not use Wilson Formula for order sizes. Therefore, the seven matrices needed a determined service level, so the high frequency and low value products have a higher service level while the ones with a low frequency and high values have lower service level. To connect the matrices, the repeated process of multiply the service level in one specific cell with the total frequency of all products in that cell and summaries this and divide it with the total frequency resulting in a total summarized service level. The safety stock can now be calculated with a SS-bas for every product, The matrices contained many cells with 50% of service level resulted from a safety factor of zero (k=0) which results in a SS-bas value

of zero making those products as make to order because of very low frequency or extremely high item value. To create new start values there are two alternative methods representatives for all the products of the different matrices. The alternative 1 is to take the median instead of the average value of all products calculated in the SS-bas values, because the average value gives a very high and not a demonstrative value. Thus, the new median numbers were added to the new SS-bas, cleaning the misleading high or low values. This method aims for a higher service level (94%) increasing the safety stock, which is expected since this alternative was completely apart from the current values that were marking for a low level of service to push down the stock value. The alternative 2 uses the two old SS-bas matrices values along with the median forming a new SS-bas index to compare with the medians of the new seven matrices. This method of comparing and using the old numbers and multiplying them with the new percentage number from the median deviation excluded a few unrealistic numbers leading to a decrease of the total safety stock value. Baring in mind the desire that Nederman had to establish an extra dimension to the current SS-bas, alternative 2 seems to the supervisor of the enterprise the most suitable as it would drop the safety stock and still remain the service level of the old methods not leaving any doubts that the improvements are a result of the new dimension. The peaks matrices values that were based on a too high demand values, affected peaks too much needing to be decreased. As a result, new peaks values were calculated through the median differences among the old and new matrices revealing a 70% for both the peak matrices being multiplied with the new SS-bas values turning them down. It was important that all the cells got a start value not only the ones with products respecting that the products can move between cells when demand or values changes whenever the model is updated. Therefore, the empty numbers were calculated by cross looking between the different matrices.

Finally, the implementation taken into the scene for 20% of the products, selected and divided randomly in five groups, one test group and four different controlling groups, having equally distributed numbers between the groups. The four groups of controlling stayed normal and the test group got new reordering points based on the new matrices. Initially, the new reordering points culminate in a higher total reordering point value for the test group considering the fact an update of this dimension did not occur since a long time. However, later the controlling groups started to increase similarly to the test group in the initial stage. As a result, all the groups received an update turning a decreasing climax in the reordering points with the test group having the lower value than its started values indicating a too high value for the stock values since the service level is maintained on the same level. The service level was observed weekly in eight different moments through collected sales data from the QlickView displaying the number of orders per products versus the number of orders per products delivered in time only for the finished goods representing 30% of every group. The cumulative service level of all groups showed they are following of each other except from a dip for the test group caused by an human error of “backorders not allowed” that were not updated with new dates in IFS containing an over represented amount of products from the teste group. However, after analysis of the cumulative service level indicates that the test group is following the control

groups which means that it is possible to maintain the service level with a more accurate and lower value of the reordering point. Another analysis of the service level on the components was made, but it will not give a fully accurate level. It will work as indicator for the shortage or close to and can be comparative among the groups to see any major differences. The shortages have a fairly distribution between the groups, functioning as indicators that the parameters in the new mode can keep the service level. Comparation between calculated values and values collected via IFS and MySigma were hard to make due to the calculated values were based on demand, lead times and item value from MySigma and previous calculated with SS-bas and the safety stock as the base. Therefore, the reordering points in the system is not exactly as the calculated values at every specific time. Consequently, to establish a good comparation calculus were based on values from the same MySigma files, thereby, if there was a full implementation, both the safety stock and the reordering point would end up with a lower value when compared to the old SS-bas. When the transfer of the old SS-bas to the new model of SS-bas, the distribution of the values over the seven matrices showed that only the matrix for lumpy purchased products had an increased value because of the tough control in a good way, this value indicates a potential for lowering the value by working with service level. In addition, the stable products, affected heavily by the old methods, would be the ones with a lower value. The variable products would not suffer a disparate control from the existing system which means that there were no major decreases. The peak products were the ones supporting a quite large decrease as the SS-bas values were adjusted with that intention to deal with the unfairly high demand. This model seems a good performer essentially for the manufactured products.

Regarding the fact that the demand pattern of the products changes over time, the update should occur often. The longer time it takes to make an update, the blunter are the products in the groups of matrices. However, every time new ordering points are implemented, the results are temporary high as the system takes a while to adjust the numbers. Moreover, as the process is time consuming, the ideal would be to occur once every 6 or 4 months, taking into consideration the workload on the supply chain department.

5 Conclusion

To sum up, visualizing the intention of Nederman in advance their inventory control in the warehouses in Helsingborg. The purpose was to solve first the division of the products into different categorizations reasoned on their demand pattern. That is the demand must be classified so it could result in a better partition of the products into different groups which was entirely accomplished standing out the fact that was easier to conduct all the complex structure of the active products. Then, it was necessary to monitor these classifications in order to direct progress on stock levels taking in account a certain service level. This was partially completed regarding that their stock level effectively lowered improving during the implementation though, it was not enough for a certain service level.

The company had already a quite good system to control the stock, but it needed a boost clarifying their methods. Nederman used a two matrices system denominated as SS-bas matrices which was effortless to operate and delivered a reliable stock level. However, the main drawback was to master all the different products to understand the reason they get graded into that specific controlling parameter. In this context, despite both the matrices and the formula for the safety stock own an appropriate potential, it is believed that to manage the right stock level considering the aimed service level would be controlling the product without the SS-bas.

Obviously, after analysing more than 8 000 products, was observed the emerging of distinctive demand pattern, for instance ones were frequent and stable while others were totally variable. Nevertheless, there are still products proven that contain the same demand pattern which allows the assemblage into different groups giving a broadly manoeuvre. The products seen as stable, presenting low standard deviation and coefficient of variance, were quite few. As a result of the existence of variation in their demand, they were considered generally a bit unstable, though the formation of a level permitted a way to diverge the products into dissimilar classes. The range products at Nederman reflects the appropriateness for make to order products. Yet it was crucial defining a limit between to make order and to make to stock products. Thereby it was made a comparison among the current products that are on stock and the ones that are on stock conferring to the new limits which provided surprisingly results such as a significant difference in the number of products that are close to the limit for make to order. Thus, many be explained by the sales organization request, an outdated database and the inducements for keeping the stock level down.

In the next step the matrices were used. In summary, seven different matrices were demarcated symbolizing the right size covering the distinct demand patterns. Although every matrix is time consuming to follow up the results of the service level, more matrices gives a more individually meticulous system with smaller groups.

The difficulty comes in the calculations use and adaptation of the contemporary way of calculus of start values. Particularly, the warehouse calculation system turned out impossible the usage of any theorical method, so the modification occurred outcome a method hard to predict and prove. The options were a method that would chase a specific service level, which would bring about a more exact stock level, or a method based on their current system not specified in a service level. Nederman focus on the second method which distance away from the problem statement of using a specific service level of 94% but shown possible to answer if an additional dimension were to be add to the existing system.

Finally, after implementation it was concluded that Nederman has the capability of improving its system controlling its products in a more individually way and on different variables dissected from historical demand pattern which leads to surpass or sustain the service level while reducing the stock level. However, it was hard to measure the service level due to the evaluation of only parts of products range, the reference group service level was compared to other four groups which reinforced the reliability of the modelling.

All in all, the use of coefficient of variance seems to be a proven working method to perform the division of products into diverse groups after demand pattern. The unique result that stands out in this enterprise is that the separation is possible to be establish for very variable products which contain an unstable demand pattern showing that any company can control their inventories found on demand patterns either stable or unstable. Therefore, the limits that differ the demand pattern must be adapted to the company's product range and needs through the shape of the demand and the kind of target.

Even though the new dimension is added, it would be not enough to control and calculate the service level and reordering point of the warehouse. In this perspective, is recommended that Nederman install an even more sophisticated system that monitor the products individually. However, if the firm insists in fully implementing the suggested system it will need to use guidelines for make to order separating stock items from products that should be make or purchased to order, starting the convention of seven matrices, update the demand patterns of their products every 4 months and assign them to the right matrix, and supervise the service level while keeping working the SS-bas values in the cells to find additional savings. Finally, the variable products with high coefficient of variance should also receive some attention since the new limits bares products that should be made to stock.

References

Arbnor, I., & Bjerke, B. (1994). *Företagsekonomisk metodlära* (2nd ed.). Lund: studentlitteratur.

Arrelid, D., Backman, S., Grönlund, M., & Svanfeldt, P. (2011). Analysis of the forecasting methods at Nederman. Lund.

Axsäter, S. (1991). *Lagerstyrning.* Lund: Studentlitteratur.

Axsäter, S. (1996). *Inventory Control.* Lund: Studentlitteratur.

Björklund, M., & Paulsson, U. (2003). *Seminarieboken - att skriva, presentera och opponera* (1st ed.). Lund: Studentlitteratur.

Bryman, A. (1997). *Kvantitet och kvalitet i samhällsvetenskaplig forskning.* Lund: Studentlitteratur.

Cooper, M., & Gardner, J. (2003). Strategic supply chain mapping. *Journal of business logistics, 24*(2), 37-64.

D'Alessandro, A., & Baveja, A. (2000). Divide and Conquer: Rohm and Haas? Response to a Changing Specialty Chemicals Market. *Interfaces, 30*(6), 1-16.

Denscombe, M. (2000). *Forskningshandboken - försmåskaliga forskningsprojekt inom samhällsvetenskaperna.* Lund: Studentlitteratur.

Gammelgaard, B. (2004). Schools in logistics research? A methodological framework for analysis of the discipline. *International Journal of Physical Distribution & Logistics Management, 34*(6), 479-491.

Holme, I., & Solvang, B. (1997). *Forskningsmetodik om kvalitativa och kvantitativa metoder* (2nd ed.). Lund: Studentlitteratur.

Höst, M., Regnell, B., & Runeson, P. (2006). *Att genomföra examensarbete.* Lund: Studentlitteratur.

Kovács, G., & Spens, K. (2005). Abductive reasoning in logistics research. *International Journal of Physical Distribution & Logistics Management, 35 Iss: 2*, 132-144.

Nederman. (2010). *Nederman Company History*. Retrieved 02 01, 2012, from http://www.youtube.com/watch?v=eA6Sa0PELkw

Nederman. (2010). *Nederman Company Presentation 2010*. Retrieved 02 01, 2012, from http://www.slideshare.net/nederman/nederman-company-presentation-2010

Nederman. (2012). *Nederman Homepage*. Retrieved 02 01, 2012, from http://www.nederman.com/about-us.aspx

Norrman, A. (2011). Lecture notes - Project in Logistics (MTTN15).

Peterson, R., Pyke, D., & Silver, E. (1998). *Inventory Management and Production Planning and Scheduling* (Vol. 3rd). New York: John Wiley & Sons. Inc.

Prof. Perego, A. (2010). Lecture notes - Logistics Management.

Wallén, G. (1996). *Vetenskapsteori och forskningsmetodik* (2nd ed.). Lund: Studentlitteratur.

Oral sources

Arborelius, F. (2012, 01 19). Logistic Analyst. (D. Arrelid, & S. Backman, Interviewers)

Blix, E. (2012, 01 19). Plant Manager. (D. Arrelid, & S. Backman, Interviewers)

Holmkvist, C. (2012, 01 21). Controller. (D. Arrelid, & S. Backman, Interviewers)

Olhager, J. (2012, 03 27). (D. Arrelid, & S. Backaman, Interviewers)

Chapter 4

A New Way of Dealing with Inventory Management in Healthcare [4]

Freitas, Catarina

Abstract

This present study explores a new tool to assess the financial impact in comparing stock management processes, evaluating them in three different perspectives. The first perspective considers how good the process is, the second one is its effectiveness and finally how strong the stock control actually is. This same structure/tool was founded with literature bases including logistics, management of stock, process quality and processes management literature. This tool was applied in a study if each of the elements was subjected to a majority quantitative analysis based on the data collected in the logistic systems of stock management as well as in the observations and processing times collected in two hospitals. This study confirms the usefulness of this new tool when comparing different stock management processes. It is also concluded that the refueling service is the process that stands out, and the results were clear to two and ambiguous for one of the processes. Replenishment services also have associated benefits when concentrated on level systems that are more significant than drive-by.

[4]This paper is based on Saraste, S. (2013). A framework for evaluating inventory management in healthcare Case: HUS Logistics. (Master's thesis). Aalto University.

1 Introduction

The management materials focused on health care were extensively studied, the interest in this even due to two factors, complexity and its potential. The relevance of this is due to the fact that the chains of health care supplies are highlighted in the amount of service levels they must supply (Beier, 1995). As well as Management materials represent a significant portion of the total health care costs and depending on parents and national health system costs depend on factors such as the salary of different types of staff, medical equipment, supplies and medicines.

Advances in medical procedures have meant that the supply of medicines had to undergo evolution in order to become more specialized. In just 20 years, the medical infrastructures have doubled the supply items of medicines. (Born & Marino, 1995) This evolution increases the complexity of the supply structures leading to increased pressure in stock levels. The management of these supply chains in the context of health care does not simply with a financial issue, the effectiveness and speed of processing also directly affects clinical outcomes. (Iannone, Lambiase, Miranda, Riemma, & Sarno, 2013).

One of the trends in terms of macro levels of logistics is precisely its integration into the supply processes. The benefits of integration logistics are proven in the literature, which was used as a starting point to identify possible benefits associated with an integrated stock management process.

However, the literature does not contain a tool that evaluates the stock management system in a comprehensive way. The purpose of this study is precisely to create this same tool that compares the financial impact of the various management processes. The tool is relevant in the management of stock in health systems, but can also be transferred to other industries, which with the appropriate changes and adaptations can be used.

There is difficulty for some managers to quantify hidden costs or hidden benefits. This tool will be used to assess the potential of the supply systems in relation to the traditional process. The importance of this tool can be seen in three perspectives.

Firstly, being the service offered to more and more hospital units the benefits of the service have to be analyzed, secondly the way this service will affect the needs of resources and ultimately where we need to make improvements. From an academic and more general perspective, this tool gives a visual representation of key dynamics when analyzing stock management processes.

This study contemplates a Rand a literature review, followed by a methodology, subsequently analyzing results ending with a conclusion of the tool studied.

2 Literature Review

This literature review examines the strands of academic literature that form the foundation for the analysis that follows. This foundation will inform how the processes are understood, how they will be studied, and what hypotheses will be tested.

This literature review focuses on how after in the way the logistics is valued, as the stock is managed and the trends of integration logistics. It speaks of different concepts that can be used to understand logistics roles and processes in the largest supply chain, such as third-party logistics and inventory vendors.

Going through other themes, ESTThe literature also tests the hypothesis formulated by this study in the possible effects of a reform in inventory management. Finally, in order to gain knowledge about the Pare spoken of concepts that are important to assess the nature of the entire process of replenishment systems

Succinctly the following table explains the contents to be addressed:

Table 1: Literature and this study

Sections	Link to study
Logistics in healthcare	Context of the study
Assessing logistics	What components form the value proposition of logistics?
Supply chain integration and redesign	Creating a hypothesis for the potential benefits of RS
Inventory control	Understanding RS as an inventory control system
Quality	Importance of process quality
Business processes	Modeling and assessing processes

The literature has identified several factors within the logistics of health care that have potentiates for effective gains. Inventory levels have been seen as one of the most interesting points of improvement in materials management. (Kumar Ordamar, Zhang, 2008).

As we analyze the part Logistics we can soon divide it into two main components: the quality of service and the minimization of cost (Beamon, 1999; Bowersox, Closs, & Cooper, 2002, p. 23).et al (2002).

The potential benefits of the logistic redesign have as objectives the integration of supply chains that include increased response, reduced variance, lower inventory levels, consolidation of the shipment and increased quality of the support process. (Bowersox et al, 2002, p. 256).

The quality may be a very vague term, often referring to a product or the ability of a service to fulfill or even exceed expectations, this being always in agreement with the requirements of consumers and competing with the products of competition.

However, quality also refers to the ability of a business unit or a process to consistently produce the same product or service that complies with standards that are predetermined as acceptable to both the customer and the producer, or even both. This definition of quality is applied to the analysis process in the "construction" of the new tool.

In order to test the effectiveness of the new tool to be created, we must take into consideration basic and simple things like the effectiveness of the process, in order to increase the quality of service that can be defined by a simple equation-resources = time used x net cost of Trab Garlic per minute, the quality of the process in order to maximize the availability of the Inventory Control force referring to the rigor of the management of this whole process.

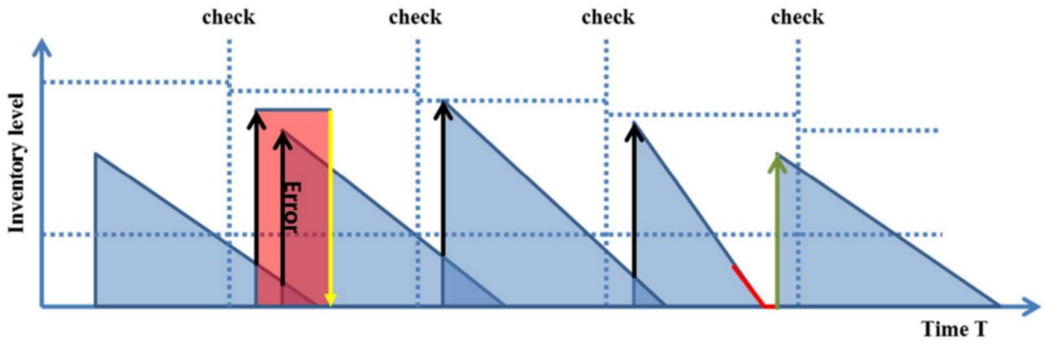
The success of the tool is dependent on these factors, functioning all in an integrated way.

3 Methodology

Applying the framework to a real-life scenario will help identify problems with the framework as well as interesting opportunities to improve even more. The Case study also serves as a way of illustrating the structure as the framework is intended to be used in practice.

Figure 10 illustrates how the process effectiveness, quality and strength of process control were addressed in practice. It depicts these three components of the inventory management process from the perspective of management through time. The Force allows a decrease in inventory (area) and the risk of inventory outputs (red line) that result in express orders (Green Line) more frequently (distance between checks) and more effective inventory management (best optimized size of order, height). Quality decreases the occurrence of errors (red area) that are sorted and subsequently returned (yellow). Efficiency reduces the amount of money spent over time, T.

Figure 10: Inventory Replenishment Process



Data

The section will first describe the sources of data on which the analysis is based. Outside the 8 main sites of the hospital district, the analysis will be limited to locations in Helsinki and Espoo. The two will be treated separately, with the Hospital of Jorvi, in Espoo acting as a control for differences based on localization. The table at the end of the section shows how the different elements of the analysis used this data.

Process Times

Data on the times of RS processes were gathered on the Jorvi website, since it was considered more representative than the RS process seems when fully implemented. The largest site, the Meilahti hospital area in Helsinki, is currently not an ideal source of RS process times. Currently it runs through a vast amount of restructuring (units to be moved, some in temporary locations) and construction (for example, the building of the big tower of the site, *Tornisairaala*). The Espoo Process RS is also well established and operational in 23 of the Espoo units. NRS was studied in Helsinki and Espoo.

Labor Costs

Labor costs are made of various components. In Finland, these consist of wage (gross), employee benefits, payment of employer's social security, employer's contribution to employee pension and employment insurance and insurance payments.

In order to calculate the cost of time spent in the inventory process, the data on average wages were collected from the bases of HUS. There are two relevant ways to compare wage costs: No extra wages, such as overtime, weekend and overnight payment; and net wages, including extras.

Items in storage

The number of different inventory maintenance units (SKUs) maintained in a private storage room was estimated from the ordered item lines that were registered in the ordering system used by HUS units. Each page in the item list contained 11 SKUs and this figure was approximate from the number of pages. The last page was assumed to be half full, that is, 5 lines full.

Unit Segmentation

For the comparative evaluation of the processes to be informative, it is important that the processes and configurations in which the process is conducted are comparable. The inventory volume, in monetary terms, during the selected period as the most appropriate indicator of the unit characteristics and will be used as the main criterion of segmentation in the analysis of quality and Inventory control.

There are two main reasons to use the monetary volume instead of the unit volume. First, medical supplies are usually more expensive than other sources, making the monetary value more accurate in separating the supporting units, which can order large amounts of inexpensive office supplies, from the care units in the data. Secondly, the importance of inventory management is in many respects related to the monetary value of the inventory in question.

Process Effectiveness

The total costs of the work to maintain the inventory management process are a function of the time spent and the cost of this time to the employer. The hypothesis of this section considers these two elements.

Process Quality

When a sort error is detected and considered meaningful, it is returned. While errors that are not directly crawled, requests for the return of items are, and this data will be used as a proxy for error requests when comparing the RS and NRS process.

Inventory Control/Force 1: Availability

The analysis of the Inventory Control force will be subdivided into an analysis inventory availability and an analysis of the efficiency of the inventory control.

Scarcity information is not available as such, but the following analysis will use the data on the requested express orders, which are orders that HUS-Logistics tracks quickly, currently guaranteeing a wait of less than 12 hours.

Inventory Control/Force 2: Efficiency Hypothesis

Hypothesis: Ordering behavior in units with RS is more efficient than ordering behavior in units with NRS.

Since the analysis in this section deals with the time it takes for a unit to reorder the same unit, a cut within the data set was required: it is natural that the closer the order is to the end of the period, the more likely the reorder is not to capture Data. Therefore, the 26.1.2013 date, roughly in the middle of the time series, was chosen as a *Cut-off*, and the analysis is limited to the periods of time that begin before this date were considered.

4 Data Analysis

The RS process is less labor-intensive

While the results in time use were not statistically conclusive, the observations strongly suggest that the hospital staff themselves tend to use significantly more time to perform the three main relevant tasks of Management of inventories, considered in this thesis as inventory verification, ordering and archiving.

One big difference is that the separate ordering task is eliminated in the RS process. The remaining tasks are also faster in the RS process, where they are characterized by deliberation and structure. The scan is fast, particularly because the task is not interrupted by manual registration of deficiencies. The bar code reader used by RS allows the task to flow smoothly.

During the inventory check, faults are recorded manually. In some units, checklists have been designed to bring some efficiency to this task, but in others, items that need to be ordered are written freeform, for example, *Notebooks*.

RS Process is less prone to error

The results of the analysis suggest that the RS process, in fact, significantly reduces the ordering errors. In fact, there was only one segment in which the NRS seemed to overcome RS: 150 000 – 300 000 euros sorted during the period, in Espoo. This anomaly in the results should not be discarded out of hand, but certainly could be a result of sample bias in this segment.

In the light of results and observations, the RS process seems very robust. As explained in the background section, bar codes linked to specific items are located underneath the item's shelf position, and barcodes are associated with predefined ordering quantities.

A fair number of returns were still ordered in RS units. In this analysis, it was not possible to identify which of these returns resulted from items ordered by the RS operator, and that resulted from the ordering performed by the unit's own personnel. Still, because of the inherent robustness of the process, discussed above, it is not

reasonable to assume that even in the case of RS units, most errors are made by the unit's own personnel when ordering inventory that is not kept in storage. Since the RS only replaces the ordering of items that are kept in inventory, it is natural that the change in process quality can only be detected in this portion of orders. One of the most common explanations for the request for errors is a misinterpretation of the order quantities. To illustrate, during an order, two secretaries struggled for seven minutes as they tried to decide whether to insert a 1 or 1 70 in the "Order Quantity"-field. The item came in boxes of 70, although there was no indication of how the quantity should be interpreted in this particular case.

Key ingredients of RS success

When comparing the two processes and their performance, some differences stand out as being key in explaining why RS performs better. The most important of these success factors are outlined here as the use of bar code readers, process structure and process ownership.

Towards expansion of RS

RS is expected to expand to a much larger proportion of units, and there is even a debate about whether to be mandated as mandatory for all units that fit a particular profile. Expansion will certainly allow and require changes. This will not only mean an increase in resources, but this thesis argues that an expansion in the SR should lead to structural changes in the composition of the workforce of HUS Logistics. The expansion also brings possibilities for process optimization.

RS expansion needs a big number of RS operators. Currently, at the site of the hospital Jorvi where the RS process is well established, two operators manage approximately half of the 23 units that are part of the service. Ten units per operator can be used as an initial estimate for the workforce required as the process expands. On one hand, these operators are very experienced and familiar with the managed storages; and one should estimate the capacity per operator conservatively, because the demands of the units vary significantly. On the other hand, if recruitment can select individuals who are as motivated and as capable as the operators in Jorvi, it should not take more than a month or two to achieve their level of efficiency.

In Addition to the efficiency gained from experience ("dexterity"), the expansion will also allow greater optimization of the process. As more units sign the service, the units can be divided among operators more efficiently, in terms of the composition of the portfolios of RSoperators, in terms of number of units and routes (from unit to unit) that allow in practice.

The expansion also offers the opportunity to adjust the process itself in order to increase efficiency. Since the number of RS-Operatives entirely personal that operated

from a specific terminal reaches critical mass, it may be possible to deliver some of its administrative responsibilities, for example, support the staff.

Technology can also increase the mobility of the RS-Operatives and your ability to perform tasks outside the warehouse. The operator is able to build and develop a relationship with the teams of the units, thus becoming the main contact between the unit and the HUS Logistics. This increases the flow of information, as well as the mutual understanding and quality of perceived service. A key to increasing efficiency lies in increasing the number of tasks performed during each route. Returning to the terminal represents a paralyzing and stopping time of the main tasks performed by the RS-Operatives: The time in the paperwork should be decreased to a minimum, in favor of more time for checking and shelving.

As RS becomes a more established service, and HUS Logistics Gains even more experience on the required service levels of different size units, clearer orientations can be defined in the service offered.

The expansion of the service has the potential to reduce the need for inventory at the level House. Because of the portfolio effect (described in the literature review) the effective management of inventories that decreases inventory levels in local storage, it will reduce the need for inventory throughout the system. The importance of the portfolio effect on general inventory needs will only increase once the HUS Logistics consolidate all of your larger storage facilities in a central installation, due to being ready at 2015. The cross docking becomes an important concept as the SR expands, since the house moves to a single centralized storage facility, minimizing interruptions in the regular supply chain (e.g. minimizing express orders) becomes even more important.

Restructuring and increasing efficiency will allow RS to expand at a faster rate than the number of operators required. Importantly, the expansion of RS will relieve some of the pressures on other functions performed by logistics. This thesis showed that the quality of the RS process is significantly better than that of the NRS, and the expansion of RS is expected, therefore, to decrease the returns in HUS Significantly. As explained earlier, this reverse logistics process ties a significant amount of resources in the recovery unit, which detect and report the error; of procurement services, which deal with supplier relations in cases where items are returned to them; and logistics operators, transporting and registering the items from the unit to the terminal, and from the terminal to the supplier.

The expansion of the RS is also foreseen to reduce scarcity and thus orders dispatched. Orders expressed mainly Logistic Strain Services, for which an express order requires separate handling and transportation. In addition, the expansion of the SR will decrease the share of requests that require assistance from the Helpdesk team, which assist the units in conducting orders.

If the positive effects of the expansion are reinforced by measures that reduce errors made by personnel ordering unstored items (e.g. education, ease of use of the ordering

platform) and measures that reduce express orders preventable (e.g. sensitization, clearer guidelines), some of the additional resources required by RS can be found within the organization. At the same time, the expansion of the customer base of HUS Logistics will likely mean that any decrease in resources in any division of the HUS Logistics is relative rather than absolute.

It is expected that the framework established in this thesis also fits as the RS is evaluated and developed in the future. This study intends to draw attention to the importance of considering the merits of the processes in a holistic way. It is, after all, very difficult to maximize the potential of a supply chain without a well-developed set of performance measures and metrics geared towards efficacy and efficiency (Gunasekaran et al., 2004).

5 Conclusion

This study proposed a new form of conceptualization of the different dynamics that are at stake when we talk about inventory management. This new conceptualization gains form when the elements are precisely defined as completely quantifiable.

There are many qualitative features of inventory management that are certainly interesting and important, especially when it is offered as a service. Still, the starting point, and in many ways the challenges encountered in the realization of this study, was to create a tool to evaluate the inventory management that was the most quantifiable and objective possible.

Reviewing the literature on inventory management and logistics in general, there is a lot of pertinent information as objectives, for example: Low inventory, high service level, low cost, shorter delivery times, predictability, responsiveness, etc., but there was no available tool that adequately integrated all these targets in a way that dealt with their conceptual conflicts and overlays.

This case study was applied as a method very rarely used in analyzing inventory effectiveness, concentrating on ordering behavior rather than the average of inventory levels, highlighting the need for a comprehensive segmentation of information before any conclusion using this method. Orders must be segmented by size, as effectively the size of the unit can allow a good and efficient order of the order. The size of the units affects for example the magnitude of the inventory and the amount of available storage space.

This study also finds an important way to dissect the types of orders from each other when preparing the data. The ability to optimize the ordering behavior differs and is highly dependent on the characteristics of the order and the type of requirement of the order.

This study aimed to compare two processes in a holistic and objective way. However, some limitations were found in its realization, more time and other resources to analyze in the process times would ideally contain more measures.

Processing times may not be considered infallible reflections of the entire stock, giving only a general knowledge of the magnitudes in question. In order to be able to have a more detailed design these same times could in future have an adequate indicator of requirements within an indicated environment.

The number of products stored in storage is the best indicator for understanding the storage management process. Having more product categories makes the task of manually monitoring the most exhausting stock levels, simply because that would be more things to take into account.

In the ordering phase the complexity of an order is not only with the same volume but also the way separate items are sent. In the storage phase, volumes play a role in the magnitude of the task, yet a larger and more complex storage room makes things in some way more difficult to determine the proper location of a commissioned product.

In order to gain efficiency in the way of perceiving the ordering behavior, a more meticulous study will have to be done delimiting the items studied for which are ordered in a more regular manner.

There are other interesting issues that deserve further study, for example in calculating costs related to the reverse logistics process associated with the cost of the order and with express orders, or for example quantifying the curve of Capacity of the units to have an operator in refueling services.

References

Beier, F. J. (1995). The management of the supply chain for hospital pharmacies: A focus on inventory management practices. Journal of Business Logistics, 16, 153-153.

Born, C., & Marino, D. (1995). Improving materials management through re-engineering. Healthcare Financial Management: Journal of the Healthcare Financial Management Association, 49(9), 30.

Iannone, R., Lambiase, A., Miranda, S., Riemma, S., & Sarno, D. (2013). Modelling hospital materials management processes.

Kumar, A., Ozdamar, L., & Zhang, C. N. (2008). Supply chain redesign in the healthcare industry of singapore. Supply Chain Management: An International Journal, 13(2), 95-103.

Beamon, B. M. (1999). Measuring supply chain performance. International Journal of Operations & Production Management, 19(3), 275-292.

Bowersox, D. J., Closs, D. J., & Cooper, M. B. (2002). Supply chain logistics management (2nd ed.). New York: McGraw-Hill.

Gunasekaran, A., Patel, C., & McGaughey, R. E. (2004). A framework for supply chain performance measurement. International Journal of Production Economics, 87(3), 333-347.

Chapter 5

Supply Chain Management: Sustainable Organization Abilities [5]

Macedo, Angely and Marques, Débora

Abstract

Sustainability has become an important variable to have in consideration when talking about organizations. The world is changing as are organizations, and we need to take our special attention to environment because it can change the whole idea we have about companies. Currently, organizations are trying to become more sustainable in order to achieve competitive advantage, which means that turning the supply chain into environmentally friendly will be beneficial for public recognition. This article will explore the issues related to the need of sustainability on the supply chain management. The purpose of this research is to establish the abilities of a sustainable organization through prior literature and to analyze its implementation into the supply chain management therefore delivering helpful insights both for academics and practitioners. A systematic literature review is the main methodological framework used to analyze this subject, which uses a quantitative approach while performing a qualitative research. Furthermore, the triple bottom line and Porter's value chain model are as well as used to provide useful guidelines for the research. The data, that will be presented, was collected during 2015 and 2016, including 2264 articles which 24 were chosen for the final discussion (Bo Wang, 2016). The outcomes provide us a general overview of present literature related to sustainable organizational competencies in supply chain management such us procurement, supplier evaluation, TI, among others.

Keywords: Systematic literature review, Supply chain management, Sustainability, Organization competence

[5]This paper is based on Wang, B. (2016). Sustainable organization capabilities in supply chain management (Master's thesis). Aalto University.

1 Introduction

Nowadays, organizations are facing a completely change in the way they interact with each other – globalization. Technological and infrastructure advances are the main reason why companies are directly connected to each other, which leads to the need for the development of their own competences. Organization capacities are the primary factor to compete with the competitors along with sustainability, which has gained an outstanding position between corporates through the latest years after the release of agreements like Kyoto protocol (Wang Y. et al., 2013). Environmental initiatives are being taken by companies in order to increase consumer satisfaction just as it provides more market value to the companies.

Sustainability is seen as a manner to build long-term value by considering how a given company operates in the social, economic and ecologic environment. Therefore, sustainability is developed on the supposition that elaborating such tactics stimulate company longevity.

The environment is an essential variable to allow the companies to obtain a competitive advantage. The capacities of a sustainable organization in relation to the supply chain have become the focus of the companies giving rise to a problem - environmental commercial barriers - which demands to act in accordance with the ecological aspects (Lai & Wong, 2012). Due to the evolution and complexity of these aspects, there is a need to organize and segment all the relevant literature on this subject - systematic literature review method.

The goal of this article is to be able to understand all the issues that comes with the implementation of sustainability in the supply chain. To do that, it is essential to change the concept of sustainable organization capabilities and focus more in the environmental impact.

The base of this discussion will be made of a systematic review, according to (Tranfiel, et al., 2003; Kitchenham, 2004; Hiroharu, et al.; 2016). It begins with recognizing the needs for the review, then developing a protocol and finally its implementation. There are two different ways of identifying the results of the systematic review. Firstly, we segment the chosen articles by theirs overall features. And then divide them based on their functionalities, such as: innovation capabilities, supplies capabilities, supply chain capabilities, IT capabilities and procurement capabilities.

The abstract article involves five stages – introduction, literature review, methodology, results analyzes and conclusion – that will give us a different perspective of corporates sustainability.

2 Literature Review

Organization capabilities are a substantial factor to have in consideration while talking about sustainability. Capability by itself stand for the aim of doing something (Dosi, et al., 2001). Recent literature affirms that capability can be defined has '*distinct competences that are difficult to imitate by current competitors, difficult to substitute by current and new competitors and valuable* (Mariadossa, et al., 2011)'. Some practices have been seen as the formation of capabilities. These

practices can be turned into skills that will allow us to know who has the better skills. If these strategic skills help a company achieving competitive advantage, it is possible to say that they are organization capabilities (Dosi, et al., 2001). Also, it is correct to say that, the idea of competence is, occasionally, seen as a variant of capabilities –competences are the company's capabilities that are vital for its survival (Prahalad & Hamel, 2000). Organization capabilities are derived from the resources – tangible and intangible – of a company (Schriber & LÖwstedt, 2015).

It is important to understand how organization capabilities helps an organization to be more sustainable. Sustainability can be defined as '*...Development that meets the needs of the present without compromising the ability of future generations* (Brundtland, 1987). The three major aspects that determine sustainability are the environment, economy and social, which can be analyzed in the triple bottom line theory (Elkington, 1997).

Social issues are the hardest ones to comprehend. We live among many cultures and it is difficult, for an only organization, to attend all of them. Due to the complexity of this topic, we will not explore it, in order to give more attention to economy and environment factors (Bo Wang, 2016).

Economic sustainability is one of the most discussed topics in these recent days because of the advantages it gives to the companies. People are starting to realize that many of the ecological problems we are facing – pollution, global warming – are due to companies' activities such as distribution and manufactory. In order to attend the need of being more sustainable, many environmental management standard certificates came into being, such as ISO 14001:2015, which offers guidelines for organizations to measure and diminish environmental impact. Adopting these standards will provide certain benefits to the companies, for example, compliance to regulations, better potential economic return as good as environmental gains (Nawrocka, et al., 2009).

Thus, turning organizations environmentally friendly will help obtaining competitive advantage and, in order to do that, it is necessary to analyze every point related with sustainable organization capabilities.

A value searching approach and a proactive approach are the best ways to deal with unsustainable organizational behaviors, because they incorporate sustainability in resource engagement and in product conception phase preventing environmental threats from occurring. Initiatives like these will demand cooperation from all the organization activities, particularly the supply chain activities (Hoek, 1999).

Supply chain management refers to the management of information and material flow in the course of multiple chain activities: transportation, purchasing, etc. (Lai & Wong, 2012). The purpose of transforming these activities eco-friendlier is to reduce all sorts of resource waste. All the activities need to follow this type of mentality with the intention of controlling all the product's life-cycle, without making unnecessary waste. Here appears the green supply chain management concept. It can be defined as '*adding the green component to supply chain management involves addressing the influence and relationship between the supply chain management and natural environment'* (Srivastara, 2007). From here, we are going to analyze various operational perspectives.

Transportation is one of the largest areas with the most emission of green gas (Greenhouse gas emission, 2015), and it will tend to grow over than 20% until 2050 (McKinnon, et al., 2012). With these statistics, organizations are fighting to reduce these repercussions without compromising their business operations. One way of minimizing these effects is to reshape the transportation vehicle itself, turning it eco-friendlier and more efficient.

Procurement is another important activity in supply chain management, which stands for the buying process of a company. It is essential to consider the different factors related to this topic, from the supplier itself to the material along with the delivery and so on. A way to prevent unnecessary wastes is to follow the concept of three R's – Reduce, Recycle and Reuse – that emphasize the need of saving resources (Zsidisin & Siferd, 2001).

Advances in technology are a component that has changed the supply chain management, providing the improvement of organization's sustainability as well as the performance. Thus, there are different manners of putting in practice these technological innovations, such as *freight consolidation* and *cross-docking.*

Industries are adopting another way of shipping their products – *freight consolidation* – which consist in transporting all the products all at once, achieving max freight utilization and generate less shipments. Some critics says that this may lead to delays although, the use of information systems may prevent this from happening.

Cross-docking is particularly used in retail industry's supply chain management activities, which minimize the warehouse nodes. Therefore, the warehouses are used as a distribution center, where the products go directly from the suppliers to the retailers.

Thereafter, a question is made: '*Can we be environmental friendly and profitable at the same time?'* (Polonsky & Rosenberger, 2001). To answer this question, it is necessary to understand the role that sustainable capabilities in organizations' supply chain management plays and how are they putted in practice.

3 Methodology

Systematic review is the research method used to better understand the phenomenon of sustainability. The adoption of this method is still insufficient regarding supply chain management, however, due to the progress evidenced in this method, it is possible to say that it is increasing. Systematic review can be defined as 'the fundamental scientific activity' (Cook, et al., 1997). It uses the meta-analysis method to test hypothesis or to provide statistical results, when the data or the topic of the research show incompatibility it is not necessary to engage in meta-analyzes. This can be quantified in three steps: Plan the review, Conduct the review, and Review the results.

Before referring, it is necessary to clarify a set of activities such as defining, defining and refining the issue of the topic discussed (Tranfield, et al., 2003). First, it is essential to assess how needs are used for systemic disease review. Another important aspect is the need for a review protocol. '*As a management review, the protocol is usually an open discussion on the topic of*

research to not limit the explorer's exploration on the subject' (Tranfield, et al., 2003). This acts impartially in all your research.

For a more detailed study on the subject, we first must establish the research method to be used, through newspapers, articles, books among others. In order to clarify and to discover the intended data. The choice of database is one of the elements to take into account in the implementation of the research. This in turn can have a direct influence on the search sequences as well as on the quality of the sample data. There are two ways to formulate research that should be considered during research. One of the ways to do research is to search with "Tufts University Libraries, 2016", that is, it is attributed a series of synonyms generated from an original concept. The other way of searching is by searching for keywords. DNA, OR are used in situations where there are multiple keywords (Kitchenham, 2004).

After the preparatory studies have been carried out, we can move on to the research. The method of data selection may vary according to different studies and usually consists of a few rounds. One way to select the search result is by reading article summaries, choosing those that have the most potential and relevance to the topic of the search, to see if they fit in the search.

'The quality of the research can be assessed by review' (Hiroharu, et al., 2016) *or 'review aganist criteria set ahead'* (Tranfield, et al., 2003). '*The assessment can be done by examining both internal and external perspectives'* (Kitchenham, 2004). The environment of the systematic review is quantifiable, studies claim that it is usually difficult to construct a review list for means of statistical models, especially in management research, since articles are elected based on the results of the subjects. Most of the time, the quality of the articles chosen are presented based on where they were published (Tranfield, et al., 2003).

Extraction of data is a regular way of recording the process of how the search is performed. Usually several rounds of data mining are practiced. Data extraction should be done by more than one person so that possible errors are detected (Tranfield, et al, 2003; Kitchenham, 2004), after data extraction a synthesis is formed.

In relation to the evaluation of the results this comprises two parts. One is to provide an overview of the articles summarizing the most relevant information from them, through an overview of tables and quantitative data. Then, a descriptive analysis should be drawn, where we can summarize the data by answering the research questions or clarifying new research within the field of research (Tranfield, et al., 2003).

The protocol review is developed to provide guidance for conducting the research. Due to narrative research methods and the nature of the research subject, critics have pointed out that managerial reviews provide biased perspectives. The benefit to face studies from previous research is that we can improve the quality of current research by developing useful guidelines for the future and absorb best practice from previous studies. In addition to that, *'synthesis of the best practice from previous research to formulate new research frameworks'* (Tranfield, et al., 2003), '*systematic review method has also been used in testing hypothesis'* (Kitchenham, 2004). The method of systematic reading review focuses on finding answers to the research questions through the unbiased search for the existing reading (Tranfield, et al., 2003). For traditional research

methods, systematic review of reading tends to be more time-consuming, however, informative and highlighted results still capture the interests of many researchers. According to Grant, there are usually two ways of dealing with the identification of a capacity organization (Grant, 2010).

The first is the category by functions of the organization, that is, '*an organization can be categorized by common functions, such as Research; Strategic; Marketing and development and so on'*. The capabilities of the organization within the function by strategy can be control of the Strategy, the development of the standard workflow among others. In the marketing role, examples of organizational skills can be, customer engagement, market understanding and brand benchmarking. In relation to the organizational capacities of the research and development function can be, research and development that meets the needs of the market, agile development etc.

The other way to identify the capabilities of an organization is to integrate it with the Porter value chain model (Porter, 1985; Grant, 2010). The Porter value chain offers a more comprehensive and systematic view that can be embraced by all organizations.

The aim of the value chain is to study the flow of value and, for organizations, the value is constantly created through exchange (Andrew Feller, 2016). The model of the value chain, according to the organizations point of view, is essentially focused on the study of the activities of the supply chain in the organization. While the supply chain prioritizes the low flow of goods; the value chain clarifies the upward flow of money. In addition, given the strong link between environmental management in operations management and the value chain model (Hayfield, et al., 1997), we can consider that the engagement of the value chain model in the construction of the theoretical framework for research, not only resonates with the concept of organizational capabilities, but also emphasizes the focus of the environment in the context of supply chain management, thus being our ideal choice.

It is crucial to understand how the review research method is conducted. The review process starts by defining the research scope; setting expectations for the study; and explaining what type of results are expected to achieve.

The research scope is based only in journal articles published in top level journals, since it will make it easier to compare the results. The quality of the research will be ensured due to this limitation on selected articles (Schmeisser, 2013). However, it is used all type of journals, from accounting sector to operations management sector. The chosen articles must be related to the sustainable organization capabilities or to the environmental practices in supply chain management in order to help on the research.

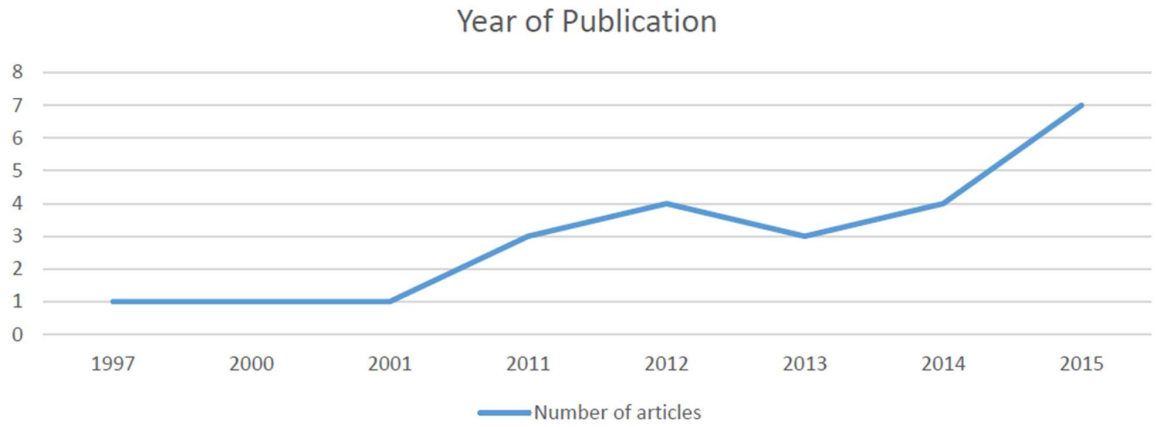
With the intention of selecting the appropriated articles, it becomes necessary to know which words are related to the topic – key words. A way to identify the key words is by studying the concept' background – sustainable capabilities –, thereby getting to know which words better apply to this study. Then it is possible to established search strings fulfilling the study purpose.

After consecutive analyzes, 24 articles were chosen to be used as groundwork of this research and, hopefully, to be capable to answer all the questions that were brought up during this investigation.

4 Results Analyzes

The chosen articles range from year 1997 to year 2015 overlaying different sorts of research, from peer review to hypothesis testing. Each one of them was analyzed by its content, research method, research topic along with the results. In order to manage all articles, they were all categorized in 5 different categories: Sustainable supply chain management capabilities, sustainable procurement capabilities, sustainable supplier assessment capabilities, sustainable information technology capabilities and sustainable innovation capabilities.

Sustainability in supply chain management became a thing of discussion in the 90s but only in 20th century has started to become more relevant in organizations. Therefore, relevant articles only became to appear after the 90s. It should be noted that sustainability research articles had been growing in the last decades, and it is noticeable that the most relevant articles were published after 2010.



As mentioned before, it was adopted a value chain model as a guidance for generating search strings, but this brought some problems because it was to notice that some of the results were repeating each other. However, an exploration with different research sequences is attributed to a heterogeneous one, which in turn leads to a difficult grouping. Thus, a way to solve the previously announced, is a possibility of a cluster with reference to different subcomponents. This way you can see lapses between a study area and a reading.

In fact, there are two ways to study the articles mentioned. One of them is the division by sections of the same from their functionalities thus enabling the necessary conditions to answer the research question: 'What is sustainable capabilities in organization's supply chain management?'. The other form is based on the research sector, thus answering the second question: 'How are they used in practice'.

After the reading and complete interpretation of the articles, we can verify that the articles provide a better analysis categorized by functionalities, even if the research is done through a set of procedures. It is also relevant to verify the different industry practices that are studied under the same function. Thus, the following functions were selected as unit of analysis and, for each section.

The study begins with a discussion of sustainable capabilities in the supply chain, covering some capabilities that influence the network or total supply chain. Proceeding with more functional built-in capabilities from procurement, supplier management to IT innovations. Therefore, it is vital to discuss and compare the sustainable supply chain management capabilities and practices.

The Environmental Management System is usually present in the early relevant literature (Rondinelli & Berry, 2000; Zsidisin & Siferd, 2001), and it contributes to various operations, therefore it is an organization capability. Rondinelli analyzed different forms of transportation and their environmental impact and, based on that information, he has developed an Environmental Management System which can monitor and reduce environmental effects based on transportations activities (Rondinelli & Berry, 2000), while Zsidisin decided to approach the issue through product innovation and life cycle perspective (Zsidisin & Siferd, 2001).

A way to improve a company's performance is by connecting quality management, environmental management and green supply chain management. This is the result of a survey conducted on 95 Brazilian companies (Jabbour, et al., 2015).

It is fundamental understanding how important is a velue chain. A value chain connects the evaluation of value with supply chain activities and, consequently, numerous of the researches united the matter of operations performance and sustainable capabilities together (Handfield, et al., 1997; Lai & Wong, 2012). The operation performance and sustainable capabilities are linked topics, however both articles have shown that economic performance is not really related to one company's sustainable capability. Even though both articles have formulated the significance of customer needs when adopting sustainable initiatives, the outcome against regulation are different. Handfield says that environmental regulations are merely reaching the bottom-line (Handfield, et al., 1997) while Lay claims that regulations present a positive impact on organizations' environmental orientation (Lai & Wong, 2012).

Food and service industry is a category destined to companies that stands for '*consumption of nature resources* (Wang, et al., 2013)' and '*the biggest impact is the goods we source* (Spence & Rinaldi, 2014). Spence used an innovative method by building the idea of analytics of governmentality and implemented it in the object of study in food and beverage industry. The outcome demonstrated that this can provide a list of things needed to help organizations in involving sustainability and handover it into economic value, as good as analyzing the environmental and financial performances. The Environmental-Financial method was applied by Jacksona in the United States industry (Jacksona & Singhb, 2015). The result of this indicate that companies are devoted to sustainable initiatives as well as performing efficiently in terms of financial outcomes. This result has favorable implications for organizations to look at sustainable initiatives in the future. On the other hand, Wang's research is based on the analyze of green supply chain management in the restaurant industry (Wang, et al., 2013). By elaborating the idea of "green restaurant", that involves green supply chain management thinking where it is developed the framework of the study.

Eventually, a question is made "How do practices transfer into capabilities?". After analyzing some environmental management system practices (Rondinelli & Berry, 2000) and compliances

of regulation (Lai & Wong, 2012), it is correct to say that practices don't turn into capabilities by themselves. The successful stationing of practices for companies is what causes competitive advantage, thus developing organization capabilities (Zahay & Hanfield, 2004).

Now it is important to which things provide methods for choosing the right practices for firms to adopt thus would help in creating organization capabilities.

With sustainable practices, discussed earlier it becomes possible to enumerate some sustainable practices for organizations. "But is everything for everyone?" Among so many market initiatives, how would companies select the best initiatives tailored to their operations? "Under a complex organizational climate, it is necessary to involve the supply chain data network in the evaluation of standards that must be defined." According to some studies of the focus of the company is ringtones the same to behavior same with an antibody of other senses peritus.

According to Govindan's article, he considers the supply chain as a whole and breaks the management of the green supply chain in different practices for discussion (Govindan, et al., 2015). Practices that include the purchase of emission management, product desing, customer orientation and suppliers. In order to test the set of practices previously mentioned and their significance in organizations with intuitionistic fuzzy theory, a self-motivating company is used as a case study. The article provides a good way for companies to identify the different sustainable practices and their importance in managing the organization. According to Wang its purpose is also to provide a model for companies to select sustainable initiatives for them. The fuzzy approach was implemented to evaluate the three dimensions of an organization, the organization, environmental performance, and resource aspects. In short we can conclude that a fuzzy approach is a good method to help transfer the right practices into capabilities.

Of the five selected articles, these focus on the area of sustainable shopping research (Walker et al., 2012; Zsidisin & Siferd, 2001; Tate, et al., 2012) . Two of them emphasize the study of the relevant practices in the public sector, while the others emphasize the theoretical aspects of the theme.

Both articles argue that about 15% to 20% of GDP is devoted to the acquisition of the public sector (Correia et al., 2013, Mansi, 2015), although the geographic region exposed was different. As a consequence of economies of scale, researchers believe that studying only sustainable public sector procurement is sufficient. While one commits itself to buying renewable resources that can save more energy, other advocates buying the right thing. On the other hand, Fernando defends the sustainable public purchases of the European countries emphasized the low carbon emission. By virtue of this we can conclude that the articles address the importance of formalities and government and policies in order to help and promote sustainable procurement in the public sector.

According to Zsidisin on the organizational network to the supply chain, it began by placing sustainable procurement in the context of supply chain management, then reduced the organizational level of sustainable procurement as a centralized discussion area in which, engaged the '*transaction cost analysis for companies to identify what are the core competences and brought*

up the potential question that whether some of the supply chain activities should be outsourced (Zsidisin & Siferd, 2001)'.

In the discussion of a company's point of view in accordance Tate, quickly captured the key variable in green supply chain management, meaning in fact some of the supply chain activities are considered outsourced to suppliers.

Some studies on purchasing and green supplier being the main topics in the management of the green supply chain show the direct impact that these two components have on the environmental level.

After analyzing the articles, it is deductible that sustainable procurement capabilities are universal therefore provide us homogenous outcomes. Almost all of them referred to the product life cycle from end to end (Walker, et al., 2012; Correia, et al., 2013; Mansi, 2015; Zsidisin & Siferd, 2001; Tate, et al., 2012). So, it is possible to evaluate these capabilities in the future.

Supplier management is an area easy to be ignored because of the place it takes inside supply chain. '*Being partially responsible/liability for unsustainable behavior gives it a mysterious and safe veil to hide behind, as well less pressure for making changes* (Caniëls, et al., 2013). However, the importance of supplier management from a supply chain system perspective has been discussed in recent studies.

Supplier assessment after green purchasing is the focus of an article (Large & Thomsen, 2011), which says that the amount of supplier greenness influences all the supply chain activities and it is necessary to improve environmental outcomes. On the contrary, Tate believes that suppliers provide the things needed to be more environmentally friendly. Tate says that the future research regarding sustainable supplier management ought to reside in the area of analyzing supplier initiatives (Tate, et al., 2012).

Supplier assessment capabilities are an issue brought up in several articles. Kumar built a conceptual model to choose sustainable suppliers by surveillance their activities regarding theirs carbon footprint (Kumar, et al., 2014). In Evangelista research, he saw that support from government is the key to suppliers adopt a green activity (Envagelista, 2014). Caniels says that internal capabilities, customer requirements and cooperative relationship between customer and supplier are the essential to providers incorporate sustainable initiatives (Caniels, et al., 2013).

Shortage of IT skills may contribute to the adoption of not sustainable initiatives (Envagelista, 2014), so it becomes crucial to understand the IT capabilities and the reason why they are linked to company's sustainable capabilities.

Information Technologies environmental integration system is a very frequent IT capability, which can increase energy efficiency inside companies (Wang, et al., 2015; Dao, et al., 2011). While studying sustainable IT capabilities, resource-based view is generally employed (Wang, et al., 2015; Dao, et al., 2011). Wang's article says that IT capabilities can affect a company's environmental performance and this influence is higher when a company is always developing its own capabilities to reach sustainability (Wang, et al., 2015). It is also said that the analysis of IT capabilities in environmental outcome context is still in its premature and future investigation areas ought to come from IT industry perspective (Dao, et al., 2011). Dao used resource-based view with

Triple bottom line theory to generate his theoretical scheme which approaches resources and IT capabilities as one total and stick them jointly in a wider concept to be developed with Human Resources management and supply chain management. Therefore, it allows IT capabilities to have more things to create than just establishing energy efficiency (Dao, et al., 2011).

Sustainable IT is linked with innovation, so it is essential to analyze this from information technology process perspective (Wang, et al., 2015; Dao, et al., 2011) to technology process and product innovation. The outcome of the connection of various green supply chain practices with technology innovation demonstrated favorable links between them (e.g. eco product design) (Lee, et al., 2014).

Sharma, engaging resource-based view, follows the same thinking as Lee. Sharma demonstrated that developing a product with minimum resources leads to the concept of green products, and such outcome show us the significance innovation capability while developing a product, providing competitive advantage to the companies while preserving sustainability at the same time (Sharma & Iver, 2012). Gabler developed the concept of "eco-capability" during his article (Gabler, et al., 2015) which stands for the fact that organizations that develop their own capabilities, combining sustainability and innovation, would be more propense to achieve competitive advantage.

The priority between the nature elements of IT and innovation, is needed that is convenient leadership in the practice activities in the practice. Resource-focused vision, such as the constitutive principles of competitive organizations' competition, can be combined as the environmental focus.

5 Conclusion

In our days, it is essential to be aware of the environmental problems we are facing. We are running out of resources and, consequently, it is necessary to stop wasting materials in unnecessary activities. In order to people and organizations fight these problems, it is crucial to turn organization's activities environmentally friendly. In this article was discussed the connection between supply chain management with organizations environmental capabilities.

This study uses s systematic literature review while studying sustainable organizations capabilities and its consequences in the supply chain management area. Proof of reservation that their activities are sustainable and meaningful. The purpose this article is to study the issues related to sustainable activities in the company. In addition, it aims to seek and clarify as possibility the things connected to environment and organizations for future studies and provide useful guidelines for its management.

It was created a systematic review protocol based on (Hiroharu, et al, 2016, Tranfield et al., 2003 and Kitchenham, 2004) with the purpose of analyzing this issue carefully. From all the articles found about the subject, only 24 were chosen in order to answer the questions brought up during the research. These questions were answer in 2 different ways – a quantitative and qualitative overview. The result says that there are 5 main current research areas concerning

sustainable capabilities – supply chain, procurement, supplier assessment, information technology and innovation – which contribute to build a guideline for corporate to check organization current operations.

In all areas, organizations results have shown a great tendency in the use of sustainable capacities. A strong focus was given to the manufacturing industry, enables us to provide much more comprehensive insights for managers as well as for a manufacturing industry. This will make organizations dealing better with issues related to these topics.

From an administrative view, three areas of specification can be highlight. First, the involvement of senior management is fundamental to the qualification of a sustainable organization. Top management's support is crucial for company's development, and it will provide organizations to identify and eliminate unsustainable behaviors. Allowing companies to be environmentally friendly lead to the improvement of sustainable capabilities. Second, the resource-based view resembles the concept of high-level support. Resource-based view can be embedded in organizations while managers are available within the organization as well as helping organizations gain competitive advantage (Lee, et al., 2014; Sheu & Talley, 2011; Sharma & Iyer, 2012). Finally, the use of the Rs (reuse, recycle, reduce, resell, etc.) can increase the company's performance in order to reduce environmental wastes (Lee, et al., 2014; Lai & Wong, 2012). The implementation of the R's can be profitable for the companies because they can reduce amounts of money they used while manufacturing products, etc. The R's are mainly focused on Reduce, Reuse and Recycle, and this stands for the goal of trying to stop the overusing of natural resources.

The outcome of this study is predicted to provide useful insights for practitioners as good as helping researchers in detecting ongoing research possibilities and possible research gaps by offering a systematic literature review on the present researches that have been made on the issue. With this information, people in the future, who have the interest of studying these issues, can more easily develop their vision of the matter.

In conclusion, it is expected to organizations improve their sustainable capabilities in order to reduce superfluous waste. In the world we live in, it is crucial to adopt these measures in order to people in future may be able to survive. People and organizations immediately need to reduce or even stop the use of some natural resources that are becoming extinct.

References

Wolf, C., & Seuring, S. (2010). Environmental impacts as buying criteria for third party logistical services.

International Journal of Physical Distribution & Logistics Management, Vol. 40 Iss: 1/2, 84 - 102.

(2007). Retrieved from Eurostat: http://ec.europa.eu/eurostat/en/web/products-statistics-in-focus/-/KS-

SF-07-117

(2008). Retrieved from Center for Climate and Energy Solutions: http://www.c2es.org/technology/overview/buildings

(2014, march). Retrieved from Walmart blog: http://blog.walmart.com/the-future-of-fleet-efficiency (2014). Retrieved from Walmart: http://corporate.walmart.com/global-responsibility/environment-sustainability/truck-fleet

(2014). Retrieved from Energy efficiency lighting: http://eartheasy.com/live_energyeff_lighting.htm Akwasi. (2013). *CROSS DOCKING; WALMAT'S INVENTORY STRATEGY* . Retrieved from http://cmuscm.blogspot.fi/2013/02/cross-docking-walmats-inventory-strategy_12.html

Aliakbar, H., & Khosrojerdi, A. (2016). Robust global supply chain network design under disruption and uncertainty considering resilience strategies: A parallel memetic algorithm for a real-life case study. *Transportation Research Part E: Logistics and Transportation Review, Volume 87,*, 20-52.

Andrew Feller, D. D. (2016). Value Chains Versus Supply Chains. *BPTrends*.

Aral, S., & Weill, P. (2007). IT asserts, Organizational capabilities, and Firm performance: How resouce allocations and organizational differences explain performance variation. *Organization Science*, page 763-780.

Aydin, G., Cattani, K., & Druehl, C. (2014). Global supply chain management. *Business Horizons*, 453-457.

Bilbao, A. M., Carrano, A., Hewitt, M., & Thorn, B. (2011). On the environmental impacts of pallet management operations. *Management Research Review, Vol. 34 Iss: 11,*, 1222 - 1236.

Blaxter, M. (1996). Criteria for the evaluation of qualitative research papers. *Medical sociology news*. *Boston college*. (n.d.). Retrieved from https://www2.bc.edu/

Brundtland, G. H. (1987). *the Brundtland Report.*

Buildings and Emissions: Making the Connection. (2008). Retrieved from Center for climate and energy solution: http://www.c2es.org/technology/overview/buildings

Caniëls, M. C., Gehrsitz, M. H., & Semeijn, J. (2013). Participation of suppliers in greening supply chains: An empirical analysis of German automotive suppliers. *Journal of Purchasing and Supply Management, Volume 19, Issue 3,*, Pages 134-143.

Caron, J., Durand, S., & Asselin, H. (2016). Principles and criteria of sustainable development for the mineral exploration industry. *Journal of Cleaner Production, Volume 119*, 215-222.

Carter, C., & Easton, P. (2011). Sustainable supply chain management: evolution and future directions.

International Journal of Physical Distribution and Logistics Management, 46-62.

Carter, C., & Rogers, D. S. (2008). A framework of sustainable supply chain management: moving toward new theory. *International Journal of Physical Distribution & Logistics Management, Vol. 38 Iss: 5, pp.*, 360 - 387.

Christensena, W., Germain, R., & Birou, L. (2005). Build-to-order and just-in-time as predictors of applied supply chain knowledge and market performance. *Journal of Operations Management, Volume 23, Issue 5,*, 470-481.

Christina Wolf, S. S. (2009). Envrionmental impacts as buying criteria for third party logistical service.

International journal of Physical Distribution& Logistics management.

Cook, D. J., Mulrow, C. D., & Haynes, R. B. (1997). Systematic Reviews: Synthesis of Best Evidence for Clinical. *Annals of Internal Medicine*, 126:376.

Correia, F., Howard, M., Hawkins, B., Pye, A., & Lamming, R. (2013). Low carbon procurement: An emerging agenda. *Journal of Purchasing and Supply Management, Volume 19, Issue 1,*, Pages 58-64.

Dao, V., Langella, I., & Carbo, J. (2011). From green to sustainability: Information Technology and an integrated sustainability framework. *The Journal of Strategic Information Systems, Volume 20, Issue 1,*, Pages 63-79.

Dosi, G., Nelson, R. R., & Winter, S. (2001). *The Nature and Dynamics of Organizational Capabilities.* Oxford University press.

Elkington, J. (1997). *Cannibals With Forks: The Triple Bottom Line of 21st Century Business. Energy efficient lighting*. (2014). Retrieved from Eartheasy: http://eartheasy.com/live_energyeff_lighting.htm

Evangelista, P. (2014). Environmental sustainability practices in the transport and logistics service industry: An exploratory case study investigation. *Research in Transportation Business & Management, Volume 12,*, Pages 63-72.

Fretheim, E. (2014). *The future of fleet efficiency*. Retrieved from Walmart blog: http://blog.walmart.com/the-future-of-fleet-efficiency

Gabler, C. B., Richey, R. G., & Rapp, A. (2015). Developing an eco-capability through environmental orientation and organizational innovativeness. *Industrial Marketing Management, Available online 12 March*, In Press, Corrected Proof.

Govindan, K., Khodaverdi, R., & Vafadarnikjoo, A. (2015). Intuitionistic fuzzy based DEMATEL method for developing green practices and performances in a green supply chain. *Expert Systems with Applications, Volume 42, Issue 20, 15*, Pages 7207-7220.

Grant, R. M. (2010). *Contemporary strategy analysis.*

Greenhouse gas emission statistics . (2015). Retrieved from Eurostat: http://ec.europa.eu/eurostat/statistics-explained/index.php/Greenhouse_gas_emission_statistics

Greenhouse gas emission statistics. (2014). Retrieved from eurostat: http://ec.europa.eu/eurostat/statistics-explained/index.php/Greenhouse_gas_emission_statistics

Gunasekaran, A., & Cheng, T. E. (2008). Special Issue On Logistics: New Perspectives and Challenges.

Omega.

Gunasekaran, A., & Cheng, T. E. (2008). Special Issue on Logistics: New Perspectives and Challenges, Volume 36, Issue 4,. *Omega*, Pages 505–508.

Handfield, R. B., Waltonb, S. V., Seegersc, L. K., & Melnyka, S. A. (1997). 'Green' value chain practices in the furniture industry. *Journal of Operations Management, Volume 15, Issue 4,*, Pages 293–315.

Haw-Jan Wu, S. C. (1995). Environmentally responsible logistics systems. *International Journal of Physical Distribution & Logistics Management*.

Hiroharu , K., Tsutani, K., Katsumata, Y., Yoshizaki, T., Okuizumi, H., & Okada, S. (2016). Effectiveness of Pilates exercise: A quality evaluation and summary of systematic reviews based on randomized controlled trials. *Complementary Therapies in Medicine, Volume 25,*, 1-9.

Hoek, R. I. (1999). "From reversed logistics to green supply chains", Vol. 4 Iss: 3, pp.129 - 135. *Supply Chain Management: An International Journal,*.

Holweg, M., & Miemczyk, J. (2002). Logistics in the "three-day car" age: Assessing the responsiveness of vehicle distribution logistics in the UK". *International Journal of Physical Distribution & Logistics Management, Vol. 32 Iss: 10,*, 829 - 850.

Hussain, M., Khan, M., & Al-Aomar, R. (2016). A framework for supply chain sustainability in service industry with Confirmatory Factor Analysis. *Renewable and Sustainable Energy Reviews*, Pages 1301–1312.

Hülsmann, M., & Pfeffermann , N. (2011). *Strategies and Communications for Innovations, An Integrative Management View for Companies and Networks.*

Itella Annual Report. (2013). Retrieved from Itella: http://annualreport2013.itella.com/en/business- groups/itella-logistics/trade-between-finland-and-russia

Jabbour, A. B., Jabbour, C. J., Latan, H., Teixeira, A. A., & Oliveira, J. H. (2015). Reprint of "Quality management, environmental management maturity, green supply chain practices and green performance of Brazilian companies with ISO 14001 certification: Direct and indirect effects". *Transportation Research Part E: Logistics and Transportation Review, Volume 74,*, Pages 139-151.

Jacksona, L. A., & Singhb, D. (2015). Environmental rankings and financial performance: An analysis of firms in the US food and beverage supply chain. *Tourism Management Perspectives, Volume 14,*, Pages 25–33.

Jonah C. Tyan, F.-K. W. (2002). An evaluation of freight consolidation policies in global third party logistics.

The international journal of management science.

Kitchenham, B. (2004). *Procedures for performing systematic reviews.* Australia: Keele University Technical report.

KPMG. (2011). *International survey of corporate responsibility reporting.*

Kristin J. Lieb, R. C. (2010). Environmental sustainability in the third-part logistics (3PL) industry.

International Journal of Physical Distribution& Logistics Management.

Kumar, A., Jain, V., & Kumar, S. (2014). A comprehensive environment friendly approach for supplier selection. *Omega, Volume 42, Issue 1,*, Pages 109-123.

Lai, K.-h., & Wong, C. W. (2012). Green logistics management and performance: Some empirical evidence from Chinese manufacturing exporters. *Omega, Volume 40, Issue 3,*, Pages 267-282.

Large, R. O., & Thomsen, C. (2011). Drivers of green supply management performance: Evidence from Germany. *Journal of Purchasing and Supply Management, Volume 17, Issue 3,*, Pages 176-184.

Lee, V.-H., Ooi, K.-B., Chong, A. Y.-L., & Seow, C. (2014). Creating technological innovation via green supply chain management: An empirical analysis. *Expert Systems with Applications, Volume 41, Issue 16,*, Pages 6983-6994.

Lieb, K., & Libe, R. (2010). Environmental sustainability in the third-party logistics (3PL) industry.

International Journal of Physical Distribution & Logistics Management, Vol. 40 Iss: 7, , 524 - 533.

Luo, X., & Bhattacharya , C. (2006). Corporate Social Responsibility, Customer Satisfaction, and Market Value. *Journal of Marketing, 70 (4),*, 1-18.

Mansi, M. (2015). Sustainable procurement disclosure practices in central public sector enterprises: Evidence from India. *Journal of Purchasing and Supply Management, Volume 21, Issue 2*, Pages 125-137.

Mariadossa, B. J., Tansuhaja, P. S., & Mourib, N. (2011). Marketing capabilities and innovation-based strategies for environmental sustainability: An exploratory investigation of B2B firms. *Industrial Marketing Management, Volume 40, Issue 8,*, Pages 1305–1318.

McKinnon, A., Browne, M., & Whiteing, A. (2012). *Green Logistics: Improving the Environmental Sustainability of Logistics.* Kogan page Limited.

McKinnon, A., Browne, M., & Whiteing, A. (2012). *Green Logistics: Improving the EnvironmentalGreen Logistics: Improving the Environmental Sustainability of Logistics.* Kogan page Limited.

Mckinsey. (n.d.). Retrieved from http://www.forbes.com/2010/03/05/building-organizational-capability- leadership-managing-mckinsey.html

Nawrocka, D. (2008). Environmental supply chain management, ISO 14001 and RoHS. How are small companies in the electronics sector managing? *Corporate Social Responsibility and Environmental Management, 15 (6)*, 349–360.

Nawrocka, D., Brorson, T., & Lindhqvist, T. (2009). ISO 14001 in environmental supply chain practices.

Journal of Cleaner Production.

Nidumolu, R., Prahalad, C., & Rangaswami, M. (2009). Why Sustainability Is Now the Key Driver of Innovation. *Harvard Business review*.

Nike. (2009). *Nike corporate responsible report FY 07-09.* Retrieved from http://www.nikebiz.com/crreport/content/pdf/documents/en-US/full-report.pdf

Nike, I. (2009). *Corporate Responsibility.* Retrieved from Nike: http://www.nikebiz.com/crreport/content/environment/4-3-5-inbound-logistics.php?cat=climate- and-energy

Nisen, M. (2013, May 9). *How Nike Solved Its Sweatshop Problem*. Retrieved from Business insider: http://www.businessinsider.com/how-nike-solved-its-sweatshop-problem-2013-5?IR=T

Polonsky, M., & Rosenberger, P. (2001). Reevaluating green marketing: A strategic approach. *Business Horizons*.

Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance.*

Prahalad, C., & Hamel, G. (2000). The Core Competence of the Corporation. In *Strategic Learning in a Knowledge Economy* (pp. 3-22).

Q. Zhu, J. S. (2008). Confirmation of a measurement model for green supply chain management practices implementation. *International Journal of Production Economics, 111 (2)* , 261–273.

Rondinelli, D., & Berry, M. (2000). Multimodal transportation, logistics, and the environment: managing interactions in a global economy. *European Management Journal, Volume 18, Issue 4*, Pages 398- 410.

Schmeisser, B. (2013). A Systematic Review of Literature on Offshoring of Value Chain Activities. *Journal of International Management*, 390-406.

Schriber, S., & Löwstedt, J. (2015). Tangible resources and the development of organizational capabilities.

Scandinavian Journal of Management, Volume 31, Issue 1,, Pages 54–68.

Sharfman, M., Shaft, T., & Anex, R. (2009). The road to cooperative supply-chain environmental management: trust and uncertainty among pro-active firms. *Business Strategy and the Environment, 18 (1)* , 1-13.

Sharma, A., & Iyer, G. R. (2012). Resource-constrained product development: Implications for green marketing and green supply chains. *Industrial Marketing Management, Volume 41, Issue 4,*, Pages 599-608.

Sheu, J.-B., & Talley, W. (2011). Green Supply Chain Management: Trends, Challenges, and Solutions.

Transportation Research Part E: Logistics and Transportation Review, Volume 47, Issue 6,, Pages 791-792.

Spence, L. J., & Rinaldi, L. (2014). Governmentality in accounting and accountability: A case study of embedding sustainability in a supply chain. *Accounting, Organizations and Society, Volume 39, Issue 6,*, Pages 433-452.

Srivastara, S. (2007). Green supply-chain management: a state-of-the-art literature review. *International Journal of Management Reviews*, 53-80.

Tate, W. L., Ellram, L. M., & Dooley, K. J. (2012). Environmental purchasing and supplier management (EPSM): Theory and practice. *Journal of Purchasing and Supply Management, Volume 18, Issue 3*, Pages 173-188.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*.

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management*, 207–222.

Transport 117/2007. (2007). Retrieved from Eurostat.

Tufts University Libraries. (2016, Jan 5). Retrieved from Systematic Reviews: http://researchguides.library.tufts.edu/c.php?g=249127&p=1658789#12780103

Tyan, J., Wang, F.-K., & Du, T. (2002). An evaluation of freight consolidation policies in global third party logistics. *The international journal of management science*.

Tüselmann, H., Sinkovics, R. R., & Pishchulov, G. (2015). Towards a consolidation of worldwide journal rankings – A classification using random forests and aggregate rating via data envelopment analysis. *Omega*, 11-23.

Ulrich, K. (2011). *Strategies and Communications for Innovations.*

Walker, H., Miemczyk, J., Johnsen, T., & Spencer, R. (2012). Sustainable procurement: Past, present and future. *Journal of Purchasing and Supply Management, Volume 18, Issue 4,*, Pages 201-206.

Wang, X. (2015). A comprehensive decision making model for the evaluation of green operations initiatives.

Technological Forecasting and Social Change, Volume 95,, Pages 191-207.

Wang, Y., Chen, S., Lee, Y., & Tsai, C. (2013). Developing green management standards for restaurants: An application of green supply chain management. *International Journal of Hospitality Management, Volume 34*, Pages 263-273.

Wang, Y., Chen, Y., & Amado, J. B. (2015). How information technology

influences environmental performance: Empirical evidence from China. *International Journal of Information Management, Volume 35, Issue 2,*, Pages 160-170.

Vanpoucke, E., Vereecke, A., & Wetzels, M. (2014). Developing supplier integration capabilities for sustainable competitive advantage: A dynamic capabilities approach. *Journal of Operations Management*.

Wu, H.-J., & Dunn, S. C. (1995). Environmentally responsible logistics. *International Journal of Physical Distribution & Logistics Management*, 20-38.

Zahay, D. L., & Handfield, R. (2004). The role of learning and technical capabilities in predicting adoption of B2B technologies. *Industrial Marketing Management, Volume 33, Issue 7,*, Pages 627–641.

Zsidisin, G. A., & Siferd, S. (2001). Environmental purchasing: a framework for theory development.

European Journal of Purchasing & Supply Management, Volume 7, Issue 1, Pages 61-73.

Chapter 6

The Problematic of Inventory Management in Small Business [6]

Ferro, Igor and Gomes, Daniela

Abstract

In this article, the authors identified the problem of inventory management in small businesses, particularly at HEM-SOL FORSALJINING AB, a company in the market of the gym sports equipment, and proposed suggestions capable of dealing with these issues. For this, the need for information arrived. Then, the authors resorted to several sources in order to find the interviews with the managers and controllers of inventory operations and secondary data retrieved from the information system that provided the annual purchasing and sales report of various items. With the notion that small entities have restricted financial resources and negotiating power and that the aim is to improve the company performance by dealing with the relations with long-distance suppliers, big fluctuation in demand and the lack of formalized inventory control systems, the authors evaluate all the retracted data and established a formal inventory control system.

[6]This paper is based on Bai, L., & Zhong, Y. (2008). Improving inventory management in small business: A case study (Master's thesis). Jonkoping University.

1 Introduction

Beginning with the background of this case, in accordance with Toomey (2000) (cited by Bai and Zhong, 2008), "The American Production and Inventory Control Society (APICS) define inventory management as the branch of business management concerned with planning and controlling inventories".

Logistics is directly correlated with inventory management in the way that it is necessary to deliver the right finished product, at the right place, time, quantity, condition and cost. That is why effective inventory management is essential and becomes a central part of supply chain management (SCM), which enhances the company competitive strength. Therefore, it is an issue for many companies since it coordinates and integrates several activities such as "sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, delivery to the customer and the information systems necessary to monitor all of these activities" (according to Lam and Postle (2006); cited in Bai and Zhong, 2008).

As said, inventory management is a crucial problem for all types of companies: large, medium-sized and small. More than 99 percent of European companies are considered small and medium-sized (SME), thus contributing immensely for the region economy. Big companies have gained much from SCM techniques, is it possible to integrate such system focused on inventory management in a small enterprise?

The greatest challenge of inventory management is to balance the supply with the demand. The company preferably would have enough inventory to satisfy the demands but not so much that costs are incremented. This is the problem of the studied company, HEM-SOL, in which the stocks are in excess, demonstrating the incapability of determining the right quantity of the demand during a specific period for each product and that the lead-time of most products is long.

The result of this study has a limited perspective because it is not a longitudinal study due to the little time had and the fact that it was not possible to reach out to other actors in the supply chain network, harming its credibility.

In terms of disposition this article follows a structure in which in the first place, it will be outlined the literature review, secondly the methodology and the findings, thirdly the results analysis, suggestions and finally the conclusion.

2 Literature Review

The buzzword Supply Chain Management (SCM) is a set of approaches used effectively to link upstream (supply and manufacturing) and downstream (logistics and distributions) value chain entities toward facilitating information exchanges, materials and cash flows (Kukalis, 1989). Thereby, inventory management is the term to refer to alterations in inventories levels that influence a company's financial results. However, a challenge comes up: the difficulty to

forecast demand and expectations of customers about the products availability and diversity (colors, package type and so on) (Coyle et al.,2003).

In this context, the demand management arises as the effort to determine and manage customers demand and to figure operating decisions (Blackwell & Blackwell,1999; cited in Coyle et al.,2003). There are two concepts that must be distinguished: independent demand and dependent demand. Independent demand/ distribution inventory/ finished product inventory occurs based on external market requirements instead of being associated to another items' demand, for example the demand of consumer goods market. On the other hand, dependent demand/ manufacturing inventory/ raw material inventory/ work-in-progress inventory depends on the other items' requirements in the manufacturing process, for example the requirement of components/ parts fundamental to finish some products (Simchi-Levi, Kaminsky & Simchi-Levi, 2004; Toomey, 2000). Thus, inventory supply and demand should be aligned and there are some approaches to concretize this. For dependent demand, Just-in-Time (JIT) and Materials Requirements Planning (MRP) systems are more appropriate to attain efficiency while for independent demand it is used the Cross-docking. Also, there is a system that is applicable in both dependent and independent demand which is Vendor-managed-inventory (VMI).

The old-style way to forecast demand is by using historical data to predict the future demand. Yet, it is not totally precise as it is very improbable that the actual demand equals forecast demand. So, aggregate forecasts and forecasts near-future demand are more accurate (Nahmias, 1997; cited in Simchi-Levi., 2004). Stock-out happens when the supplier is incapable of satisfying demand with the available inventory. In this case, four scenarios can happen: the sale is lost, the customer waits until refill, back orders the product or lose the client (Coyle et al., 2003). In contrast, safety stock protects against fluctuations in demand or supply (Toomey, 2000), avoiding stock-outs and diminishing of the customer service level. For this, the quantity set should cover more than normal demand during the replacement lead time (Krajewski & Ritzman, 2002).

Inventory turns shows the annual number of times that average inventory sells. To increase this number, the company needs to hold fewer inventories on average while fulfilling the demand (Goldsby et al., 2005). Mathematically, inventory turns are expressed as:

$$Inventory\ turns = \frac{Sales\ volume\ at\ cost}{Value\ of\ average\ inventory}$$

Several parameters must be considered from different perspectives in order to evaluate the performance of a supply chain. Though, some of them constitute tradeoffs of inventory, in other words, conflicting goals in SCM. Three tradeoffs were identified: Product variety-inventory tradeoff (the supplier wants to increase sales and product variety, but that is impossible without increasing inventory levels); Lot size-inventory tradeoff (manufacturers want to have large lot sizes to reduce costs per unit. However, typical demand does not come in large lot sizes, leading

to high inventory); and Transportation cost-inventory trade-off (full loads reduce transportation costs. Conversely, demand is in small quantities, so, once products come in full loads, they wait a long time to be used, leading to higher inventory costs) (Simchi-Levi., 2004).

Moreover, inventory carrying costs are the costs related with the conservation of inventories, such as capital (inventory investment), inventory service (insurance and taxes), inventory risk (obsolescence, damage, pilferage, relocation) and storage space costs (plant, public, rented and company-owned warehouses) (Goldsby et al., 2005).

Inventory can be classified in five groups in light of three motives of inventory control – transaction, safety and speculation motives: Cycle stocks (batching alternates between an upper level (at the moment that a batch arrives) and a lower level (just before the arrival of the next batch)); Pipeline stocks/ process inventories (includes materials in process, in transport or in transit to another processing unit); Safety stocks (inventory expected to have right before the arrival of new replenishment to protect from forecasting errors like uncertainty of demand, processing time, yield and so on); Speculative stocks (caused by the possibility of higher selling price); Anticipation stocks (generated by seasonal/ time varying demand of some products). Despite this classification, it is not always easy to identify to which of the categories a certain item belong as the stocks may be originate from more than one motive and a degree of substitution is real (Minner, 2000).

Frequently, small business' managers are concerned about the inventory control. In order to reduce this problem, it can be applied numerous inventory control systems and control techniques:

- ABC analysis – items in the inventory are classified as A, B or C, according to the dollar volume generated in annual sales, determining the importance of each item (Fuerst, 1981; Onwubolu and Dube, 2006). The advantage of this division is that it provides policies and controls for each class related to better forecasting, physical control, supplier reliability and reduction in safety stocks (Onwubolu et al., 2006). Nevertheless, there are some drawbacks. Even though an item can be labeled as a C, it does not mean that this item should be eliminated from the product portfolio. Indeed, if there is a C stockout in a manufacturing endeavor, it will cause a severe delay in the process. Additionally, not all inventory situations can be classified (Fuerst, 1981).
- When to order? – two main types of models with a common concept which is the inventory position: the actual inventory at the facility + items ordered by the company but not arrived yet – items back ordered. Whenever the inventory position is at or below the reorder point, an order should be placed to increase the inventory level. The continuous review model is characterized by the everyday inventory revision and the reorder point system (ROP), that determines in which point an order should be placed based on the most likely lead time (MLLT), average demand (AD) and safety stock (SS) ($ROP = AD\ x\ MLLT + SS$). In the periodic review model, there are no fixed costs and the inventory is reviewed at regular intervals in order to meet the base-stock level defined by the company (Simchi-Levi et al., 2004; Blackstone, Jr & Cox, 1985).

- How much to order? – three models: EOQ model and two alternative models. The EOQ model assumes that the stock is replenished as soon as stock-out (Onwubolu et al., 2006):

$$EOQ = \sqrt{\frac{2\ x\ anual\ demand\ x\ cost\ per\ order}{variable\ holding\ cost}}$$

The following two alternative models are less expensive to implement in small businesses. In the Maximum Inventory model it is set the maximum inventory level for each product based upon the manager's experience or analysis of the company's financial situation and desirable ROI: $Order\ Quantity = Maximum\ Inventory\ Level - ROP + DDLT$. The Desired Covering Period model bases on sales forecasts to set the order quantity to cover the needed period (Lin, 1980).

A warehouse is the place where raw materials or manufactured goods are stored during some time until their distribution for sale. Three basic functions of warehouse stand out: movement, storage and information transfer. In its turn, movement can subdivide in three more activities: receiving inbound goods and make sure that everything related to quality and quantity is correct; transferring goods to specific locations in the warehouse; and shipping goods outbound to customers. There are two ways to perform storage: temporary storage and semi-permanent storage (example: safety stock). Lastly, the information transfer function occurs at the same time that the product is moved and stored (Lambert & Stock, 1993).

In addition, there are 3 types of warehouses: private (owned by the company), public (avoid capital investment, financial risks and it is flexible) and contract (specialized form of public warehousing, whose growth is linked to factors like product seasonality, geographic coverage requirements, flexibility in testing new marketing, expertise and dedicated resources, off-balance sheet financing and reduction in transportation costs) (Bloomberg et al., 2002; Coyle et al., 2003).

The warehouse's layout should have optimized capacity usage and storage safety. Also, it must be efficient, flexible and improvable (Bloomberg et al., 2002). Warehouse visibility is the first step to achieve rational utilization of space and it includes labels on the grid of columns, dock numbers, three-sided overhead zone identification signs and aisle on each slot in a pallet rack (Baudin, 2004). The Warehouse Management System helps the manager control operations (Coyle et al., 2003). E.g.: Barcode scanning which matches serial numbers to customer purchase orders.

Purchasing has two central objectives: for resale or consumption /transformation (Dobler, Burt & Lee, 1990; cited in Quayle & Quayle, 2000). The major purchasing decision processes are 'make or buy', supplier selection, contract negotiation, design collaboration, procurement and sourcing analysis. The most important purchasing activity is related to the Supplier Relationship Management, which implies maintaining good long-term relations with reliable suppliers to reduce product costs and increase product quality and customer services (Aissaoui, Haouari & Hassini, 2007).

The use of Information Technology (IT) enables efficient and effective SCM development. IT goals can be classified in four groups for SCM – collect, access, analyze data and facilitate partner collaboration. Integrating Supply Chain IT is not easy task because of the worries about the magnitude of return on investment, information too detailed for the customer or heavy investments on IT (Simchi- Levi et al., 2004). Enterprise Resource Planning (ERP) is an information system that makes efforts in the sense of planning in accordance to supply and demand information taken across the entire network (Toomey, 2000).

When speaking about Small Business and SCM, it is discovered two definition approaches: Qualitative (a small enterprise meets three criteria: independent, simple management structure and relatively small share of the market) and Quantitative (small enterprises are heterogenous because nor assets, turnover, profitability or employment fully account for its size) (Bolton Report, 1971; cited in Carter & Evans, 2006). There is a more uniform approach adopted by EU, which classifies small businesses in medium-sized, small or micro, depending on employee number, turnover and balance sheet. In general, SMEs are not able to implement SCM to its full extent, mainly because they are managed at arm's length by larger customers and have to follow the norms stipulated by the buyer (Arend et al., 2005).

3 Methodology

Business and management research is defined as a research that provides findings which advances knowledge, understanding and addresses business issues and practical managerial problems. As this article is based on practical work, HEM-SOL Corporation was chosen to collect empirical data. On September 2007, the company was visited and the general management and an assistant in logistics and purchasing were interviewed, elevating the data credibility and discovering the overstock inventory problem.

There are two types of possible research approach: deductive (certain theories are developed and verified) and inductive (data is collected and later analyzed so that theories can be developed). In this scenario, the deductive approach would be more appropriate.

In the research work there is eight strategies, however it was only used the case study, cross-sectional studies descriptive and explanatory studies. The case study strategy involves empirical investigation of a phenomenon within the real-life context using multiple sources of evidence like records, interviews, direct observation. This strategy is subdivided in single-case and multiple-case. It was chosen the single-case as it is analogous to a single experience. The cross-sectional research is the study of the phenomenon at a specific time (less than three months) and the descriptive study, therefore, is to describe relevant aspects of the phenomenon from different perspectives. On the other hand, the explanatory studies establish causal relationships between variables.

Quantitative research techniques produce precise numerical information that represents the abstract concepts. Qualitative research methods try to investigate inherent traits of the objects of inquiry and tend to be more interpretative. Case studies usually provide qualitative

instead of quantitative data for analysis and explanation and, according to the authors, this article project is one typical qualitative research.

Primary data was collected through in-depth interviews, whose questions were prepared in advance, with the general manager and non-participant observation in fieldwork. It was also used semi-structured approach in the later stage of data collection actions to keep focus on identified questions and dig deeper and unstructured interview approach to flexibly pick up as many facts as possible. Secondary data refers to the product catalogue of the company and 2007 sales report for twenty sample items, selected through proposing sampling (the most ordered and have different unit prices). The process of analyzation starts with the classification of qualitative non-standardized data into certain categories, according to different theories. Then hypotheses were developed by comparing the theories and the data, further analysis and drawing a conclusion.

The credibility of data collection was achieved by the mutual verification of sources. In case of any divergency, the question was again asked in the next interview. As the study development was not extended in a greater timeline and the managerial suggestions presented needed to be tested by the company, its credibility is limited.

4 Findings

HEM-SOL FORSALJINGS AB started the business with sun-tanning products in 1993. Five years later, it swapped to the business of gym sports equipment wholesale and rapidly become one of the best Scandinavian wholesaler and exporter. This company is in Jonkoping, Sweden, and not only sells several quality gym equipment and sport machines for commercial gym use but also for household exercise use.

The company employs eight people, including the owner which is the top manager (collaborates with suppliers to design new products, makes decisions about purchasing and inventory levels and supervises other employees), one man in sales department (exploits the market but does not make sales forecast), two men in the warehouse operations (operate forklifts to load and unload goods), two men in the customers after-sale service, one female accountant and lastly another female dealing with logistics issues and assisting the owner concerning purchase issues.

Despite the May-July period being considered the low season, the company's annual turnover is approximately 25 million SEK, counting with around two thousand different products, sold mainly in Europe and Africa.

In 2001, domestic manufacturers of gym sports equipment decided to sell directly to the consumers market, obligating HEM-SOL to leave them and establish new supplier relationships in China. By 2008, the company had seventeen suppliers: twelve in China, two in Germany, two in Poland and one in Pakistan. Germany and Poland supply windows and lockers for gym use and their lead time is relatively short (about one to two weeks) so there is no need of keeping inventories in the warehouse. Also, the payment deadline is within 30 days after the goods are

sent out. Pakistan offers leather gloves, but as it is light, and the quantity purchased is not large, it is purchased in advance and transported by air three times per year. All the rest comes from China, taking two to two and a half months to arrive. As this relationship is long term, HEM-SOL's payment term is done by Telegraphic Transfer (T/T) and made when the copy of shipping products is received.

Therefore, HEM-SOL's everyday routine is to transport the products from suppliers to the warehouse and then to the customers with an exception: if the order is from Africa and it is substantial enough, the products are sent directly from China to Africa in Full Container Load (FCL).

As seen before, the owner issued the purchase order when someone noticed there was little inventory left. However, this situation changed and now the inventory management system warns when the level of certain items falls below the pre-set safety stock level. In addition, HEM-SOL retains and manages two warehouses, which main function is to store the inventory, according to customer orders. All inventory is manually handled. Consequently, the company needs to examine in-warehouse inventory for all items twice a year to correct possible errors.

On one hand, inbound logistics is assured by a Third-Party Logistics service provider for transportation. Products from China are shipped by sea and truck while products from Germany and Poland are conveyed by lorry and by a different transportation company. On the other hand, out-bound logistics depends on the customers and whether they desire or not to arrange transportation themselves.

HEM-SOL invested 30 000-40 000 SEK in a kind of ERP information system for small business, developed by Microsoft, called "Navision". This system can integrate financial management, inventory management and sales management in the company. Thus, it needs maintenance to be upgraded, which costs 1 000 SEK per month.

Finally, some problems were perceived: excess stock for certain items; frequent inventory stock-outs notwithstanding the substantial investment in inventory; and the extended lead-time of some suppliers in China due to production delay. The inventory value reached about 12 million SEK, but the company's goal is to decrease this number to 8 million SE whereas maintaining the customer service level.

5 Analysis

The analysis will take place with the built-in literature review and the support of empirical data to present solutions for the problems already identified in this article.

5.1 Inventory turnover

The problem is that the current inventory value is about 12 million SEK and the annual sales turnover is 25 million SEK. The result of applying the target inventory turns' formula showed that the current inventory turns are of 2.1. The company's manager set the objective to reduce the company's average inventory value to 8 million SEK showing the need to increase

the inventory turns value to 3.1 inventory turns in order to achieve that goal. This target will be the bridge for this analysis, and it will underline the road that must be taken to improve HEM-SOL's inventory management.

5.2 Inventory tradeoffs

Presently, HEM-SOL's product variety has about two thousand types, some of them only varying on colors, and this is problematic for it has negative effects on inventory reduction efforts. Identifying the best-selling colors and eliminating less popular alternatives would contribute to inventory reduction while still satisfying customers' demands.

Suppliers in China do not impose many limitations of lot size, which benefits the company since it can order the quantity desired, avoiding having a fundamental role in the inventory level.

In consequence of the long-distance relationship with the suppliers (Sweden-China), the transportation costs are high, forcing the company to use Full Container Load (FCL) to minimize the costs. But, at the same time, it increases the inventory level, constituting another tradeoff to inventory reduction.

5.3 Inventory control systems

HEM-SOL does not have a formalized inventory system. The inventory is restocked when the manager, depending on his intuition and experience, orders or when a warehouse' employee warns that it is needed. This unpleasant situation can have two outcomes: stock-out or overstock. Therefore, the solution would be the constitution of a formalized and standardized inventory control system.

ABC Analysis

In HEM-SOL's two warehouses there are lots of different products. If employees controlled each and every single item, the labor costs would increase exponentially. A way to save time, effort and money on the daily basis is by classifying items into different level groups based on percentage of dollar usage, ranking them from A level products to C level. High priority A items should be controlled regularly on inventory records and reviewed in terms of forecasting, demanding inquiry and order quantity determination. Medium priority B items do not need as much control and reviews as A items. Lowest priority C items need the least control, can be reviewed over a long time, ordered in larger quantities and have more safety stocks.

When to order?

In order to resolve the problem of when-to-order, it was tested the continuous and periodic review. As of this, in the continuous review model, by applying the ROP formula, showed that during the same three-months lead time for some items it was set at the lowest provoking stockouts and for others even higher that the largest possible demand inflicting the company with overstock. Thus, the perfect ROP does not exist because it is not capable of solving both problems simultaneously. So, the ROP system is not appropriate for the company.

From the preceding examination, it was possible to determine A, B and C's lead time which is three months (as the average lead time from out-Europe suppliers is around two and a half months). Also, the target inventory turns is about three. Joining these two facts enables a proposition of once per quarter review period for A items, once every four months for B items and twice a year for C items. Four in four months each review produces one replenishment, and assuming that the aggregated order quantity for one year matches the actual annual demand of each item, the average inventory turns are of three times resembling the inventory turnover target. There is one specific characteristic somewhat special that can be found in C item's demand: the first half year is similar to the second. This condition gives the opportunity to set the replenishment order at the beginning of April, arriving before July to meet with the demand of the second half of the year. Another order should be placed at the start of October, so that it arrives just before January in order to cover the demand of the first half of the year.

As of this, the policy that should be taken to solve the problem of when to reorder is the periodic review policy.

How much to order?

In this segment, it is identified the most suitable order quantity replenishment model. Firstly, it was applied the EOQ formula, but it was found that HEM-SOL was lacking in the necessary input data like order and holding costs, making the application of this formula unsubstantiated. In the tryout of the Maximum Inventory, a conclusion is reached: the formula cannot be used because the ROP system is not used either and it does not make sense to set a max inventory level in the period review system of HEM-SOL.

Thus, the alternative chosen is the Desired Covering Period, that should be the same as the review period (3, 4 and 6 months for A, B and C items, respectively). The quantity ordered does not have to equal in every replenishment and it ought to be defined according to the demand forecast. It is obvious that last year's data is more reliable than previous years, but still can vary. If this demand diminishes, there is a possibility of excess stock and to solve this the company needs to keep an updated long-term analysis of the demand. In case of stock-out, the possibility of losing the customer is reduced as showed by the historical data which dictates that the most common scenario is the one where the customer waits until the products are available.

5.4 Inventory carrying cost

Capital costs are the only factor that affect inventory carrying costs. HEM-SOL does not support any cost related to inventory taxes, damage, pilferage and relocation. The two rented warehouses constitute fixed costs which is not considered in the inventory carrying costs. Also, the insurance premiums is about 36 000-48 000 SEK per year and the obsolescence costs are minor. As the objective of the company is to decrease the average inventory value to 8 million SEK, insurance premium and obsolescence costs will slightly decrease. The most predominant change will be the decrease of capital cost.

5.5 Warehouse

Both contract warehouses are rented since it would be too much of an investment and high risk for a small business as HEM-SOL. As the demand has a considerable seasonal fluctuation, contract warehouses ends being the best choice so the spending on finance won't be too high.

Warehouse Layout

Warehouse visibility represents one of the most important factors to improve its efficiency. As so, distinct floor mark in bright yellow and grid of columns are two good ways to identify the areas. In its turn, each specific zone should have identified triangle signs above the racks so that it would be seen from every direction. In HEM-SOL it was recognized that the lack of location guides and unreliable location addressing are two main problems as the items are not found where they should be or have the wrong identification numbers.

Warehouse Management System

Surprisingly, HEM-SOL does not use barcode scanning system. Although this system transforms the operations into more efficient and accurate, suppliers are the reason why it is not put in practice. Habitually suppliers place different items, or same items but in different colors, into one wooden box for the shipment, becoming tough to consolidate the items with one barcode label on arrival.

5.6 Purchasing

The company in question is not engaged in production. It is actually a wholesaling company, meaning that its core business is purchasing. In this follow-up, the manager's top priority is to preserve and develop relationships with suppliers to guarantee consistent delivery (lead time and quantity), good product quality and reasonable price besides decreasing transaction costs.

As international competition is increasing day after day, suppliers get in a situation of great pressure to maintain their customers. For that, they need to do their best to fill every requirement, positioning HEM-SOL with greater bargaining power. Additionally, the manager cooperates with suppliers in designing and developing new products, highlighting the trust between the two parts which is even more evident with the payment term choice (Telegraphic Transfer (T/T)).

5.7 Information System

As mentioned before, HEM-SOL's information system is called 'Navision'. This tool is useful to management because it updates inventory records of every item, every day. Therefore, administration can use this to support the right decision-making. Although 'Navision' replaces old data with new one, erasing historical inventory records. The solution for this malady is making daily data backup. These records can be utilized to draw a graph for each item's activity

during a whole year, which can be a tool to measure inventory management performance, making it easily to identify the occurrence frequency of overstocks and stockouts for particular items.

6 Conclusion

Small businesses are considered the driving force for an economy. They range from being essential to large and medium enterprises to increase employment rates, being a fundamental instrument of society. Therefore, when looking inside their structure, these organizations have similar structures but less complex than larger businesses. Furthermore, if the goal is to develop Supply Chain Management, the implementation and adaptation of a theory for large scale business into a small one must consider the limitation of resources and bargaining power. And because of this affliction, capital investments should have a more controlled and conscient approach.

The relationship between inventory management and small businesses is crucial to its survival. The company's studied performance can be improved substantially if it is implemented inventory management. In this context, the goal of this article was to connect theories to a true story and suggest solutions for the issues found.

6.1 Theoretical Conclusions

On the subject theories of Supply Chain Management (SCM), inventory management, purchasing, Information Technology (IT) and small businesses are interrelated when employed in this article's problematic. In other terms, they must all be taken in account, either by different perspectives or to different extent, as a solution of using an efficient inventory control system.

Although, as said before, small businesses constitute a predominant percentage of the economy, the theories related to managing inventory facing rapid fluctuations on demand in small businesses are in short supply. Most of these techniques did not meet with the requirements that made them limited in terms of application for the inventory management. Nevertheless, the vision that spurred from constructing and researching an interlinked theoretical framework helped state the following:

1. The validation for the allocation of resources on inventory should be supported by the ABC analysis model that categorizes each and every item that has availability for commercialization.
2. In order to help management select the best way to place new orders for inventory restock, it was chosen the periodic review policy.
3. To support and determine which is the ideal order quantity, the selected theory was the 'Desired Covering Period'.

This problematic can be seen as a small contribution to theory evolution of inventory management in small enterprises because of the specific way theories were selected in order to support a solution.

In this article, it was mentioned in the analysis section, even if by a brief moment, the inventory control techniques, such as the Economic Order Quantity (EOQ) model and a continuous review policy, that allowed to reach the conclusion that both were inappropriate for this case problematic.

6.2 Practical Conclusions

By analyzing the sales report of about twenty items in the year 2007, it was revealed that the demand between each one had a considerable variation. Considering the ABC analysis, the items classified in different categories have some peculiarities. For example, A items need to have more assessment while C item need it less. For the management, this approach helps save a lot of time, costs and efforts.

Based on the ABC analysis, it can be said that each categorized item could be differentiated with alternate review periods. A items should have priority being reviewed as they account for 20% of the total amount of items, but more than 50% total dollar value. More frequent review can help management control and minimize excess stock and stockouts occurrence. With this analysis it was found empiric that with the monthly distribution pattern of 2007 and the three months lead time that the reviewing of products should have the following order: A items - three months; B items - four months; C items - six months.

In conclusion, the EOQ model cannot be applied in consequence of the lacking availability of necessary inputs. Instead of this, it was applied the Desired Covering Period approach in regard to order quantity determination. It is suggested that order quantity can vary between replenishments based on historical demand records and, with that, it can be said too that the desired covering period should be the same as the item's review period.

6.3 Criticism to the Study

The fact that this research is built on the comparison between existing activities and estimated activities and due to the assumptions linked with estimations, the final product can be judged in terms of its credibility because assuming that historical events are representative of the future and something as demand permanency being immovable/ constant is unrealistic. Therefore, this article is relatively strong hold because, in the authors' point of view, the estimations were based on a solid investigation.

References

Aissaoui, N., Haouari, M., & Hassini, E. (2007). Supplier Selection and Order Lot Sizing Modeling: A Review. Computer & Operations Research, 34, 3516-3540.

Arend, R. J. and Wisner, J. D. (2005). Small business and supply chain management: is there a fit? Journal of Business Venturing, 20(3), 403-436.

Bassin, W. M. (1990). A Technique for Applying EOQ Models to Retail Cycle Stock Inventories. Journal of Small Business Management, 28(1), 48-55.

Baudin, M. (2004). Lean Logistics. New York: Productivity Press.

Blackstone, J. H., JR., & Cox, J. F. (1985). Inventory Management Techniques. Journal of Small Business Management, 4(1), 27-33.

Bloomberg, D., Lemay, S., & Hanna, J. (2002). Logistics. Upper Saddle River: Prentice Hall.

Buxey, G. (2006). Reconstructing inventory management theory. International Journal of Operations & Production Management, 26(9), 996-1012.

Carter, S., & Evans, D. (2006). Enterprise and Small Business-Principles, Practice and Policy. Harlow: FT Prentice Hall.

Chapman, S., Ettkin, L. P., & Helms, M. M. (2000). Do Small Businesses Need Supply Chain Management? IIE Solutions, 32(8), 31-35.

Chopra, S., & Meindl, P. (2001). Supply Chain Management: Strategy, Planning, and Operation. Englewood Cliffs: Prentice-Hall.

Christopher, M. (1998). Logistics and Supply Chain Management. London: Pitman.

Coyle, J. J., Bardi, E. J., & Langley, C. J. JR. (2003). The Management of Business Logistic: A Supply Chain Perspective (7th ed.). Mason: South-Western.

Davenport, T. H. (2000). Mission Critical: Realizing the Promise of Enterprise Systems. Boston: Harvard Business School Press.

ENSR (1997). The European Observatory for SMEs-Fifth Annual Report, European Network for SME Research, Zoetermeer: EIM Small Business Research and Consultancy.

ENSR (2004). Highlights for the 2003 Observatory. European Commission, Brussels.

European Logistics Association/A.T. Kearney (2004). Differentiation for Performance. Deutscher Verkehrs-Verlag GmbH, Hamburg.

European Union (2005). 'SME Definition', http://ec.europa.eu/enterprise/enterprise_policy/sme_definition/index_en.htm

Davis, C. H., Raafat, F., & Safizadeh, M. H. (1983). Production and Inventory Information Processing: Material Requirements Planning. Journal of Small Business Management, 21(3), 2535.

Frazelle, E. H. (2002). Supply Chain Strategy: The Logistics of Supply Chain Management. New York: McGraw-Hill.

Fuerst, W. L. (1981). Small Business Get A New Look at ABC Analysis for Inventory Control. Journal of Small Business Management, 19(3), 39-44.

Gadde, L-E., & Mattson, L-G. (1987). Stability and Change in Network Relationships. International Journal of Research in Marketing, 4(1), 29-41.

Gillham, B. (2000). Case Study Research Methods. London: Continuum.

Gils, A. E. J. (2000). Cooperative behavior in small and medium-sized enterprises: the role of strategic alliances. Groningen: Rijksuniversiteit Groningen.

Goldsby, T., & Martichenko, R. (2005). Lean Six Sigma Logistics: Strategic Development to Operational Success. Boca Raton: J. Ross Publishing, Inc.

Grix, J. (2004). The Foundations of Research. New York: Palgrave Macmillan.

Hakansson, H., & Persson, G. (2004). Supply Chain Management: The Logic of Supply Chains and Networks. The International Journal of Logistics Management, 15(1), 11-26.

Heide, V., & Heide, M. (2007). Can the SME survive the supply chain challenges? Supply Chain Management: An International Journal, 12(1), 20-31.

Helms, M. M., Ettkin, P. L., & Chapman, S. (2000). Supply chain forecasting-Collaborative forecasting supports supply chain management. Business Process Management Journal, 6(5), 392-407.

Krajewski, L., & Ritzman, L. (2002). Operations Management. New Jersey: Pearson Education Inc.

Lam, J., & Postle, R. (2006). Textile and apparel supply chain management in Hong Kong. International Journal of Clothing Science and Technology, 18(4), 265-277.

Lambert, D. J., Cooper, M. C., & Pagh, J. D. (1998). Supply chain management, implementation issues and research opportunities. International Journal of Logistics Management, 9(2), 1-19.

Lin, E. (1980). Inventory Control System for Small Business. American Journal of Small Business, 4(4), 11-19.

Maxwell, J. A. (1996). Qualitative Research Design: An Interactive Approach. Thousand Oaks: SAGE Publications.

Onwubolu, G. C., & Dube, B. C. (2006). Implementing an Improved Inventory Control System in a Small Company: A Case Study. Production Planning & Control, 17(1), 67-76.

Quayle, M. (2003). A study of supply chain management practice in UK industrial SMEs. Supply Chain Management: An International Journal, 8(1), 79-86.

Quayle, M. (2000). Supplier Development for UK Small and Medium-sized Enterprises. Journal of Applied Management Studies, 9(1), 117-133.

Quayle, M., & Quayle, S. (2000). The Impact of Strategic Procurement in the UK Further and Higher Education Sectors. The International Journal of Public Sector Management, 13(3), 260284.

Saunders, M., Lewis, P., & Thornhill, A. (2003). Research Methods for Business Students (3rd ed.). Edinburgh Gate: Pearson Education Limited.

Sekaran, U. (2003). Research Methods For Business: A Skill Building Approach (4th ed.). New York: John Wiley & Sons, Inc.

Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2004). Managing The Supply Chain: The Definitive Guide For The Business Professional. New York: McGraw-Hill.

Toomey, J. W. (2000). Inventory Management: Principles, Concepts and Techniques. Norwell: Kluwer Academic Publishers.

Welsh, J. A., & White, J. F. (1981). A Small Business Is Not a Little Big Business. Harvard Business Review, 59(4), 18-27.

Yin, R. K. (2003). Case Study Research: Design and Methods (3rd ed.). Thousands Oaks: Sage Publications.

Chapter 7

Value Creation Through Inventory Management
[7]

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Abstract

Having a stock management system that does not guarantee accuracy, decreases the company's competencies and its ability to control inventory quantities and respond to customer needs. Through the investigation of two principles of stock management, which mainly affect punctual delivery, accuracy and quantities of stock records, eight companies were used to understand how they manage their products, always taking into account that the sizes and characteristics of the companies were different. Through the collected data, we noticed that of the surveyed companies, half reported the use of ABC stock classification techniques and/or cyclic counting for precision of the stock. Not all companies had accurate information about their delivery classifications on time before implementing a stock management technique and the responses ranged for those who had this information. The precision data of the stock also proved difficult to collect. However, companies that provide stock accuracy information typically indicate drastic increases in accuracy after the implementation of an inventory management technique. Contrary to expectations, a stock decline has not been reported by most companies after the implementation of a stock management system. Through the example of Nestlé, we also discussed how technologies could help in these stock management processes and the challenges and opportunities that they can bring. In today's world, gaining competitive advantage through some details can be very important to survive the competition. Study limitations and guidelines for future investigations were also discussed.

[7]This paper is based on Lanman, J. (2005). Inventory management improvement techniques (Master's thesis). Eastern Illinois University.

1. Introduction

Based on the principle that organizations are currently seeking maximum efficiency and effectiveness it is extremely important to know where to apply the available resources. According to Gaither & Fraizer (1999), the competition is getting bigger, more intense and fiercer.

Lanman (2005), organizations can improve their competitiveness through a good stock management method, which ensures accurate and objective information, helping to reduce inventory quantities, their costs and improve delivery on time. The implementation of processes to reduce stock quantities makes it possible to invest in something necessary, instead of applying money in excess stock. The failures in stock control originate many problems within several departments of the organization that should be promptly investigated to eliminate the causes being that they are the responsibility of all.

To study this topic, Lanman (2005) used two methods that allow organizations to have more confidence in the stock information and generally are related simultaneously. The ABC inventory classification is a proven method to reduce the amount of stock and understand it, using the Pareto law, and cyclic counting also intends to help improve stock accuracy, both of which have as main objective Find errors in the process and through root cause analysis, identify and eliminate the cause of the errors.

The aim of the study was to investigate the effectiveness of the two methods to manage stocks, as well as how they can be used to understand where the stock problems are within the organization, and how to solve these problems. It is likely that a company that increases the accuracy of its stock records is able to reduce stock levels and improve delivery on time. As the methods mentioned above are both systematic ways to increase the accuracy of the stock register, the companies that use them must have reduced stock records, more accurate and better delivery records on time. In this way, and according to Lanman (2005), the study will seek to answer five main questions, where the possibilities for improving the management of stocks are evaluated to reduce delivery times, to evaluate the advantages of using the two main methods under study and its Applicability in obtaining better management of organizations.

After this introduction, this article presents a literature review where relevant theoretical content will be enunciated later and based on the methodology that will be used to deepen the study, analyze data, present results in order to draw conclusions and future perspectives.

2. Literature Review

Lanman (2005) reveals that, most companies have some stock and when it is in excess it becomes a problem for companies. More stock leads to a cost that the company

has to bear. The financing charges, the cost of opportunity, insurance, taxes and repositioning expenses are some of the main expenses associated with the total cost of stock.

When companies work with offshore suppliers, they look at the stock levels differently, since they need to take into account the shipping time of the goods. Due to this need, companies must have minimum Stock of Security to cover this shipping time and sometimes, prevent any problems that may occur during the transport as catastrophic events that damage or eliminate the products.

According to Tersine (1982), maintenance costs include capital cost, taxes, insurance, repositioning, storage, shrinkage, obsolescence and deterioration. The usual cost of annual maintenance is 20 to 40% of the stock investment. Also stated that the cost of maintaining stocks is usually 20 to 40% of the cost of products sold per year. LaMacchia (2004) It is necessary to give some importance to impacts of keeping excess stock, to implement plans to try to reduce it, and also to reduce expenses with them.

Brooks & Wilson (1995) tell that stock records as "hard copy or electronic documents that reflect how much and what kind of inventories a company has on hand, committed (allocated) to work-in-process (WIP), and on order" the importance given to the stock register is due to the fact that This being used to make decisions like when and what to receive, order or sell and consequently allows the Organization to perceive what has stock and quantity available. All stock records must be accompanied by documents proving all transactions made. They also tell that it is important to take into account that sometimes not having enough stock can be a loss of opportunity to attract new customers, possibly losing valuable market share.

Williams (2004), reveals that the way stock levels are determined is a key element that distinguishes companies with good and bad results. Having knowledge to determine the amount needed to have enough stock to sustain production and not have excess stock, is critical to be a successful company. To have this knowledge, it is necessary to realize what type of search the company satisfies.

Tersine (1982), mentions that there are two basic systems of stock demand, independent demand and dependent. We talk about dependent demand when the demand for a good depends directly on another good, while the indirect demand is when there is no direct relationship between the demand for two goods. Dependent and independent products should be treated with different methods of reordering to maintain stock levels. In independent demand products, many companies reorder or maintain their stocks by using the equation of the quantity of economic orders, which helps determine how much product to buy, when it should be ordered, the total cost, the average stock level and how much should be requested at a time as well as the maximum stock. In dependent demand products, many companies determine the stock levels by planning material requirements, where thought is not only with the short-term stock, but also with the medium/long term, since the concern is to always keep materials are not available for production, leaving aside the concern for the customer.

According to Tersine (1982), it is understood as a replenishment lead time the real time required to replenish the stock after the order is made, and this time includes several steps until it reaches the end, such as: internal order preparation time, transmission time of the order to the supplier, manufacturing time and assembly, transition time of the supplier's merchandise, preparation time of the internal merchandise. During this time it is necessary to take into account the variations of demand to prevent any changes in the need for materials.

Gaither & Fraizer (1999) underline that, there is a need to maintain a safety stock, precisely to prevent the effects of demand fluctuations and supply of stock, with the aim of avoiding the lack of stock. Although expensive, the security stock is important, but it has to be balanced, not too much. Through the order point equation, it is possible to establish the optimum safety stock, and if you can clearly predict possible variations in demand during the delivery time, you can reduce the safety stock.

Brooks & Wilson (1995) demonstrate that, the ability of a company to respond to customer needs is affected by the accuracy of the stock records. Decisions of large monetary amounts are taken daily on the basis of information from stock levels. One of the methods to ensure that the stock records are accurate is through the cycle count. Piasecki (2003) defined the cycle count as any process that verifies the accuracy of inventory quantity data, counting portions of the stock continuously.

Lanman (2005) underline that the ABC inventory classification**,** through the use of Alfredo Pareto's theory, helps to perceive which products are most important to the company and therefore deserve more attention in verifying the Stock quantities. According to Slack, Chambers & Johnston (2002), Pareto's law establishes that a small proportion, about 20% of the total products included in the stocks, accounts for approximately 80% of the total cost value. In this way, this principle can be used to classify the various products in stock according to their importance.

Green (1970) tell this classification aims to answer three questions, and in the first question we intend to understand which products should merit attention from the system, subsequently it is intended to know which quantities of a product should be requested at the time That the request is made, then the third question seeks to find answer to when the product should be reordered. The "Economic order quantity" and "Material Requirements planning" systems help answer the last two questions while inventory analysis helps answer the first question.

Lanman (2005) tell that ABC analysis distributes the products of the stock by three categories, based on usage or cost. Category A For more successful goods or that quickly enter and leave, whereas category C is the products opposed to those in category A, where category B is between the two, which represents an intermediary of the previous two. After categorized, the products will be the target of frequent counting and this frequency will vary according to the category where they are inserted, and category A products will be counted more frequently. The company must define the frequency of the counts according to the time, the quantity of products, the need, the capacity and the available

resources. Through stock precision teams, the company helps protect the process, taking into account that they have several planning, implementation, training and monitoring functions that are important for the cycle counting program, and still identify the Successes and failures. For all this, the Organization must give these teams, whatever they may need. Of course, the ABC inventory classification is a good management tool that can help a company better control its stock levels, since it identifies "vital" products that account for most problems. This helps provide tolerance patterns for various stock levels, providing a systematic approach to stock management. It enables the prioritization of products in a system and that an organization distributes the population in easier to manage parts by creating a plan for each of these parts. Despite this, the system has some limitations as the privilege to high volume products, thus ignoring the low volume products. This method does not take into account the specific characteristics of the items and does not consider the impact of the variables on the operations, also assuming that the items that move more quickly are those that have the most transactions, and do not take into account the lead time. That being said, it should be recalled when this method is used.

Piasecki (2003) says that in the inventory count there are two common methods that are used, which are manual count and scale count. These are used daily by most companies. The first is simple since it only counts individually each product, there are, however, several techniques for its accuracy related to how they are counted. The scale count, most common in small components, uses scales that can be programmed to convert a sample counted into a unit weight and use the unit weight to convert the total weight back into a part count. The accuracy of the process depends on the sensitivity of the scale in relation to the weight of the items to be weighed, the precision of the weight of the tare, the accuracy of the sample count, the consistency in the unit weight of the materials being weighed and the relationship between the count of the sample and the total count.

Lanman (2005) reveals that some tools are used to resolve certain issues and do root cause analysis. In a succinct manner, Pareto analysis can be used to segment errors by type and frequency, the cause and effect diagrams and brainstorming techniques can be used for inventory inaccuracies and their effects on the organization, the graphs of control to monitor the day-to-day cycle counting process, and the graphs and histograms can be used to help identify which and how often errors are occurring.

It is important to note that these precise control processes help the organization improve. After performed, the physical count is compared to the value that the stock management system claims to be available. This data is translated into a stock record accuracy sheet, (see appendix A) that registers all counted products, and still a column for the physical count value and the system value. At your side, usually another column mirroring the allowable tolerance. The fifth column is Hit/Miss and is used to calculate the results of the comparison between the physical count and the system value. This activity is completed for all parts of the system when all parts have received a hit or Miss rating. Brooks & Wilson (1995) reveals that the tolerances to the error, as a rule, are

established to count errors, are usually higher the higher the use of the product, similarly are smaller the lower the use of the product, being even common, in these products, tolerance near zero. The accuracy of the registration is calculated using the following equation:

$$Record\ Accuracy = \frac{\text{total accurate records}}{\text{total records checked}} \times 100\ \%$$

After this, Piasecki (2003) reveals that the challenge that arises will be to understand which method to use to be as accurate as possible. Among which, variation of the liquid product, gross or absolute variation of the products, average absolute variation and "good count Bad count". The "Good Count Bad count" method tolerances are assigned, and the reported accuracy is defined by the number of good counts divided by the total number of accounts. The liquid product variation method displays the system as a whole, and the accuracy depends on the comparison between the counted and the system values. The crude variation method of the products compares the sum of the absolute variances of the product with the sum of the system values.

3. Methodology

To try to understand the best ways to control the stock and gain competitive advantage with this same control, Lanman (2005) used the qualitative research method with eight companies that agreed to participate.

The companies were chosen on a set of specifications, all of which would have to be manufacturers in the aircraft category, classified by the U.S. government as ACLs 3728. Another requirement determined that companies had to have more than 20 employees in the northeast of the province of Illinois. According Siccode (2019) in the date of the realization of the research S.I.C. 3728 is composed of 799 companies, with the aforementioned requirement, the number of companies identified has become 12. In April and May 2005, the 12 manufacturers were contacted to participate, of which only 67% accepted. An element of each company was selected to participate, each of which would have to be highly informed about your company's inventory system. We selected three presidents, two Vice-presidents and three managers, who participated through the phone by telephone call.

Leão, Mello, & Vieira, (2009) Risjord, Moloney, & Dunbar (2001) tell that qualitative research always has an interpretative character, that is, the subjectivity of those investigating is present throughout the research development. On the other hand, qualitative research also assumes a certain degree of induction. Zikmund (2000) usually small samples of people are used, however this research does not seek to generalize the results, but rather understand the phenomenon in study, through the analysis of data corresponding to experiences, attitudes, habits, opinions, feelings.

According to Lanman (2005) the using of eighteen questions in multiple choice format, was essential to research that used essential questions to evaluate the best practices for this study. In question number one, two and three the goal focuses on understanding each organization's philosophy:

1. Number of employees?
2. Number of different components produced?
3. Number of customers?

The questions numbers four, five, six and seven aim to realize the date of implementation of the cycle counting process and/or classification if stock ABC:

4. Does the company use cyclical counting techniques for inventory accuracy?
5. During which decade did the company implement the cyclic counting program?
6. Does the company use the ABC inventory classification?
7. During which decade did the company implemented ABC inventory classification?
8. Which method of ABC inventory classification best describes your company?

Then question Nine seeks to understand how many resources the organization used to initiate the stock precision project, following two issues related to the time required and the methods used to achieve that same precision

9. How many resources (people) did the company allocate to start the inventory precision project?
10. Did the company use teams to drive the initiative?
11. How many months has it taken the company to achieve its inventory accuracy goal?

Subsequently, it was asked which cyclic counting techniques each organization used, followed again two questions related to the accuracy of the inventory records and the current use of the same

12. Which cycle counting techniques are used in your installations
13. What was the accuracy index of the company inventory at the beginning of the implementation?
14. What is the company's current inventory accuracy rating?

The questions number fifteen and sixteen sought to know what amount of stock the company had and what amount of stock began to have, while the remaining two questions sought to know the delivery indexes on time before and after implementation.

15. How much stock (in thousands of dollars) did the company take before implementation?

16. How much stock (in thousands of dollars) the company took after implementation?

17. What was the delivery rate on the company's deadline before implementation?

18. What was the delivery rate within the company after implementation?

In a summarized way, the questions sought to answer the following topics: which philosophy of the stock management of each organization; date of implementation of the cycle counting process; Current percentage of stock accuracy; percentage of accuracy of Initial stock; Time required to implement stock control; Resources allocated the cyclical counting process; reduction in stock levels; Metrics used to analyze the system and procedures for conducting cyclic counting activity.

To validate the research questions, Lanman (2005) distributed the research by three specialists (Apendix B) in the field of precision of the stock for review. The experienced candidates were chosen because they fulfilled the following criteria:

- Experience with cyclical counting;
- Experience with ABC stock classification;
- Experience with implementation of any cycle count or ABC inventory;
- Classification;
- Actively working on a stock management capacity;
- Possess a deep knowledge of the stock systems.

When analyzing these issues, the experts pointed out some flaws and proposed some possibilities of alteration.

According to Lanman (2005) the investigator used the tools included in the Microsoft Excel software to analyze the data. For each question, it was determined which answer was most frequently chosen and considered the best practice for this study.

It is important to note that this research is limited by several issues:

- The data from the present study came from an internal analysis, telephone interview format and were not verified;
- The level of knowledge of the elements that responded was also not verified;
- The willingness of companies to share information about their inventory structure;
- Despite the existence of methods, it is important to realize that each organization is different, and this will oblige to adapt to the reality of the Organization.

This research has Lanman (2005) only used manufacturers of parts and equipment for aircraft with 20 or more employees to answer the questions of the study which shows the small size of the sample and the respective limitation of the investigation.

To try to find different perspectives on how companies control their stocks, we seek to understand, through Saraiva (2015), how a multinational like Neltlé organizes its stock. In the analysis of results will be made a reflection on the functioning of the company in question, trying to understand whether or not there are similarities with the research companies made by Lanman (2005).

The article Lanman (2005) did not use some parameters that could be relevant to assess the quality of stock Management, and thereafter decide on possible improvement measures to be implemented. According to the authors Bowersox (2008), Carvalho & Ramos (2009) and Roldão (2002), managers can make use of various tools, such as, the rate of rotation, the rate of coverage, the rate of rupture and the level of service, because they are the ones that most often arise in the literature and because they apply to all Types of stocks.

4. Results analysis

Aiming to conduct an analysis of the problem under study, according to Lanman (2005), the answers to the questions presented in the methodology were organized in a table with the objective of perceiving the responses of the participants, which reflect the stock practices of sample companies.

The first question the results were as follows:

A. 1 to 25 employees	(4)
B. 26 to 50 employees	(1)
C. 51 to 75 employees	
D. 76 to 100 employees	(1)
E. 101 to 125 employees	(1)
F. > 126 employees	(1)

In the second question the results were as follows:

A. 1 to 25 components	(1)
B. 26 to 50 components	(1)
C. 51 to 75 components	
D. 76 to 100 components	
E. 101 to 125 components	
F. 126 to 150 components	(1)
G. 151 to 175 components	
H. 176 to 200 components	(1)
I. > 200 components	(4)

In the third question the results were as follows:

A. 1 to 15 customers	(2)
B. 16 to 30 customers	(4)
C. 31 to 45 customers	
D. 46 to 60 customers	

E. 61 to 75 customers
F. 76 to 90 customers (1)
G. 91 to 105 customers
H. 106 to 120 customers
I. > 120 customers (1)

In these first three questions, it was possible to verify that half of the companies employed twenty-five people or more, and two of the companies had more than one hundred employees. Six companies also indicated that they produced more than 120 components, with four producing more than 200 components. Most of the sample companies have a small range of customers, since 75% of the sample has 30 or fewer customers, and a company has more than 120 customers.

In the fourth question the results were as follows:

A. Yes (4)
B. No (4)

In the fifth question the results were as follows:

A. 1950 (1)
B. 1960 (1)
C. 1970
D. 1980 (1)
E. 1990
F. 2000 (1)

By analyzing the results of the fourth and fifth questions, we conclude that only four companies used precision stock techniques, which represents half the sample. All these companies that used stock precision techniques produced more than 176 components, which also means that, of the five companies that produced more than 176 components, only one does not use these techniques, given very important and evidences the Importance of records accurately when the number of components is high. In addition to producing more than 176 components, of the four companies that use stock logging techniques, three have more than 76 employees. The number of customers and the decades when these companies started the records vary enormously, which does not allow for a relevant analysis.

In the sixth question the results were as follows:

A. Yes (4)
B. No (4)

In the seventh question the results were as follows:

A. 1950
B. 1960
C. 1970 (2)
D. 1980
E. 1990 (1)
F. 2000 (1)

In the eighth question the results were as follows:

A. The company uses the dollar value to categorize inventory (1)
B. The company uses the usage or movement to categorize inventory
C. The company uses both the value and usage to categorize inventory (3)

Half of the revel companies that use the ABC stock classification and 75% of these, reported in previous questions, which use cyclic counting techniques. Companies using the ABC classification reveal producing 176 or more components, and three out of four had 76 or more employees. Compared to the fifth question, we conclude that the ABC classification has been implemented in decades newer than cyclic counting. For the three companies that report using the ABC classification, it is both used the dollar value and the use or movement to categorize the stock, and only one company has selected the dollar value.

In the ninth question the results were as follows:

A. 1 to 3 people (3)
B. 4 to 6 people (1)
C. 7 to 9 people
D. 10 to 12 people
E. 13 to 15 people
F. > 16 people

In the tenth question the results were as follows:

A. Yes (1)
B. No (3)

The previous two issues reveal that most companies have allocated few resources to start inventory precision projects and do not try to drive the initiative through the use of teams. The only company that uses 4 to 6 people to start inventory precision projects is also the only one that powers these projects through teamwork, still corresponding to the company that has more customers. The head of the company concerned explained that he began using cyclical counting and ABC classification to avoid the annual stock count.

In the eleventh question the results were as follows:

A. 1 to 3 months
B. 4 to 6 months (1)
C. 7 to 9 months
D. 10 to 12 months
E. 13 to 15 months
F. 16 to 18 months (1)
G. 19 to 21 months
H. 22 to 24 months
I. > 24 months (1)

Although only three companies responded to this question, the data were considered valid to draw conclusions. The company managed in just four to six months to achieve the accuracy that another company only reached after more than 2 years, and, curiously the company that managed to be faster, revealed not to use cyclic counting method unlike the other two, Using only the ABC classification, which is also used by the other companies that responded to this issue. The company that reported to have lasted 16 to 18 months is the same that uses more than 3 people to start inventory precision projects and uses team system. The company that revealed to take more than two years, is the company that has more than 126 employees.

In the twelfth question the results were as follows:

A. Control Group
B. Location Counting (1)
C. Transaction Counting
D. Product Group counting
E. Random selection grouping (4)
F. Other

Four of those who responded to the twelfth question listed the random selection grouping as the cycle counting technique used in their facilities. The only other selection was an interviewee who mentioned the location count, and this was the company with the smallest number of employees and customers, producing more than 200 components. The other four companies also reported producing 176 for more than 200 components.

In the thirteenth question the results were as follows:

A. 10% to 20%
B. 21% to 30%
C. 31% to 40%
D. 41% to 50%
E. 51% to 60%
F. 61% to 70% (2)
G. 71% to 80%
H. 81% to 90%
I. 91% to 100% (1)

In the fourteenth question the results were as follows:

A. 55% to 60%
B. 61% to 65%
C. 66% to 70%
D. 71% to 75%
E. 76% to 80%
F. 81% to 85%
G. 86% to 90%
H. 91% to 95%

I. 96% to 100% (3)

Inventory accuracy data is difficult to collect and only business leaders could provide stock data. Two of the respondents, however, indicated dramatic increases in the stock precision index since the implementation of a management technique.

In the fifteenth question the results were as follows:

A. > 200
B. 200 to 300 (1)
C. 300 to 400
D. 400 to 500
E. 500 to 600
F. 600 to 700 (1)
G. 700 to 800
H. 800 to 900
I. 900 > (2)

In the sixteenth question the results were as follows:

A. > 200
B. 200 to 300
C. 300 to 400
D. 400 to 500 (1)
E. 500 to 600
F. 600 to 700
G. 700 to 800
H. 800 to 900
I. > 1 milion (2)

One person who responded to the fifteenth question had no answer for the sixteenth question. Of the three remaining respondents who reported stock before and after the implementation of stock monitoring techniques, only one reported a decrease in stock (from 600 to 700 for 400 to 500); Two companies indicated increases in stock (one from 200 to 300 for more than 1 million and the other from more than 900 to more than 1 million).

In the seventeenth question the results were as follows:

A. 55% to 60%
B. 61% to 65%
C. 66% to 70%
D. 71% to 75% (1)
E. 76% to 80%
F. 81% to 85%
G. 86% to 90% (1)
H. 91% to 95%
I. 96% to 100% (2)

In the eighteenth question the results were as follows:

A. 55% to 60%
B. 61% to 65%
C. 66% to 70%
D. 71% to 75%
E. 76% to 80%
F. 81% to 85% (1)
G. 86% to 90% (3)
H. 91% to 95% (2)
I. 96% to 100% (2)

Although not all companies had data on their delivery indexes on time before the implementation of a stock management technique, for the four companies that reported before and after the implementation data, one reported an increase in deliveries on time (from 71-75 to 96-100%), one reported a decrease (from 96-100 to 91 to 95%), and two remained unchanged (one in the range of 86-90% and the other in the range of 96-100%).

In the case of Nestlé, according to Saraiva (2015) all transactions of the articles, carried out in the warehouse, are recorded in the SAP system. The system database includes not only all articles, but also all its characteristics and settings. In the SAP system, you can access the article information, such as the reference, the current stock level, the warehouse location, the minimum and security stock levels, the Purchase Order (PO), the value, the delivery time, and more. It is also possible to obtain a history of entries and use of the articles, through reports. At any time, it is possible to make changes in the configuration/parameterization of the articles and if it is a new article, it is necessary to create it in the SAP system.

5. Conclusions

During this research, a questionnaire was developed in order to evaluate the stock management techniques, and the results were based on the reports of only 8 organizations. One point bad of this research was to have a small sample and the generalization of the results, being a point to discuss in order to improve in the next research.

This research was guided by five questions enunciated in the introduction. In the first question, there were some limitations because most companies could not provide information about their delivery classifications on time before implementing a stock management technique. The organizations that provided information about the delivery on time indicated mixed results, one of them reported a decrease in the delivery rate on time, another an increase and two reported changes indicated. With the current results it was not possible to conclude that an improvement in delivery on time resulted from the implementation of a stock management system.

In the second question, the companies that produced the most indicated that they used the ABC stock classification and consequently were more likely to report the use of the cycle counting method. In contrast, organizations with production below 150 components were no longer using the ABC method. Of the four companies that reported using the ABC method, only three (75%) Had 76 or more employees, the number of clients did not induce the use of the same method. The combination of the value and use of the dollar was the most popular inventory method of ABC reported by respondents. When we used the value only in dollars it led to the organizations indicating that they applied the ABC classification as a main tool to avoid the annual stock count. Based on the limited sample of the study and the components produced and employed, large companies seem more likely to use the ABC method preferring the combination of dollar value, probably using a complementary method of inventory.

In the following question, companies with the highest number of employees and products produced indicated the use of the cycle counting method, and the number of clients attended was not related to this method. Three quarters of those who used the number of recounts reported the use OF ABC inventory classification. There Was no clear pattern related to which stock management method was placed in the first place, that is, a company started using THE ABC method before using the cycle count. There was also a third company that used the two stock classifications in effect in the same decade. The random selection grouping was the cycle counting method endorsed by most manufacturers. Only one company, with few employees used the reciprocating counting method and local count. The way this generalized practice can be adopted for other manufacturers cannot be determined in this study.

In the fourth question, the manufacturers who responded to the research developed in this study did not seem to have the objective of reducing stock, most likely because of the research having focused on the manufacture of aircraft equipment and parts. There have been some examples of enormous increases in stock accuracy after the implementation of a stock management method and only one company reported a reduction in inventory. Although the survey data did not provide relevant details, it was not possible to determine whether an increase, decrease or no change in stock levels was related to the philosophy of stock management or to the growth/decline of the business.

In the last question, it was difficult to obtain the precision data from the Inventory. In general, companies reported dedicating few resources to the inventory precision project and the time they took to achieve their stock precision goal was highly variable, from a few months to years. Of the three respondents only two reported enormous increases in their stock accuracy index since the implementation of a stock management technique. The results of the present study are limited to the size of the sample, and it is not possible to take any kind of conclusion about them. During the survey it was notorious that approximately half of the aircraft parts and equipment manufacturers who participated in the study reported the use of stock management techniques. The largest companies supported the use of stock management techniques and those who used the

cyclic counting technique most likely used the ABC classification as well, even knowing that they allocate few human resources for the implementation of Stock management practices. No clear pattern of changes in delivery was found on time, contrary to what was expected. It was difficult to determine whether stock changes derived from stock management or some other factor, such as growth and business decline.

Using the case of Nestlé as a means of comparison, we found that, in today's world, the use of technologies allows us to gain time and this is a scarce resource for companies. Through the use of these technologies will be able to achieve high levels of accuracy and thus obtain the competitive advantage.

References

Bowersox, D. J. (2008). *Supply chain and logistics management.*Rio de Janeiro: Elsevier.

Brooks, R., & Wilson, L. (1995). Inventory Record Accuracy: Unleashing the Power of Counting Cycle. New York: John Wiley & Sons, Inc.

Carvalho, J. C., & Ramos, T. (2009). *Logistics in health.*Lisboa: Syllables editions.

Gaither, N., & Frazier, G. (1999). Production and Operations Mamagement, Eighth Edition. Cincinnati: South-Western College Publishing.

Greene, J. (1970). Production and Inventory Control Handbook. New York: McGraw-Hill Book Company.

LaMacchia, C. (May 10, 2004). *Ten Ways to Reduce Inventory. Retrieved from While Maintaining or Improving Service: http://www.tehprogressgroup.com/publications/wp15tenways.html*

Lanman, J. (2005). Inventory Management improvement techniques.

Leão, A. L., Mello, S. C., & Vieira, R. S. (2009). The role of theory in the method of research in administration. *Organizations magazine in context, São Paulo, v. 5, N. 10*, 1-16.

Piasecki, D. (2003). Inventory Accuracy: People, Processes, & Technology. Kenosha: OPS Publishing.

Risjord, M., Moloney, M., & Dunbar, D. (2001). Methodological triangulation in nursing research. *Philosophyofthe Social Sciences, v. 31, N. 1*, 40-59.

Roldão, V. S. (2002). *Planning and scheduling of operations: in industry and services.*Lisbon: Monitor.

Saraiva, J. M. (2015). *Proposal for improvement in stock management of Nestlé 's non-production warehouse.*Lisbon: Faculty of Science and Technology and the new University of Lisbon.

SICCODE, B. (May 4, 2019). *Siccode*. Retrieved from siccode.com: https://siccode.com/sic-code/3728/aircraft-parts-auxiliary-equipment

Slack, N., Chambers, S., & Johnston, R. (2002). *Production administration. 2. ed.*São Paulo: Atlas.

Tersine, R. (1982). Principles the fInventory and Materials Management: Second Edition. New York: Elsevier North Holland, Inc.

Williams, M. (May 10, 2004). Reducing Inventory Levels Through ABC Jnv. Retrieved from Management Techniques: http://proxy.library.eiu.edu:2067/itw/infomark/276

Zikmund, W. G. (2000). Business Research methods. *5. ed.*Fort Worth: Dryden.

Appendix A

Inventory Record Accuracy Sheet

Date ____ **Counter** _____

Part #	Inventory Record	Physical Count	Tolerance	Range		Hit	Miss
1	100	99	± 2%	98	102	X	
2	100	95	± 2%	98	102		X
3	100	92	± 2%	98	102		X
4	100	94	± 2%	98	102		X
5	100	99	± 2%	98	102	X	
6	100	98	± 2%	98	102	X	
7	100	102	± 2%	98	102	X	
8	100	103	± 2%	98	102		X
9	100	105	± 2%	98	102		X
10	100	98	± 2%	98	102	X	
11	100	102	± 2%	98	102	X	
12	100	100	± 2%	98	102	X	
13	100	96	± 2%	98	102		X
14	100	97	± 2%	98	102		X
15	100	106	± 2%	98	102		X
Totals **15**	**1500**					**7**	
						47%	**Accurate**

Figure 1 - Example of inventory record accuracy sheet

Appendix B

Expert 1:

Ron Tupper
Owner/President
DAPCO Industries

DAPCO Industries is a manufacturer ofparts from screw machines and CNC machines. DAPCO implemented ABC Classification and cycle counting in the early 1990's

Expert 2:

Rick Ross
Materials Manager
Rockford Spring Co.

Rockford Spring Co. is a manufacturer ofsprings and wire forms. Rockford implemented cycle counting in the late 1980's

Expert3:

Charles R. Bovard
Operations Manager
Total Quality Warehouse
A Division of Agracel, Inc.

Total Quality Warehouse is a company that offers warehouse service to local manufacturers. Charle gained his knowledge of ABC Classification with Sherwin Williams in Effingham, IL.

Chapter 8

Inventory management of slow moving spare parts
[8]

Figueira, Andreína and Gonçalves, Fátima

Abstract

Inventory management of slow-moving spare parts is a complex process, which is more critical, more costly and more difficult to predict than for other types of parts. Properly managed slow-rolling inventories increase company productivity, optimize your inventory-related costs and investments, and increase efficient production without delay. There are traditional models of classification of parts in inventories such as the ABC model that classifies them according to a single criterion, but for the case of the spare parts of slow rotation this presents limitations and that is why the mathematical model arises. This model, based on three theorems, is a two-phase multi-criterion model that takes into account some variables such as the level of criticality and allows to establish the size of orders and the ideal replacement point. The model is adapted for inventories of slow-moving parts with a longer service life than the rest and for repairable parts inventories. The study presents examples of slow-moving real parts and concludes that the new model is capable of improving performance generally while in others almost no difference.

[8]This paper is based on Liu, Z. (2013). Inventory management of slow moving spare parts in National Electricity Power Plant of China (Master's thesis). Molde University College.

1 Introduction

The stock management of slow-moving spare parts is different from the fast-moving spare parts in some factors such as unit value, annual consumption and mode of delivery. Replacing slow-moving spare parts, which are usually replacement items, is usually more expensive, slower, and more difficult to predict than quick-turn item replenishment. This highlights the importance of developing specific techniques for this type of items that allow to reduce the cost of logistics or cost of storage and transportation, thus the total cost.

The main objective of this study is to present the most appropriate way of maintaining the balance between the minimum cost and the continuous production, that is to say, to implement a good inventory management that guarantees an efficient production, as well as the reduction of the costs associated to the inventories, which may lead to increased productivity of the company. To improve productivity and cost optimization are presented some fundamental models for the management of inventories, especially the mathematical model that arises to solve the classification limitations before the types of pieces that presents the ABC classification model.

The study uses as an example the National Electric Power Plant in China (NEPP) which in 2000 was privatized and with this there were changes in its objectives which brought many challenges to the top managers, as was the inventory control of parts of since the increase in turnover was leading to a large increase in costs due to waste. The importance of trying to improve the management of inventories in the company relies on the fact that it is one of the largest electricity generating companies in China, now also focused on the construction, operation and management of electricity businesses. More specifically it is determined that the conventional methods are not suitable for the management of inventories of parts of slow rotation commonly used in the NEPP and therefore are presented models focused mainly with this type of pieces.

The present article begins with the presentation of a review of the literature studying indispensable concepts in the study of inventory management. It continues to make explicit the methodology used in the study as well as the results obtained in the application of different models. Finally, in the conclusion, the contributions to the solution of the problem are enumerated as well as to what extent the initial objectives were reached.

2 Literature revision

Spare parts are those that are kept in stock for the purpose of replacing damaged or defective parts. Depending on their function, the replacement parts may be mechanical or support, mechanical ones being those specific to a particular type of machine and those of support that are common to all equipment and are produced by professional manufacturers. Depending on the origin the parts may be produced with a particular design for a

specific purpose (usually mechanical parts) or from an outsourced source when purchased from other manufacturers. The parts can also be classified by their frequency of use, with high frequency of use being those which are usually inexpensive, low frequency of use and high value parts. Finally, they are also classified on the basis of their maintenance, namely, repairable and non-repairable spare parts, in the latter case being discarded in case of failure.

To ensure that an entity does not have to stop its activities due to the break in its stock, it is necessary to maintain a continuous process of planning, organization and control that allows matching supply and demand of parts as well as to avoid losses and wastes. This process is known as stock management focuses on raw materials, manufacturing products, components and finished products and is defined as "the planning and scheduling of operations seeking in particular to create security against delays in delivery by suppliers, maintain the interdependence between manufacturing operations by generating more flexibility, increasing flexibility in the face of variations in demand". (Roldão & Ribeiro, 2007, p. 237). Good stock management will increase the company's gross and net profit by reducing acquisition and transportation costs and ensuring a response to customer demand.

Spare parts are defined as those that help keep a computer running. In this case there are characteristics that must be considered regarding inventory management for this type of parts, such as establishing maintenance policies, in which it is important to define whether faulty parts are repairable or not, as well as to know the moment and frequency with which the transportation costs for the repair site will be kept, known and considered. Lastly, it is necessary to pay attention to the time of obsolescence of the machines since both the spare parts and the equipment have a certain useful life.

There are different ways of determining the level of stock management performance. The first way to monitor and control inventories is the Inventory Turnover Calculation (ITOR), presented by Zongjian (2013), which is the "cost of replaced goods divided by the average inventory level in the hand" (p. 14). Allows you to estimate how many times a company's inventory has been replaced during a certain period. Another way is to study the level of service or, what is the same, to know the quantity of stock needed to satisfy the demand, being for this fundamental to know the probability of exhausting the stock before the spare time and determining the fill rate. In addition to these two indicators there are also some others such as the average cost of stock maintenance and the cost of incremental ordering.

Inventory costs can be divided into three groups: the cost of ordering or related to the purchase of products, transportation costs that also include the storage costs and cost of breakage that result from not having the product when it is needed.

Slow-moving spare parts are those that have low demand, both in the quantity of orders made and in the size of orders and are provided by the BTO (build to order) model which indicates that the products are produced when an order exists. There is also another classification of parts such as the fast-rotating parts, which have a higher demand and

more affordable prices, provided by the BTS (build to stock) model which means having available stock for when there is an order. Although there is no clear distinction between slow and fast rotation, Zongjian, (2013) defines slow-moving spare parts as those in which the frequency of demand is less than 12 units per period. The exponential and moving average method of damping is one of methods used in demand forecasting (Zongjian, 2013). In the case of low-moving items, it is difficult to predict the demand since it is very volatile and at high turnover rate, the historical data is limited.

According to an analysis of the results obtained from research of publications in scientific journals, it is known that most companies use traditional inventory control models. One of the traditional methods of item categorization in an inventory is the ABC classification model or also known as the "Pareto principle" on the basis of annual dollar volume and defined as "a methodology that classifies items in descending order of values (in cost or quantity), usually resulting in the creation of three classes: A, B and C"(Roldão et al., 2007, p. 438), these three phases being described as: A-Very important, B-important and C-little important. "To determine annual dollar volume for ABC analysis, we measure the annual requirement of each item per unit cost" (Heizer & Render, 2006, p. 477). This categorization allows us to establish the amount of time, resources and effort that will be devoted to each item. Although it is a very useful method, it presents the problem that it is based on a single criterion through which the multi-criterion approach that allows including more than one parameter in the classification of items.

The rotation of stocks is another important concept linked to this study, called by Roldão et al. (2007) as "the quotient between the total volume of annual outputs and the average value of inventories" (p. 439). That is, inventory turnover reflects the efficiency of the company's production according to the level of outflows (sales) and the level of inventory remaining in the warehouse. The security stock in which it is concerned is the form of "to ensure protection against the variation of delivery times and the consumptions" (Roldão et al., 2007, p. 439), that is, to have a base of support to respond variations avoiding breakages.

The hierarchical analysis process (AHP) is, according to Zongjian (2013), "the structured technique for organizing and analyzing complex decisions" (p. 17), which allows characterizing substitution parts hastily and assign weights for each parameter, taking into account the qualitative and quantitative criteria making comparisons with pairs.

In stock management, several models emerge according to Roldão et al. (2007), such as the Economic Order Quantity (EOQ) model, which allows minimizing total costs and obtain the optimal order quantity, considering as relevant costs the acquisition cost, cost of ordering and cost of ownership of stock; the continuous revision model (Q, R) is based on the fact that "whenever the order point R is reached, it is considered a quantity of product equal to the economic quantity Qe" (p. 448); the periodic revision model (S, T) in which "the position is revised at fixed intervals, and an amount that replaces a certain level T of stocks" is ordered (p. 450).

Vendor Managed Inventory (VMI) is the result of the relationship between the supplier and the retailer where the supplier is in charge of replenishing and deciding the time and size of the stocks. On the other hand, there is the jointly managed inventory (JMI) where production companies and inventory owners work together in inventory management. The latter is used in most industrial companies and is based on 3 elements: the storage location, the security inventory and the inventory owner.

3 Methodology

After studying theories about classification of spare parts inventory, Zongjian (2013) begins to identify the limitations they present when applied in most industrial companies and, in this case, NEPP, namely: it is not logical to treat these with the ABC model, since it is known that it uses only one criterion, and, for example, it is not possible to classify the parts according to the price when it has already been demonstrated that the low rotation parts have a higher price than high-speed parts; on the other hand, it is known that the level of criticality varies from one piece to another, and the greater the criticality, the greater its value, and therefore cannot be determined by the price either; Finally, there is the obsolescence faced by parts and equipment that, once again, have nothing to do with price.

In response to the limitations of the traditional criteria, other methods of multi-criteria inventory classification (MCIC) have emerged which, because they are linked to better results, are better suited to the management of inventories in companies such as NEPP. It is proposed a complex computational tool based on the use of matrices that allows classifying the inventories in two criteria with equal weight. However, it is well-known that it may be necessary to consider three or more criteria for which genetic algorithms and artificial neural networks (ANN) will be used but with the problem that they do not take into account qualitative criteria and are so complex that they become difficult to understand by inventory managers. Finally, we present the analytical hierarchy process (AHP) that allows us to "obtain a single scalar measure of criticality of stock items by subjective judgment" (Zongjian, 2013, p. 21).

In the ABC classification model, the criticality of spare parts has always been an important criterion in its classification, insofar as the criticality of the equipment is of no importance and it is for this reason that the two-stage classification model for the inventory of spare parts of equipment.

The first phase of the model is based on the classification of equipment according to its level of criticality. A critical equipment "is one that presents the highest degree of complexity in the solution of defects, or one that physically imposes access difficulties for eventual corrective action" (Marques, Marçal, Neto & Pilatti, 2006, p. 5). This concept will give rise to three subgroups: vital, essential and auxiliary equipment. Following the classification of the equipment, the spare parts inherent to auxiliary equipment are classified directly into group C, which will decrease the work to be done since the second

phase will consist only of dividing the vital and essential equipment parts into categories A, B and C. When the grading process is completed spare parts of group A should get more management attention. In order to deal with this second phase, the AHP process will be used since it allows assigning different weights (or amounts) to each criterion. In the case of slow-moving spare parts, they shall conform to a special class of class A; (BTO), the annual consumption (up to 50 units) and the unit value (more than US $10.000) will be differentiated from the rest by means of three criteria.

For the presentation of the Zongjian (2013) inventory control model, it assumes the following: "The number of components whose corresponding parts slow-moving spare parts in one kind of equipment is single" (p. 24), all components and its spare parts can achieve the same performance, the service life of the parts is longer than the replacement time, the model is under continuous control and evaluation of the point and order quantity (s, Q), the lead time is calculated through Poisson distribution, inventory control policies with service levels greater than 98% may be accepted.

There is a mathematical model of inventory management for expensive and slow-moving items based on three fundamental theorems:

- Theorem 1: indicates that "when demand is small, discrete distribution is used as Poisson distribution to represent demand at waiting time" (Zongjian, 2013, p. 25).

$$P(x|\mu_L) = \frac{{\mu_L}^x}{x!} \times e^{-\mu_L}, x \in \{0,1,2,3,4 \dots\}$$

- Theorem 2: "indifference between reorder points (s) and (s + 1) when (Q> 1). Where P (s + 1 | μL) = probability that a Poisson variable with mean μL takes on the value s

$$\frac{P(s+1|\mu_L)}{P_{\leq}(s|\mu_L)} = \frac{QVr}{DB_1}$$

  + 1 and P ≤ (s | μL) = probability that a Poisson variable with mean μL takes on the value less than or equal to s" (Zongjian, 2013, p. 25).
- Theorem 3: "Values of Q, V, r, D and B1 are used to evaluate the critical ratio" (Zongjian, 2013, p. 26).

$$CR = \frac{QVr}{DB1}$$

Parameter definition: Probability (P), average demand in lead time (μL), Reorder point (s), order size (Q), unit value, total stock-out costs which are caused by no supply of stock after failure of component (B1), critical ratio (CR).

Turning to the application of the mathematical model, Zongjian (2013) uses as an example a type of spare part called "generator transformer" to demonstrate how the application of the mathematical model can improve the stock control policy. It is known that the plant is formed by four production lines and two machines in charge of heating the combustion system. Both the production lines and the machines all work independently and have a separate stock. It is also known that the policy used to control the stock is to replace the damaged parts and at that moment to order the new part from the

supplier. With this policy the probability of having to stop the plant due to breaks in the spare stock is quite low since the lifetime of these parts is much longer than the spare time, but in the same the managers choose to maintain a security stock consisting of extra items for each production line. In the analysis of the performance of the stock policy used in this case the current total cost and service level is studied hastily with the levels of cost and total services obtained with the suggested model, the mathematical model.

In slow-moving spare parts inventory systems, identical pieces may only be installed in one type of equipment, leading Zongjian (2013) to determine whether the model is applicable slow-moving spare parts with a longer service life and higher value as is the pressure generator that there is only one and is shared by the 4 production lines. For this, Zongjian (2013) modifies one of the previous assumptions: the inventory control policy will only accept service levels higher than 99%, while the rest remains constant and calls this new model as "extended model".

It is common for slow-moving spare parts to be repairable. The Zongjian (2013) to address the issue of inventory control for repairable components, uses the optimization model based on the assumption that "limited repair capacity and each repair is not perfect, repair time is much shorter than lead time and its effect can be disregarded and the inventory control policy with service levels which are more than 99% can be accepted" (p. 36), uses as example the main axle of suction fan and maintains the remaining premises. In this case, four spare parts are kept in the central stock (since there are four production lines) and the replacement order is given only when one of the parts reaches the end of its useful life.

4 Analysis of results

Based on the evaluation of the criticality of spare parts Zongjian (2013) classifies the parts used in the NEPP according to the 3 criteria already mentioned, concluding that only the diesel generator, generator transformer, generator cubicle, 6kv station section, unit auxiliary transformer, main generator, change over cubicle, forced draft fan, pressure governor, main axle can be considered as parts of slow rotation.

In the explanation of the mathematical model Zongjian (2013) uses as example the generator transformer with a unit value of $39.000, lead time of 36 days, stock-out costs of $35.000 each time, holding costs of $10 per day for each unit, ordering costs of $850 each time, annual demand in 2011 of 9, demand in each production line of 1 and valid period in warehouse of 450 days. Next, using SPSS with 50 samples it was determined that the respective annual total cost is $48.609. Each production line uses an independent stock control system but uses the same components so that orders can be coordinated in order to reduce the total annual cost as a result of lower ordering and maintenance costs.

By means of the mathematical model, Zongjian (2013) determines the ideal size of the order (Q) by means of the calculation of the CR and the respective annual cost (CRT) for each Q, giving as a result that the ideal (Q *) to minimize costs is 2 with the equals 3

and the CRC of 20684. This means that “the best solution is making an order of two items each time when only three left in inventory” (p. 31). Using the total relevant cost and service level hastily between the suggested policy and the current policy, it is concluded that it is possible to reduce total costs by 57% if the suggested model is used. Knowing that Q * is 2 with service level between 98.3% and 98.97% it is confirmed that inventory control policies can be accepted as long as they comply with the basic assumptions of the model (service level> 98%).

To explain the extended application of the model, Zongjian (2013) uses the pressure governor as an example with the following characteristics: unit value of $45.00, lead time of 55 days, stock-out costs of $140.000 each time, holding cots of $11.5 per day for each unit and ordering costs of $900 each time. Obtaining annual inventory retention costs of 8101, annual order costs of 439, and lastly, the relevant 10-year total cost of 85400 with service levels considered as 100% in current policy. For the application of the now suggested model it is necessary to re-determine Q and its respective total annual costs to be able to conclude that “the best inventory control policy is ordering item each time when inventor level” (Zongjian, 2013, p. 34) since for s = 1 the CR will be 0.0615, the TRC 84184 with service level of 99.74% reinforcing the basic assumption of the model (service nick> 99%). Comparing the current policy with the suggested policy, it is concluded that there is not much difference in the total cost for 10 years since it only reduces the cost by 2%, which is not considered as a relevant variation, so both could be considered.

In the inventory control policy for repairable components Zongjian (2013) uses the main axle of suction fan as an example having the unit value of $11,200, the lead time of 30 days, stock-out costs of $35.000 each time, holding costs of $3 per day for each unit, ordering cots of $320 and repairing costs of 2.200 each time per unit. For the current model, the relevant total cost for ten years with a sample of 20 is 203837. In the model now suggested the total cost “The function of total ten-year relevant cost is determined by three variables, namely number of repairs, order size and reorder point” (Zongjian, 2013, p. 39). Repairable components do not have a limit on repairs, in which case the maximum number of repairs is 8.

Zongjian (2013) presents the specific data for each number of repairs (m) where m is equal to 0 when the parts are not repairable, it is equal to 1 when soon after the first repair the component should be discarded, it is equal to 2 and so on. The following table reflects the best stock policy for each value of m:

m	Lifetime (days)	Ten-years demand	Purchaising cost (pc)	Minimum TRC	Q	s
0	151	24.2	271040	309879	1	2
1	292	12.5	140000	193940	1	1
2	427	8.55	95760	157431	1	1
3	540	6.76	75712	143604	1	1
4	572	6.38	71456	150731	1	1
5	594	6.14	68768	159251	1	1
6	604	6.04	67648	169950	1	1
7	615	5.93	66416	179911	1	1
8	620	5.887	65934	191564	1	1

From the previous table it can be concluded that the minimum annual cost (TRC) is 143604 which corresponds to the number of repairs (m) equal to 3 with a (Q) equal to 1, an s equal to 1 and service levels of 99.85 %.

The following is a comparison of the costs of the current policy with the costs of the suggested policy. The current policy reflects on the ordering cost of 1885, a holding cost of 32320, a purchase cost of 65968, a repair cost of 103664 and the TRC of 203837 and does not present stock-out cost; in so far as the suggested policy presents an ordering cost of 2163, a holding cost of 20761, a purchase cost of 75712, a stock-out cost of 352, a repair cost of 44616 and a TRC of 143604. These figures show a decrease in the costs of applying the suggested model, both of which have the same level of service of 99.85% which is acceptable in the plant.

In order to demonstrate the impact on the reduction of the TRC resulting from the application of the inventory control policy for repairable components, the following table shows the calculations for the remaining parts, which have not been studied but which have already been determined in the beginning, which are slow-moving spare parts, namely: Diesel generator, 6kv station section, forced draft fan and unit auxiliary transformer.

Item	Current policy					Suggested policy					Costs saving
	Q	s	TRC	P_1 %	P_2 %	Q	s	TRC	P_1 %	P_2 %	
Diesel generator	4	8	24470	99.97	99.99	2	7	19636	99.80	99.92	4834
6 kv Station section	6	12	24312	99.99	100	3	9	17836	99.95	100	6476
Forced draft fan	15	10	10060	99.99	100	10	6	8200	99.73	99.97	1860
Unit auxiliary transformer	5	6	45629	99.99	100	2	4	27381	99.70	99.82	18248

(Zongjian, 2013, p. 50)

In the previous table the reduction of TRC, as well as the values of Q and s, is evident. It is also verified that the service levels are always within the accepted parameters.

5 Conclusions

After defining the concept of slow rotation spare parts as those that have low demand, and to study the characteristics of the management of inventories of this type of parts, the mathematical model is presented. This new model helps managers, through three theorems based on a discrete Poisson distribution, to define the order sizes and optimal order point through a policy that, in general, seeks to reduce total costs and avoid breakages of stock hastily with models already known as are the model of the economic quantity of order, the model of continuous revision and the model of periodic revision.

It is extremely important to understand how the way to manage inventories is a variable directly related to the efficiency levels of any production company, since it directly affects its capacity to respond to variations in demand and, therefore, influences the profit from the activity. Inventory management studies the types of parts that the company has in its inventory as well as its specific characteristics and, based on these, allows determining the optimal order quantity and order size to minimize the associated costs (ordering costs, transport and storage). It is also important to remember that the management method to be used should be adapted to each function that fulfils the parts that compose it. The performance level of stock management is measured by ITOR (Inventory Ratio Rate Calculation) to determine how many times a company's inventory has been replaced in a given period. A high ITOR is the result of a good inventory management policy.

Many industries still use traditional methods such as the ABC classification model but, when compared to the multi-criteria method, it is concluded that the latter is more

efficient, since it allows bettering to classify the pieces in order to identify those of fast and slow rotation in base more than one parameter. One of the most important limitations of the ABC model is that it takes into account the criticality of the parts and not the criticality of the equipment, insofar as the multi-criteria model classifies the equipment in: vital, essential and auxiliary equipment according to the level of criticality. This classification streamlines the classification of the pieces giving management clues as to which groups should pay more attention. Finally, the AHP process is used to assign weights to each group. All this highlights the importance that managers must give to the classification of the pieces and how this influences the result.

Regarding the suggested model (the mathematical model), it can be said that in the irreversible slow rotating parts, it is possible to increase the service level and decrease the minimum annual cost (TRC), while for rotating parts with longer lifetimes others, this policy does not show any improvement, and it is therefore ideal to maintain the current policy. On the other hand, for repairable parts, it is added as a variable the number of repairs and it is concluded that the suggested model allows better results in terms of the minimum annual cost (TRC), maintaining the levels of service accepted by the managers. The fact that these data do not all point to the same policy, makes it impossible to conclude that the mathematical model is 100% more effective than the current model more, it allows to intuit that small changes or improvements in it will allow to reach a more efficient model in all cases.

A number of modern inventory management approaches have been studied, from which it can be summarized that the Vendor Management Inventory (VMI) is the most appropriate strategy for low turnover parts that are purchased from multiple suppliers. For slow-moving parts, as they are often of high value, suppliers do not keep inventory if they do not expect orders producing in an attempt to mitigate risks associated with breakdowns and obsolescence, this is known as build-to-stock (BTS). For this second type of parts (slow rotating parts, high value, high specificity and low demand) the most appropriate is the Jointly Managed Inventory (JIM) that allows reducing stock levels through inventory sharing.

The main objective established at the outset of the investigation was to present a more appropriate way of maintaining the balance between minimum cost and continuous production through good inventory management to ensure efficient production and reduction of inventory costs (order cost, transportation and warehousing) to improve the company's performance. This objective can be considered as achieved since it was suggested the mathematical model and it was evident that this allows, although not in all cases, but in the majority, reduce the minimum annual cost and thus increase the profits.

In spite of the main objective being fulfilled, it can be considered that questions remained unaddressed that could be dealt with in future investigations, namely the fact that some parts require special maintenance, for example, those that are in danger of being invalidated in time and those that need large spaces for storage. It is suggested to present a new model in the future, or to modify an existing model that addresses these issues.

References

Heizer, J., & Render, B., (2006). *Operations management*. New Jersey: Person.

Marques, A., Marçal, R., Neto, A., & Pilatti, L., (2006). *Os principais equipamentos utilizados nas empresas de beneficiamento de mármore e granito, suas funções e importância no processo*. Retrieved from https://docplayer.com.br/10976918-Os-principais-equipamentos-utilizados-nas-empresas-de-beneficiamento-de-marmore-e-granito-suas-funcoes-e-importancia-no-processo.html

Roldão, V., & Ribeiro, J., (2007). *Gestão das Operações*. Lisboa: Monitor.

Zongjian, L., (2013). Inventory management of slow moving spare parts in National Electricity Power Plant of China. Master's degree thesis, Molde University College, Molde, Norway.

Chapter 9

Big Data and Analytics and its Influence on Management Control [9]

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Abstract

The influence of big data and analytics in the control of management and the benefits and challenges that organizations experience when using data (large) are the object of study of this article. The existing literature on big data is focused mainly on theory and formulation of expectations and often focuses only on its positive aspects.
The results are partially aligned with the expectations present in the existing literature, while it only pays limited attention to technological and managerial challenges that may arise in the process towards the use of more data. They suggest that the big data does not have a significant effect on management control, but an indirect effect is instilled to exist. This indirect effect suggests that during the project data, organizations can change the use of a coercive form of control to a more favorable way. ("Influence of big data and analytics on management control," Luuk Vloet, 2016). In order to extend existing knowledge, qualitative methodology is used, by conducting several interviews to five employees from five different organizations that are members of the management team or are closely involved with the data and developments in your organization. The results show that the expected impact of big data on the management control was not reached in the different organizations. All five organizations have realized that they have to follow the developments in the data area because it is a progressive development in the market and its not keep up can lead to adverse effects on the organization.

[9]This paper is based on Vloet, L. (2016). Influence of big data and analytics on management control. Why changes in management control by means of big data and analytics are not achieved yet (Master's thesis). Radboud University.

1 Introduction

Throughout the article is intended to reveal the influence of the big data and analytics management and control systems analyze further expectations present in the existing literature on the respective date and big influence on the management control. The objective involves examining how companies that will implement big data and analytics deal with the challenges of the same, to what extent can succeed in its implementation and what big data impact and analytics on systems management control. In order to achieve this, a literature study is conducted to examine the literature and the related results, which will lead to new insights into the big data research area, information technology and management control,

The scientific relevance of this research is twofold. First, as Frizzo-Barker et al. (2016) note, for big data is relatively new, emerging concept, the big data research is in the early stages domain. This results from the fact that, at present, there is not much research done in this area. For this reason, this thesis can add insight into this direction of research studied relatively limited. Second, many articles on big data are based on the benefits of big data are either very technical studies based on theory and formulation of expectations, with limited focus on the challenges (Frizzo-Barker et al., 2016). Articles that discuss the challenges of Big Data, practical evidence is lacking on these challenges through qualitative studies. Besides that, just a few influences from big dates are investigated. For example, do not have a lot of research that investigates the influence that big data has on the management control principles have been made. For this reason, the focus of this thesis are the challenges of big data and the connection between big data and analytics management control. Thus, this thesis contributes to scientific research on management control areas and big data influences. It provides scientists with new insights into how companies deal with the benefits and challenges of big data and the impact on management control. Thus, this thesis contributes to scientific research on management control areas and big data influences. It provides scientists with new insights into how companies deal with the benefits and challenges of big data and the impact on management control. Thus, this thesis contributes to scientific research on management control areas and big data influences. It provides scientists with new insights into how companies deal with the benefits and challenges of big data and the impact on management control.

In order to obtain a clear answer as to the above mentioned subject matter, several steps are taken. First, Chapter 2 contains a review of the literature. This is focused on big data definitions, benefits and challenges. After this literature review, in Chapter 3, contains the research methodology. In order to examine the expectations of the literature review in chapter 4, the experiment results and further discussion will be presented. Finally, Chapter 5 is devoted to conclusion, limitations and suggestions for future research.

2 Literature Review

The literature review shows that research has been done, what the results of these studies and these findings and expectations differ or combine with each other (Saunders, Lewis, & Thornhill, 2009). Thus, it is possible to define gaps in existing literature that allow to reveal flaws in the existing literature in order to show in which areas the existing studies can be extended.

2.1 Information Technology and Management Control

2.1.1 Information Technology

During the last decades, the use and the potential of IT applications increased dramatically (Chen et al., 2012). This development provides organizations with more development possibilities in the area of information technology. This enables organizations aprimorem existing methods and systems, but also led to new technologies in information technology. These new technologies are based on systems, technologies, processes, business applications and software organizations (Malachi, Malachi, & Hwang, 2016; Shaikh & Karjaluoto, 2015). One reason for the increase in the potential of IT applications is the development of the Internet (Demirkan & Delen, 2013). The emergence and development of the Internet make even greater amounts of data occurring in the world and this number is still continuously increasing at an incredible rate. This is emphasized by Moore's Law, which states that the amount of available data doubles every 18 months (Marsh, 2003). These technological developments may also affect the information systems and for this reason, organizations have also invested in these systems. Examples of these technological developments are ERP systems and information databases (Dull, Gelinas, & Wheeler, 2012; Shaikh & Karjaluoto, 2015). (Influence of big data and analytics on management control, "Luuk Vloet, 2016) 2003). These technological developments may also affect the information systems and for this reason, organizations have also invested in these systems. Examples of these technological developments are ERP systems and information databases (Dull, Gelinas, & Wheeler, 2012; Shaikh & Karjaluoto, 2015). (Influence of big data and analytics on management control, "Luuk Vloet, 2016) 2003). These technological developments may also affect the information systems and for this reason, organizations have also invested in these systems. Examples of these technological developments are ERP systems and information databases (Dull, Gelinas, & Wheeler, 2012; Shaikh & Karjaluoto, 2015). (Influence of big data and analytics on management control, "Luuk Vloet, 2016)

Several benefits can be achieved with the use of information technology. For example, information technology may lead to increasing speed and reliability of transactions and data. Moreover, it can improve communication between and within organizations, but also can improve the internal processes (Mal et al, 2016;. & Shao Lin, 2016). However, the rise of information technology also creates challenges for organizations, as they need to handle large

amounts of data. To achieve this, for example, more technical knowledge is required, which is not always easy to reach (Chun, Kim, & Lee, 2015). Examples of recent developments in information technology are the emergence of ERP systems and cloud computing (Granlund & Malmi, 2002) but developments are visible in relation to smartphones, tablets and other communication tools. Moreover, another development is the increase of big data (Shao & Lin, 2016). These new developments have changed the way to collect, store and disseminate data. Therefore, these developments may have a vital influence on the management control systems (Teittinen et al., 2013).

2.1.2 Management Control

In the past, the accounting was seen as a passive tool to help in decision making (Chenhall, 2003). However, this view has changed and nowadays many studies have examined the active role that the management control systems have (for example, Ahrens & Chapman, 2004). The controls are needed for two reasons. First, due to personal limitations, employees do not always know exactly what the organization expects of them or how they can do their job as efficiently as possible. This can be caused by lack of skills, information or training, but also because of some personal bias. Some of these defects can be avoided, but some need to be resolved through controls (Merchant, 1982). In second place, it is possible that the individual goals of employees do not meet the organization's objectives. In this situation, there is a lack of congruence of goals and in such situations, you need controls to ensure that employees do not act in their own interests, which may occur due to two causes. At first, there may be a lack of direction, and the staff just do not know what the organization wants them, secondly, are also possible motivational problems. (Merchant & Van der Stede, 2012). and staff simply do not know what the organization wants them, secondly, are also possible motivational problems. (Merchant & Van der Stede, 2012). and staff simply do not know what the organization wants them, secondly, are also possible motivational problems. (Merchant & Van der Stede, 2012).

Merchant (1982) refers to the management control as a tool that can ensure that employees work in accordance with the agreed plans. According to him, the management control is a behavioral problem and administrative control exists to influence employee behavior in the desired direction. He mentions various types of control and argues that not all types of control are applicable in any situation. Moreover, argues that it is not always preferable to have a rigid form of control because this can have some adverse effects, such as destroying the morale of employees or employees who are only focusing on the areas of measurable results. ("Influence of big data and analytics on management control," Luuk Vloet, 2016)

The management control includes all the features that managers have to ensure that employee behavior and decisions they make correspond to the objectives and strategies of the organization (Malmi and Brown, 2008). For this, the administration is concerned with the organization of resources and guidance activities in order to achieve organizational goals. In this, the management control is related to objective setting processes and formulation of strategies for the management control is the end of this process. Anthony (1965) adds to this

that the management control includes processes that enable employees to obtain resources to achieve these goals. In addition, the management control ensures that resources are used effectively and efficiently. According to Merchant & Van der Stede (2012), management control deals with employee behavior control, and that to prevent employees exhibit behaviors that are not in accordance with the organization's goals or to prevent employees fail in their activities. However, beyond this definition, also the difference between the trainer and coercive control is taken into account because the existing literature hopes that in case of organizational changes, a form of more coercive control can best contribute to achieving the potential of these changes (JORGENSEN & Messner, 2009 in "Influence of big data and analytics on management control," Luuk Vloet, 2016). Therefore, it is expected that the form of control in organizations affect the potential of big data for organizations. this being to prevent employees exhibit behaviors that are not in accordance with the organization's goals or to prevent employees fail in their activities.

2.1.3 Management Control Methods

In addition to various management control settings, various forms of management control are discerned in the literature. One way of describing the management control is based on the distinction between coercion and a means of control (Adler & Borys, 1996; Ahrens & Chapman, 2004). Coercive control is based on a control approach "from above", aiming to avoid the reluctant attitude (Jorgensen & Messner, 2009). The coercive control also emphasizes centralization and pre-planning and provides employees with only limited stock options. It was developed with organizational rules in order to produce an infallible system based on disqualification (Adler & Borys, 1996; Ahrens & Chapman, 2004). On the other hand, It provides more power to enable control of employees and therefore employees are able to deal more effectively with the inevitable contingencies in their work processes (Jorgensen & Messner, 2009). This is possible thanks to organizational rules that take into account the employee intelligence. Thus, there are formal procedures required to make the infallible work processes, as is required for coercive control. The only formal rules that are used, are focusing on support staff in their work (Adler & Borys, 1996; Ahrens & Chapman, 2004). (Influence of big data and analytics on management control, "Luuk Vloet, 2016). Employees are able to deal more effectively with the inevitable contingencies in their work processes (Jorgensen & Messner, 2009).

Through four principles of system design, it is possible to discern the differences between coercive control and activation. These four design principles are repair, internal transparency, transparency and overall flexibility, and include coercive control and activation. This contrasts with a lot of literature that attributes these four principles only to allow control (Adler & Borys, 1996). The repair is based on the question whether employees are allowed to "repair" defects in alone systems (Jorgensen & Messner, 2009). When using a form of activation control, employees are free to recover failures, and even possible to achieve improvements. In coercive control, any deviation from the standard type is seen as suspect and there is no possibility of

"repair" by staff (Adler & Borys, 1996; Ahrens & Chapman, 2004). The internal transparency focuses on the inner workings of the organization. In this, the question is whether employees understand the systems and equipment that are using (Ahrens & Chapman, 2004; Jorgensen & Messner, 2009). When using the activation control, the procedures, the reasoning behind the idea and the rules are clear to employees and managers. On the other hand, coercive control focuses on procedures and processes geared to the fulfillment of obligations and duties, but the goal is not to help employees because they only need to implement the work instructions (Adler & Borys, 1996). the question is whether employees understand the systems and equipment that are using (Ahrens & Chapman, 2004; Jorgensen & Messner, 2009). When using the activation control, the procedures, the reasoning behind the idea and the rules are clear to employees and managers.

The overall transparency asks the question if employees know how their work relates to the organization as a whole. The activation control uses the "usability" approach, which states that employees are aware of the broader process in the organization and know how their work fits into this broader process. The coercive control, on the contrary, is asymmetrical, which means that employees do not know the broader processes of the organization, just have to fulfill their task and must not interfere with the work of others (Adler & Borys, 1996; Ahrens & Chapman, 2004). Flexibility is related to the flexibility that employees have in the use of systems (Ahrens & Chapman, 2004). Activate the control states that deviations from procedures and processes cause not only risks but can also provide learning opportunities for the organization. These opportunities may even contribute to the improvement of procedures and processes. In coercive control, in contrast, the bypass procedures and processes is difficult. The supervisor permission is necessary to make detours and the procedures and processes described are strictly, and staff to accomplish this (Adler & Borys, 1996). (Influence of big data and analytics on management control, "Luuk Vloet, 2016).

Despite the obvious differences between these two forms of control, this difference is not extreme distinction. A company is not entirely coercive or enabling fully, they are present side by side in a company. This is confirmed in case studies of Ahrens & Chapman (2004) and Jorgenson & Messner (2009). Both claim that the enabling and coercive control can interact with one another. Thus, it is possible to achieve and balance both efficiency targets and flexibility within organizations. For example, it is possible by means of formalization with centralization and standardization to a particular level in order to achieve efficiency, flexibility and fine-tuning the operation of the process, which depends on specific operational situations. This flexibility ensures that the knowledge and local experience serve as a support to achieve the organization's goals. Thus, it is possible to achieve efficiency and flexibility, using qualified form of management control systems (Ahrens & Chapman, 2004).

2.2 Big Data

2.2.1 Introduction

One of the new technologies in IT is big data and analytics (McAfee & Brynjolfsson, 2012; Shao & Lin, 2016). Over the past years, big data has emerged as a new area of innovation enabled by IT and there is a noticeable increase in the use and potential of big data and analytics (Frizzo-Barker et al, 2016; Goes, 2014). One of the reasons why big data has become so popular is the availability and accessibility of data improved. This creates opportunities for enhanced research areas that were previously difficult to examine due to the low availability of data (Liu, Li, Li, & Wu, 2016). Contemporary society experiences a massive explosion of information and data. People are interacting with more information and more information is shared (Demirkan & Delen, 2013). As a result of the rapid development of various information technologies, large amounts of data can be collected (McAfee & Brynjolfsson, 2012; Zhou et al, 2016.). It is expected that the big light date to a change in many ways for the company. For example, a "shift in thinking about data infrastructure, business intelligence and analysis and information strategy" (Frizzo-Barker et al., 2016, p.403) is expected.

The difference between big data and other information technologies is that big data is not just save or access data, but also analyze this data (Bello-Orgaz, Jung & Camacho, 2016). By using big data, organizations are able to measure significantly more about business in your organization and you can make translations of this knowledge, which can improve decision making and, therefore, the organization's performance (McAfee & Brynjolfsson, 2012). Through the big data it is possible to combine private information preferences and consumer products with information from social media to understand and anticipate customer needs more accurately, which can improve decision-making. Moreover, with the use of big data, organizations can optimize processes, which means that the big data can have a considerable influence in organizations, also related to accounting and control. (Assumption et al., 2015). It is thus likely that the big data also has an influence on the management and control within organizations.

2.2.2 Definition

In the literature, due to the increase of big data, many big data definitions and / or analytics emerged with a variety of meanings, so that there was a standard definition of 'big data' in the literature (Porche, Wilson, Johnson, Tierney, & Saltzman, 2014). For example, Chen et al. (2012) refer to as big data sets and techniques of large and complex data "require advanced technology, unique data storage, management, analysis and visualization." These data sets are impossible to be analyzed by hand and need new tools for database management because the current traditional tools are generally insufficient (Frizzo-Barker et al, 2016;. Rao, Saluia, Sharma, Mittal, & Sharma, 2012). The large data sets exceed the capabilities of organizations (Ma et al., 2015), because they have data sets with sizes that go beyond those of traditional software tools skills and common in organizations to capture, store, manage and process data

(Bharadwaj, El Sawy, Pavlou and Venkatraman, 2013; Chang et al, 2014.). Thus, the big data creates a new wave of innovation (Tambe, 2014) and for organizations who wish to become an organization with big data, it means that investments should be made. This must be done on two levels: investments to process increasing amounts of data and also investments in order to make the processes in the most appropriate organization for a substantial commercial value of data and information.

Among others, Chow-White & Green (2013) argue that the big data requires not only a technical development. They argue that the big data also requires a social and cultural change in organizations, what is needed to become an organization that enables making decisions based on data. For a more comprehensive and clear understanding, it is important to consider the existing organizational and institutional structures of the organization. Moreover, it should also be taken into account the interaction with existing embedded practices of knowledge building and decision making within the organization. Through the development of the social and cultural environment in the organization, it becomes possible to collect and analyze information in real time, leading to better advantage for the organization.

Goes (2014) refers to the big data as the "creation of huge amounts of data through a wide range of various new sources of data" (p.3). This is based on structured and unstructured data, which have specific characteristics: it is based on large-scale data, have problems with the application resources to run these sets of large-scale data and leads to easier analysis and better interpretable data. data (Cuzzocrea, Saccà, & Ullman, 2013; Due, Kristiansen, ColomoPalacios, & Hien, 2015). (“Influence of big data and analytics on management control," Luuk Vloet, 2016)

2.2.3 Big Data Parameters

Technological changes caused by big data meant that the possibilities with the data generated to increase greatly. The literature identifies four aspects that caused the change, referenced through 4V's: volume, speed, range and accuracy (Frizzo Barker et al, 2016; Goes, 2014; Porche et al, 2014; Salehan & Kim, 2016). First, the volume is based on the amount of data. In recent years, the amount of data available has grown explosively (Sharma, 2016), and it is expected that this growth will continue in the coming years. An important aspect of big data, therefore, is the large volume of data that becomes available. This is possible, for example, because the measurement data using sensors has become more viable as more and more devices are equipped with sensors, such as smartphones, machinery and vehicles. These sensors create the possibility to gather this data. In addition, it also displays a second development, which is the development and use of social media such as Facebook, LinkedIn and Twitter (Asuncion et al, 2015; & McAfee Brynjolfsson, 2012). This development led to an exchange of public information on a broader level than before, but also led to a change in how the data should be processed (Sharma, 2016).

Secondly, the selection is based on diversity of formats, sources and types of data, ways in structured and unstructured (Frizzo-Barker et al, 2016; Porche et al, 2014.). With the

introduction of big data, the range of data has increased considerably (Sharma, 2016). An example is the introduction of social media, in which the big data are in the form of different notifications, messages and status updates, but also images. This variation is also caused by different types of sensors that are currently using historical information and weather forecasts, GPS signals from mobile phones and tablets, and so on. This results in a flow of data that came in many different ways and therefore is available in many different forms.

Thirdly, the speed is the speed at which data analysis is possible (Frizzo-Barker et al., 2016). This is also related to the speed at which research can be made on data and data recovery speed (Porche et al., 2014). The big data caused the increased speed of these resources due to a larger system of calculation speed and this leads to more current information (Goes, 2014). In many situations, the rate of data creation is more important than the volume that creates because this speed can provide competitive advantages (Davenport & Harris, 2007; McAfee & Brynjolfsson, 2012). However, other authors mention that most of the time, this competitive advantage is short-lived because the data-based insights are easily replicated by other companies (for example, Ross, Beath & Quaadgras, 2013). The development of the data rate is also related to the development of computers, which allows the processing of information in real time is done better and faster.

Fourth, the truth is related to the reliability and quality of data (Asuncion et al., 2015). This accuracy of the data is important to use data, eg for strategic decisions. Besides the importance of accuracy of the data, also the accuracy of the analysis is becoming important because, when using big data, it is possible to couple different types of data for a variety of analyzes. To ensure that this analysis is useful and rational decision-making is possible, it takes reliable and updated data, but also the method of analysis to be correct, and management needs specific skills to be able to draw conclusions. Do not use reliable and / or high-quality data would lead to data with limited value, or may even have negative influences on business performance (Jamil, Ishak, Sidi, Affendey and Mamat, 2015; Park, Huh, Oh, & Han, 2012).

2.2.4 Characteristics of big data

Big data has several features. Initially, various data formats are possible because the big data consists of structured data, unstructured and semi-structured. In addition, the big data consists of multiple data sources, eg, the Internet, social media and sensors. Finally, there are also differences in data processing. Basically, the big data consists of three different formats: first, the structured data are the most direct form of data, and have specific fixed formats, making it relatively easy data management; (Chen et al, 2012). second, as opposed to structured data, there are also unstructured data in which specific patterns are absent. This is an important feature of big data therefore this data feature unstructured, it goes beyond many traditional data or analysis. Data is collected in various formats, not only in numbers but also through texts, photos, videos and even geographic locations and times through GPS signals. (Chang et al, 2014; Chow-White & Green, 2013; Sharma, 2016); Finally, the semi-structured data is a combination of structured and unstructured data. semi-structured data are not always

manageable through standard techniques, but despite this, the analysis of these data formats is also possible using the run ad hoc or single (Chen et al., 2012). In addition, big data appears in many different forms. First, one of the most well-known data sources is the Internet. Today the Internet is a great source of data because everyone is, anyway, connected to the Internet through mobile phones, tablets, laptops or even television (Demirkan & Delen, 2013). With the use of these devices, the behavior of people can be seen and creates large amounts of data and information, which are largely unstructured and this amount is still growing because of the many possible applications (Rao et al., 2012).

Second, also social media is an emerging source of big data. During the past few years, social media and its use, such as Facebook, Twitter, LinkedIn and blogs have increased considerably (Asuncion et al, 2015; Demirkan Delen, 2013). On the one hand, organizations are using these social media tools to promote their products and services and keep in touch with their customers. This is possible for example, addressing the client through news posts about the company on Facebook and discovering the needs of customers through blogs. By the time the organization meets customer needs in social media, you can close sales through Facebook ads that will drive customers to the organization's website. After that, after-sales service is possible by following customers on Twitter (Guesalaga, 2016). On the other hand, customers make use of social media and receive information on products and services from various organizations (Salehan & Kim, 2016).

Third, the sensors are one of the main sources of big data, because a great diversity in the applications of these sensors is available. The use of sensors in business processes, it is possible to measure properties such as temperature, speed, weight and movements (Kolomvatsos, Anagnostopoulos, & Hadjiefthymiades, 2015). The sensors create the ability to track individual items that pass through a specific area of the supply chain, which creates data by which bottlenecks can be traced, and also the optimization of business processes becomes possible and alarms at the time specific criteria are met (Brynjolfsson et al, 2011;. Kolomvatsos et al, 2015.).

In addition to the different formats and data sources, two forms of data processing are possible: processing and batch-oriented data processing in real time (Kolomvatsos et al, 2015.). The first batch processing oriented, is based on the collection of business event data that are processed at once. This is because the data processing in large volumes is way cheaper and more efficient, related to the periodic mode, where there is a delay between multiple data processing steps. However, this has the disadvantage of a possible delay in the data, because the data are not always updated. In the second method, real-time data processing, this is avoided because the data are processed without time delays. This is achieved by immediately, in which the data is updated immediately when these new data is created. The disadvantage of this form are the costs of such systems, but the advantage is that in this system the data are always updated (Dull et al., 2012).

2.3 Benefits and challenges

2.3.1 Benefits of Big Data

Cost reduction and better margins

One of the most frequently mentioned benefits of big data is the cost reduction (Asuncion et al, 2015;. & Demirkan Delen, 2013). One way to get this cost benefit is through economies of scale and economies of scope, which arise due to an increase in operational size. This is possible because organizations transfer their data to corporate deposits specially equipped to produce analytical applications (Davenport, 2014). ("Influence of big data and analytics on management control," Luuk Vloet, 2016).

In addition, economies of scale and economies of scope also arise because the speed of goods and services in the supply / demand chain should increase (Demirkan & Delen, 2013). Another way to get cost benefits are possible when employees are trained to use big data. When this is the case and a learning environment and education is created within the organization, you can perform tasks more effectively, resulting in cost reductions (Sharma, 2016). In addition to cost savings, other benefits to increase margins and profits come through big data. A well-known example is the dynamic price (den Boer, 2015). In this, the supply and demand are better coordinated, which is reflected in the price of goods and services. Based on the number of visits or the number of purchases,

Faster and better decision-making

By using big data, collection, data storage and analysis becomes easier and cheaper at the same time creating greater availability, visibility and transparency of information. These new techniques allow organizations to find new patterns and connections in data at a level that would not be possible without big data, which can lead to several advantages for decision making within organizations. Initially, these techniques can lead to a more precise management and predictive than before (Frizzo-Barker et al, 2016;. & McAfee Brynjolfsson, 2012). Another way to collect customer information can voluntarily, it happens when customers provide their personal information to the organization, for example, to get extra discounts or other actions / promotion benefits (Chow-White & Green, 2013). By collecting and analyzing these data, there are opportunities to develop models that predict future customer demands. Thus, it becomes possible to predict customer demand, leading to decisions based less on intuition, as previously happened often, but based more on data (McAfee & Brynjolfsson, 2012).

Second, the big data provides other possibilities. Plus the ability to predict customer behavior future, you can also determine the current state of the client. In this way, organizations can gain insight into customers' fortunes (Khade, 2016). The analysis of data patterns of a particular customer (eg click behavior on a site) can provide insight into what a customer might need at any given time. In this way, the organization can respond to specific customer

requirements through more narrow targeting of customers, for example by offering special products in the search category, leading to more effective sales activities focused on customer needs. In this way, the organization can align sales, bringing these items to the specific attention of the customer, or offering special discounts to the customer. By using this way of working, organizations use big data to improve sales activities (Fanning & Grant, 2013). ("Influence of big data and analytics on management control," Luuk Vloet, 2016).

Third, this making faster and better decision can lead to improved business performance due to increased efficiency and effectiveness of the organization and organizational strategy (Chang et al., 2014). This is confirmed in the research of Brynjolfsson et al. (2011), which states that companies that have decision-making based on data and business analysis show higher performance. This is not just based on the productivity of the production, but also other profitability measures and market value are taken into account. This improved performance is made possible by the availability and use of accurate information for decision making, which is created by big data (Davenport & Harris, 2007).

Fourth, making faster decisions and better is possible because the big data increases the opportunities for employees and organizational managers ask questions and give answers to these, leading to greater accuracy. Big data can provide better and more valid responses, both resulting in a decreased risk of wrong answers and an increase in correct answers to the questions (ChowWhite & Green, 2013).

Fifth, using big data, just can not improve performance, but it is also possible to better measure performance. This is possible because most accurate and detailed performance information is available on almost all aspects of performance, for example, inventory of resources, but also absenteeism of employees. As such information is now best known for organizing the enhanced features are designed to best leverage this information. Thus, it is possible to make better management decisions (Fanning & Grant, 2013).

Optimization of processes and products

The Big Data enables organizations to discover which specific products a specific target group needs at a given time. In this way, you can adjust the desires and needs with the organization's processes, making it possible to bind customers more time to the organization. customer behavior this perception also allows better meet customer needs through customized products and services. By measuring these customer buying patterns, for example, by the use of social media, organizations can determine which methods are most effective to serve customers (McAfee & Brynjolfsson, 2012; Spenner & Freeman, 2012). In addition, through crowdsourcing, the big date can lead to the development of products and identify customers' needs for new business. Thus, organizations are able to better understand the heterogeneity of customers or personal preferences (Frizzo Barker et al., 2016). Moreover, it is also possible to optimize business processes because there are more insights into bottlenecks in business processes and throughout the supply chain. This can also lead to more insight into what extent

arise unnecessary costs. Through these complex diagnostics, you can get deeper insights into the processes to find specific solutions to specific problems. This leads to a greater potential for troubleshooting and process optimization (Frizzo-Barker et al., 2016). ("Influence of big data and analytics on management control," Luuk Vloet, 2016).

2.4 Big Data Challenges

2.4.1 Technological challenges

Technological challenges are based on IT infrastructure, security and privacy and other technological challenges. At first, to reap the benefits of big data, to have possibilities to collect, store, manage and analyze data in a better way, information technology in organizations are important. Without a good IT infrastructure, you cannot take advantage of big data (Demirkan & Delen, 2013). Due to the growth in the volume and variety of data, major challenges have emerged to the infrastructure of the organization. Big data volumes lead to problems of data storage, data processing and data exchange, which go beyond the existing database systems or extend their IT infrastructure to its limits (Asuncion et al., 2015; Sharma, 2016; Zhou et al, 2016). As an example, the data sets available through big data contain amounts of data greater than the capacity of a single computer. The data sets consist of large and complex data that can be difficult to combine in a single storage location. This also presents difficulties in communication of data within and outside the organization and, therefore, can be time consuming to communicate (Ma et al, 2015.); ("Influence of big data and analytics on management control," Luuk Vloet, 2016).

First, the challenges arise with the data collection. The new amounts of data lead to many new and valuable knowledge. However, not all data should have the same value. Distinguish real and valid information noise information is an important aspect in big data. But the realization of this is not easy, for example, because the unstructured data forms are created due to big data (Chang et al, 2014;. Goes, 2014). This is reinforced by the emergence of more sensors and other measuring data, which are often based on unstructured data (Cuzzocrea et al, 2013; Ma. Et al, 2015.).

Second, the high variety of big data can cause problems in time to bring the data in connection with each other (Asuncion et al, 2015;. & McAfee Brynjolfsson, 2012). The integration of big data from different sources because many barriers because all these data formats have their own specified formats. This diversity has the consequence that effective access to this data is difficult (Ma et al., 2015). In addition, there are problems with the storage of the data because of the complexity. For example, as a result of large quantities of unstructured data, the number of different data dimensions increased in large quantities (Chang et al, 2014;. Cuzzocrea et al, 2013.). It is also important that the data are stored so that they can be easily migrated between different data centers / cloud providers (Assumption et al., 2015). When this migration is not well organized, the lack of accessible data and well integrated causes the problem that employees can not make good use of the data (Zhou et al., 2016).

Third, the effective and efficient processing of large volumes of data and the analysis of data after processing are important (Demirkan & Delen, 2013). The analysis is the generation of knowledge and intelligence, which is needed to support decision-making and strategic objectives (Goes, 2014). However, this processing and efficient and effective analysis are not always possible because the big data leads to large amounts of data collected by various sensors and parameters. This creates several elements modeling, which complicates the interpretation of the information necessary for decision making (Zhou et al., 2016). Therefore, for an effective decision-making by big data, it is important to transform big data into intelligent data. For intelligent noise data, the information is filtered, resulting in valuable data. Only then can make the large volume and variety of large volumes of data are relevant to the organization, which also increases the accuracy of the data. For example, this can be achieved by processing and transforming big data in unstructured structured data. If this processing and data processing are made, it becomes possible to analyze the data, for example through Business Intelligence, which generates diagrams and figures, leading to effective and efficient data (Cuzzocrea et al., 2013).

2.4.2 Management challenges

In addition to the technological challenges also occur managerial challenges. Without effective management of these challenges, it would not be possible to fully enjoy the benefits of Big Data (McAfee & Brynjolfsson, 2012). These management challenges are divided into leadership challenges, employee skills, decision making, and organizational culture. ("Influence of big data and analytics on management control," Luuk Vloet, 2016).

The first challenge is related to managerial leadership (Goes, 2014). Organizations do not take advantage of the big data simply by having more and better data. Important for big data is to have leaders in the organization that set goals and what success is. This is because there will always be a need for vision and human perception in organizations. It is also important to encourage the search for opportunities, market developments and creative thinking (McAfee & Brynjolfsson, 2012). Moreover, the changes caused by big data, for example, use of new systems, strategic analysis, challenges of information technology and transformation within the organization should be guided by the leaders (Goes, 2014).

In addition to leadership, employee skills are a second managerial challenge. According to Tambe (2014), for new adopters of big data of employees' skills are an important aspect. Big data leads to valuable data, but also larger volumes of data and more variety in structuring data. Nowadays, not only structured data exist, and this increases the need for data scientists and programmers who can handle the challenges of unstructured data and semi-structured result. This can be done by changing the ad hoc analysis to an ongoing conversation with data (Davenport & Patil, 2012). Only then you can create business value within the organization.

However, it is not always easy, for example, accurately identify the most valuable information in these large data sets. On the other hand, the development of big data also results in (the need for) other necessary skills. For example, the resources available to handle the high-

volume, variety and velocity improved in recent years. These new technologies require new skills, for example, the IT function, which should integrate all relevant internal and external resources within the organization. To address these issues, the organization needs professional analysis and data science (Goes, 2014; McAfee & Brynjolfsson, 2012). However, it becomes very difficult to find managerial talents for this work, due to lack of people with deep analytical skills and people who can make effective decisions (Chang et al, 2014;. Chen et al, 2012;. Davenport & Patil, 2012; Due et al, 2015.). Moreover, it is also important to train in other aspects. For example, when organizations want to make more use of social media, because the big data offers possibilities for this, it is important for the organization to create organizational competence and commitment in this area (Guesalaga, 2016). Only when employees are well trained and know how the raw data should be translated into data and information, the Big Data advantages can be achieved. Moreover, it is important that employees know how this information should be interacted and communicated within the organization to achieve these advantages (Chen et al., 2012). ("Influence of big data and analytics on management control," Luuk Vloet, 2016)

The third managerial challenge is centered on information and decision making based on that information. It is important that the rights of information and decision are present at the same location. People who understand the problems caused by big data must have the availability of certain data, but also need to be able to communicate with employees who can solve problems. If this is not the case, this can lead to problems with effective problem solving (McAfee & Brynjolfsson, 2012). These problems may arise because the people who create the data do not have enough understanding of how users of the organization's data use that information. For this reason, it is necessary a good communication between the data creators and data users, which is not always easy to achieve (Redman, 2013).

This leads to the managerial challenge based on organizational culture. When data are not appropriate or are unreliable, managers rely on intuition in decision making. This feeling can occur at the time that employees have to correct the data errors themselves. This creates a climate of mistrust in the data (Redman, 2013). In addition, in many companies, decisions are based on intuition. However, this is not desirable because the use of big data creates the need for a change in decision-making based on data (McAfee & Brynjolfsson, 2012). Experience has shown that organizations make data-driven decisions are more profitable than companies that make decisions based on intuition. But to get a decision making based on data, major organizational challenges arise to achieve a cultural change, in which changes in the structures of the organizations are necessary. This can be achieved, for example, using new workflows that need to be implemented with incentives based on the prioritization of decision making based on data to guide people in their work (Fanning & Grant, 2013;. Ross et al, 2013) .

2.4.3 Other challenges

In addition to these technological and managerial challenges also arise other challenges. One such challenge is the challenge of cost versus benefits. analytical solutions such as big

data, are expensive and, therefore, an economic service is required. This is particularly a problem for small and medium enterprises due to high investment costs (Sun et al., 2011), but also a cost-benefit compensation has to be made to the collection and use of data (McNeely & Hahm, 2014). Big data is not proving their value when the cost of collection and use of data are greater than the benefits. Another challenge is related to the work of employees, which becomes more difficult by big data and analytics. For example, the data tell the company to increase sales through promotion in the last month of the year to achieve the goals of the year, but in the long run the organization aims to brand building and through promotions that brand image is damaged (Horst & Duboff, 2015); ("Influence of big data and analytics on management control," Luuk Vloet, 2016).

3 Research Methodology

In order to expand the existing knowledge and gain new insights into these topics, interviews are conducted with five employees from five different companies several interviews are conducted in different organizations. This is different from interviewing for a single organization and has the advantage that it is possible to examine if it results in an organization also results in other organizations, which increases the generalization of research (Bleijenbergh, 2013; Saunders et al, 2009). When comparing the different organizations with each other, you can examine the similarities in the various organizations, but also examines where substantial differences occur in various organizations. This extends the big data research and provides more insight into the great influence of the data has management control. The employees are members of the management team or intimately involved with data and developments in your organization. In this way you can get insight into multiple companies in a survey. All companies are located in the Netherlands, but in spite of this similarity, there are still many differences between the companies. Moreover, the goal is to interview a wide range of different companies in order to get a broader view of big dates and the influence that big data has on the management control in organizations. For this reason, there are major differences between companies in terms of the area of industry, technological development and size. Both industrial and service companies are taken into account, some of which use advanced systems such as ERP, but also some that do not use advanced systems. In addition, small business employees with less than 75 employees are interviewed, but also employees of larger companies that have more than 450 employees are interviewed. In addition, all companies are at a stage in the data field use (large) in your organization. At the time of the survey, one of the organizations studied was just doing a master data project in order to make better use of data in the future. They have the data as possibilities to provide and embarked on a long project, in order to achieve more strategic benefits with the help of ERP system. One of the organizations studied was already moving more. They implemented a renewed version of its comprehensive ERP system (almost) all organizational entities and this allows them to more strategic advantages using the system in the data field. In contrast, two other organizations were studying

the potential of big data, but came to the conclusion that it was difficult for them to explore the potential of big data at this time. ("Influence of big data and analytics on management control," Luuk Vloet, 2016)

For the first organization at the time of interview, they were busy with the early stages of implementing a new ERP system in which they were aware of the strategic advantages that are possible, but due to the complexity of the implementation is not reached at this point . The organization sees this as a future opportunity. The second organization could not achieve the benefit of big data, because according to them the investments to be made are huge. The latter organization was on a stage even earlier. They were aware of the fact that they first need a new ERP system before they can unleash the potential of data (large) better. For this reason, they are driving a new system because they could make limited use of data in your current systems. However, beyond these differences, during interviews is no distinction between the companies, which are all treated equally. The purpose of interviewing managers from different companies in different industries with different technological developments and different sizes, is to gain more insight into big dates and big data has an impact on the management control.

4 Results and discussion

4.1 Trends data

Company A has noticed that your current ERP system really fails in data processing and information because the system design is insufficient for this. For this reason they are driving a new ERP system, so that more opportunities may arise to store data in the system, allowing them to get more data and system information in the future. Also company B has seen that the current structure of your system was inadequate. Because they have observed that the system offers more possibilities for this, they decided to renew its current system. At this point they are updating and cleaning the primary data in your organization, later in the project they are also going to optimize (the drawing) of the processes in the organization.

Within the company C, a comprehensive global ERP system was missing. However, the organization saw the need for such a system, because they wanted to capture more data for the entire organization. For this reason, the organization began with the implementation of a global ERP system for the entire organization, a year ago. In addition, they are also implementing both CRM across the organization. All this together will take several years, but this means that the organization is actively engaged and is investing heavily in data possibilities. Company D also has been able to implement new CRM systems in your organization. In addition, they are working to a central database for the organization, which gathers and combines data from different systems that the organization has used in the past. This serves as a basis for growth in the use of more data (large) in the future. Finally, also the company and noted that its old ERP system was not sufficient for the use of more data. So they performed a complete reimplementation of their system where they connect with all organizational entities in one system. Now, this is as good as done for the entire organization and are working to make a

business intelligence and data analysis for your organization. This should provide a way to work for the entire organization in the area of data and analysis. they performed a complete reimplementation of their system where they connect with all organizational entities in one system. Now, this is as good as done for the entire organization and are working to make a business intelligence and data analysis for your organization. This should provide a way to work for the entire organization in the area of data and analysis. they performed a complete reimplementation of their system where they connect with all organizational entities in one system. Now, this is as good as done for the entire organization and are working to make a business intelligence and data analysis for your organization. This should provide a way to work for the entire organization in the area of data and analysis.

4.2 Possible improvements

4.2.1 Improvements in decision-making

Interviews with five different companies make it clear that companies have been possible improvements to the decision-making within the organization. One of the benefits of business is to provide more uniformity, for example, in reports. This should lead to greater reliability of the reports: "What helps of course, is that the reports are uniform and they are comparable to previous reports, so without the need for a lot of hacking, medicate and other things that have to be made. [Thus] the reports in all departments become more reliable. "(Company B, 26/05/2016). In addition to making these reports also data collection may be faster through more advanced data systems. As a result of these systems, employees no longer need to collect all the data manually and they no longer have to put this data in formats by hand. These actions can be performed with one touch by the system.

At first, this can increase reliability because manual labor is more vulnerable to errors and mistakes. Secondly, it also offers the advantage that these activities can be performed faster by employees because it gives them less work. The advantage of this is caused employees to have more time available for the next phase data, ie data analysis. Previously situations arose where there was often no time for that, because the collection and processing of data for reports took so long that the organization has not done anything with the insights of the data provided. Now that information is available with a push, you can respond faster to the insights provided by the data and employees also have more time available for it: "And soon, is the opposite. If you have information at the touch of a button, giving you only the time to 'what we are really going to do with these ideas?' "(Company E, 0306-2016). "Two and a half to three hours of work per day, easily, I'm working on data analysis. At the moment we can just extract that [data] of business intelligence systems, then going to save us a huge amount of time. Then we can go much faster with sources, we can draw conclusions much faster and can also take action on it. We can just go faster to a higher level within our entire company, I think. "(Company A, 23.5.2016). 0306-2016). Then we can go much faster with sources, we can draw conclusions

much faster and can also take action on it. We can just go faster to a higher level within our entire company, I think. "(Company A, 23.5.2016).

In addition, data use can also bring benefits to a more operational level in the organization based on the daily work and daily decisions. The advantage of the increased availability of data is that executives can draw conclusions faster. Thus, it is possible to perform faster and collective preventive actions within departments. When the data is more readily available and executives get to see this information in real time, they can control it faster and can take action quickly: "At the time, I only see every day on my screen what are the reasons why my department is not performing well, then I can take actions more quickly. At this point I'm running behind the facts. I see a day later, when the tracks are available in the system, that a department has not carried out properly. In fact, I'm already very late and then I think, 'OK, what could have happened,' rather than preventive system and indicates that something is threatening to go wrong. "(Company A, 23.5.2016).

4.2.2 Process improvements

In addition to improvements in decision making, companies also see possible improvements to the processes of the organization. At first, the data can improve communication between the various entities of the organization. Previously many organizations had separate systems for each different entity. As a result, the systems of the various entities of the organization were not connected to each other, which caused the entities totally had no understanding of the operations in other entities. From the interviews it becomes clear that using more data and better systems, communication between these entities improvement. Thus, it is no longer necessary to contact other entities, for example, to know what your inventory is and no mail traffic is required between the entities.

In addition to better communication between the entities, also better communication within the organization and better communication with customers and suppliers is possible. This happens when more uniformity occurs in communication with external parties. Where previously a lot of communication went through texts, through the data, you can establish better communication: "[previously worked] to order texts, suppliers texts like: 'Beware, delivery address has changed!' Instead of organizing it well with partner roles. "(Company B, 05/26/2016). To organize it in a way different to the data, it becomes possible to make the supplier aware of the fact that something has changed, for example, through standard codes for communication. This can provide benefits is described by the company B project manager: "You do not need to call later. Today about 80% is being called back by phone or is checked by the staff. I hope this will be about 20% in the future. "(Company B, 26-052016).

Second, in addition to better communication, also more standardization of processes can arise making use of data. When using big data becomes possible to analyze the data more accurately, but the data analyzes mainly become more intelligent. This ensures that the data can be channeled better and analyzed, which allows the system to analyze a large part of the data itself. This means that the system can automatically come with solution variants for

standard situations. Thus, the system can ensure that the arrangement process can be more uniform, in which intervention is required only for special situations. As a result, also the resolution process is simplified and unified: "This data analysis, as it can be done more accurately and especially smarter, then at the end of the process you have your data increasingly channeled, making it possible that a percentage has been considered and was also solved by own systems with solution variants. [...] This ensures that and in the end, you only have special offers, special products, to the left. "(Company D, 05.31.2016).

Finally, through the use of more data comparison also more opportunities arise. In this way, you can compare how a unit is running in contrast to another unit, thus giving the opportunity to learn from each other: "In any case, this way you can compare how a unit is doing in relation to another and you can learn from the other. Thus, comparing the data you see the differences. And you can investigate these differences. "(Company C, 26/05/2016).

5 Improvements in relation to customers

Finally, the data use can also lead to benefits for better opportunities to customers. The aim of this is to obtain more insight into what is going on in the mind of a customer. Through for example, CRM systems can gain insight into who are the strategic customers. Thus, it is clear where most of the value-related benefits with customers to the organization are, but in this way, it is also possible to retain more satisfied customers and preserve them for the company. Through increased use of data, there are interesting opportunities possible for organizations in the services to the market. An example of this is anticipating based on customers, sales or purchasing behavior to better match market needs: "If you turn around and ask: 'Customer, what are you looking for? And if the customer says, 'I'm looking for this and that ...' So, this result, the customer's requirement, should be able to be folded so that the company says: "We consulted our database; You were looking for this, and based on their behavior (or whatever) we see that and to what extent links it to what you're really looking for? Is that correct? "(Company D, 31.05.2016). and based on their behavior (or whatever) we see that and to what extent links it to what you're really looking for? Is that correct? "(Company D, 31.05.2016). and based on their behavior (or whatever) we see that and to what extent links it to what you're really looking for? Is that correct? "(Company D, 31.05.2016).

5.1 Problems in the use of data

5.1.1 Organizational systems

First, during interviews with five different companies, it is clear that most companies have realized that their system (ERP) is not enough to fully achieve the benefits of data (large). However, the interviews show that it is not easy to simply achieve these advantages. This goes back to system implementation (ERP), as it happened in the past. As evidenced by the following quote from Company B at the time of application only existing processes are copied

and integrated into the system: "In 2005, a lot has stuck together to resemble its predecessor. Instead of taking into account the forces of SAP. "(Company B, 05/26/2016). Therefore, a disadvantage is that it is not easy to achieve strategic advantages with the ERP system. The company B that have realized this and they now have a project to improve it. However, this is a great project that will take several years, in which the master data must be cleaned first, after which, subsequently, processes can be optimized. Only in this way can support the use of data by the organization's systems. And also, now realized that they have to pay attention to their systems before they could achieve more benefits from data. For this reason, they opted for a re-implementation of their ERP system. Now this is completed, it seems that they can really explore more options in the use of data, for example, the potential of Business Intelligence: "Within the organization we are busy with the implementation of an SAP. And now we have almost completed this, we can also, of course, build business intelligence tools so that they apply to all, so that we can actually make the investment in business intelligence and data analysis. [...] Nowadays there are so many entities have moved to the new SAP system so that now more and more focus is put this project in Business Intelligence. "(Company E, 03.06.2016).

However, it is not easy to achieve this level with the ERP system is proved by other organizations surveyed. For example, company A, which makes use of a relatively old and simple system it is still far from that level. They continue to work with a relatively old system that only supports limited use opportunities of today's data. Partly for this reason they are currently guiding towards a new ERP system has to support them in these opportunities, "That's really the reason why we are involved in the negotiations for a new system since a while, because we have seen that the ability to process information in our system is very limited. " (Company A, 23.5.2016). However, it will take several years before reaching the level of organization E.

Second, it is clear that the software systems seems to be a problem. For example, the storage capacities of the organizations data systems can cause problems: "Due to the large amount of information that our system has to process, we just have to wait until the system is ready. And it can be obviously a great disadvantage. By the time he wants to process more and more information in the system, then at a certain point of time the system can not handle it anymore. "(Company A, 23.5.2016). This means that the system processing capacity becomes an important element in organizations. The possibility of data can be huge, but at the time the system has reached its maximum capacity, then the organization has reached its top.

Third, also security and privacy issues can arise. A problem in this data privacy occurs when a company collects specific data, eg customers. At the time the organization store these customer data and use it again later, the question arises at the time it occurs violation of privacy. It is important that organizations, on the one hand market this information to them on the right as well, while on the other hand, respecting the privacy rights of its customers. In addition, the interviews reveal that it is relatively simple in most organizations to gain access to systems where the data is located. This relatively simple approach is possible because in most

organizations only a login name and a password are required to log in to the relevant systems. By the time an employee knows the login and password of another person, he / she has immediate access to a lot of possibly sensitive in training. In addition, he also appeared in some of the organization permits for various functions in the system were not well decorated. Which is why they are not well equipped in all organizations is because in practice, it has been difficult to organize these authorizations as well, with the result that it is not always clear who need access to exactly which rights. The result is that certain employee should not be able to have access to certain data from your job profile, but still have access because of the wrong design. he also appeared in some of the organization permits for various functions in the system were not well decorated. Which is why they are not well equipped in all organizations is because in practice, it has been difficult to organize these authorizations as well, with the result that it is not always clear who need access to exactly which rights.

Fourth, it is also important that employees have access to valid and reliable information. This means that it must be properly checked where the data is derived. Otherwise situations may arise in which employees make use of data that is simply not correct and is not valid: "The disadvantage of working with data is that you need to know for sure it's good. Because if you do not know where it comes from and you do not know if the sources of where you get it are good, then there is the risk that you are going to make decisions based on inaccurate data. And that's a big risk. "(Company E, 06.03.2016).

Fifth, it seems that many organizations make use of many separate systems of the past. This means that organizations can have a lot of information available, but it is difficult to combine the data from the old systems. To be able to solve this problem, companies have to make certain conversions to ensure that they can connect these separate systems into a comprehensive database. However, it is difficult to combine these data is evidenced by the following quote: "They have a lot of information, but it is still very difficult to combine the old data, traditional systems. [However, the organization] has noticed that traditional separate systems are no longer sufficient in the major market developments to collect qualitative information and use this information in the organization.

5.1.2 Administrative issues

From the interviews, it seems that stimulation of management is important in order to support the achievement of the advantages that (large) data can provide. It turns out that the company C, which is implementing an ERP system, the implementation of the project is on schedule. According to the respondent company C, this is due to the commitment of the top of the organization and the urgency that have given to this project. These policies can also be published in the vision of the organization, which has an explicit focus on the ERP project. Company D has also realized the importance of commitment from the top: "Yes, it is definitely supported [...] Because they now recognize that improvements in automation are necessary to continue to survive in the long run [...] they realize that if these improvements are not made in the short term,

However, from the interview with Company A became clear that this support is not always obvious. This organization has a clear dichotomy in its management of the data usage ideas. The respondent in the enterprise is aware that this could cause more problems in launching their future, new ERP system: "On the one hand management says, 'That will bring us a lot, this will bring us a lot of money.' But on the other hand, there are some who say: 'Just focus on our core business, the production of products, which is the most important thing and we have to know in detail what is happening in the organization when it goes well.' [...] Therefore, there is some friction between opinions in the management. I obviously feel that this can still give resistance to the truth rolling out the new system "(Company A, 23.5.2016). Also, in the B management company is not entirely convinced. The feeling within this organization is that management is delaying the project, they have the feeling that management does not want to hear the need to develop because it does not concern them. As evidenced by the quote above, management commitment to missing can cause problems in project implementation. This also means that the bad management supports the use of more data in some organizations. However, all respondents indicate that top commitment is desirable to be able to explore more data opportunities. They have the feeling that management does not want to hear the need to develop because it does not concern them.

With the exception of a dichotomy in management, there also seems to be a dichotomy in the thoughts of employees on the use of data (more). This has two causes. At first, there seems to be a significant difference between older workers and young employees in related organizations. it seems easier to the young skilled workers to deal with the latest developments than older employees: "The older employees who, for example, already working 20-30 years within the organization have the thought, 'Let me do my job, but I do not want to go thinking a lot about systems because I know much better how to do it for me. ' I see a real dichotomy in this. "(Company A, 23.5.2016). This is because the older generation of employees adopted a certain way of thinking, making and acting from the past. In practice, it seems hard to get these fully proficient employees in the latest trends, because of their past experience. Because of this, the generation gaps appear within organizations.

Second, this difference also arises between the different departments of the organization. This is because employees in one department, for example, finance, are more able to handle the data than employees in another department. As a result, the differences between the various departments that arise are often remains difficult to pass. For this reason, in making practice (more) data usage it is not always easy to accomplish for the entire organization, because not all employees have an affinity for working with data: "Finances of course, often obviously knows a lot well what they need, where to get it from, and how they should get insights from it. But if you give only numbers to someone in sales, then that person falls off, 'Yes. whatever, but I have no skill with numbers, to forget it ' "(Company E, 03.06.2016). In addition, making more use of systems and data appears to be a real business change. Maximum organizations have realized that it is necessary to provide training to employees on new systems and methods. Through this training, organizations try to create more support for data and employee data

systems: "Every time when major changes occur in these systems, [...] who spend effort to train several times. Just to achieve more support for these systems. "(Company D, 31.05.2016).

Finally, the interviews suggest that intuition still plays an important role in operations. However, there are disadvantages in the use of intuition. One respondent states that the use of intuition can make it difficult to supervise everything. In addition, decisions on intuition have the disadvantage that they are partly based on emotions. This means that these decisions can not always be made on a rational level. In recent years, organizations have seen that the level of intuition has already gone down. This came about because the staff did a lot of standard work by hand in the past, which today is already being implemented by the system. This has the consequence that intuition in this standard work is already reduced. Nevertheless, companies have realized that the degree of intuition in your organization should become even smaller: "More routine means fewer errors and less work. This means you can handle more work. And that's where we need to go [in the future]. "(Company B, 26/05/2016).

Nevertheless, according to the interviewed companies, some intuition is always required. First, this is necessary because the current systems sometimes have limitations that can only be solved by using intuition. A company gives an example of this, where the system performs scheduling based on backward-scheduling. This brings escalation causes failures in programming at the time that there are fewer orders. adjust it manually based on own judgment, then it is necessary to distribute the capacity of the production department in the same way. Besides that, organizations indicate that it is important that employees lose no feeling for business, something that can happen for quite confidence data and will always be necessary to assess whether the results are true. In addition, the respondent thinks people will always keep looking for confirmation of how they think about something: "You can make a good analysis of any results, but you often see in the conclusion: 'What do you think?' Where people continue to look for confirmation of how other people think about your opinion. "(Company D, 05.31.2016).

In addition, the experience and knowledge are always needed to interpret the data of the past, but also to decide whether this data is also applicable in the future: "Of course I try to make use of data, but also the experience plays a role in the results you see from the data in order to interpret these data. You will do this also a bit of personal experience. You see the results of data, but you also try to look at the past and to the future, if the information you get is also usable one-on-one in the future. "(Company D, 31.05.2016).

5.1.3 Other disadvantages

In addition, the interviews suggest that companies have some other issues to make use of data. First, organizations are aware of the fact that they have to be careful so that the work does not become too complex by using more data. Through data, a lot of information becomes available, but it is a lot of work to process all this information: "It's definitely interesting to be able to do all kinds of analysis from their data, but I think we have to protect against the fact that we put too much information into the system so that we can no longer distinguish between

major and minor issues. You must know where the limit is. And we are still exploring this, you know. We can start analyzing all the information, but what is, at any given moment important and where you should focus on? "(Company A, 23.5.2016).

Organizations need to properly understand what they want to analyze and what they. I do not want to analyze because it takes too long to make things visible in a readable format. For example, some things just are not interesting enough to analyze: "For example, someone needs to go more often to the bathroom. I would not go so far as to incorporate all that kind of stuff in the ERP system. There must be a line drawn somewhere between what is relevant waste [and not]. [...] And yes those little things .... It is very difficult to determine how far we go. "(Company A, 23.5.2016). Finally, although sometimes companies know what they want in the data area, they also realize that the cost of investments for this could be huge for the organization. Because this could hinder organizations, it is not always possible to explore all possible opportunities for data: "To a large extent, they know where they like to go with him, but they know they can hardly achieve this because of cost considerations, because required large investments. "(Company D, 3105-2016).

5.2 Visible Changes in management control

The results of the experiment suggest that the company noted the importance of the data. Therefore, the companies have launched several projects to be able to explore more possibilities of using data. The interviews suggest that, as regards control over these projects organizations are shifting from the use of a coercive form of control in a more favorable control. This means that organizations give more importance to the knowledge of employees on operations, processes and systems. In addition, it can be seen in many organizations that employees are increasingly freedoms in its operation. Furthermore, insights and ideas of employees are increasingly appreciated by organizations in these projects,

At first, the interviews show that organizations are convinced that it is increasingly important that employees understand the systems and processes of the organization. This is related to internal transparency, the extent to which employees are aware of the processes and systems they work with as well as the overall transparency, the extent to which employees know how their work relates to the activities, processes and organizational objectives as a whole. For this reason, during the project data to watch it in different ways. Company D, for example, has developed a tool that provides insight into the organization's processes. In addition, they have seen that employees recently gained more insight into the organization's goals: "It's hard to say whether each employee can monitor the coherence of the organization's objectives. I think not previously, especially when they are actually directed to these processes, then they acted on these processes, and the process was handled properly, then it was considered good.

Then it was according to the rules. And we are seeing a change of rules based on principle based. And this more entrepreneurship is expected. "(Company D, 05.31.2016). To achieve this entrepreneurship, more knowledge about the processes and whole targets the organization

is required. And now also made clear processes and organization systems, which makes clear that the systems have an interface with each other and how the processes appear in it. Therefore, employees understand how the primary processes occurring in the organization. However, also other organizations have seen the importance of insight into processes for employees, but not quite realize it yet. Therefore, these companies the definition of processes is included as a focus of attention in the projects. For example within the company B, employees have sufficient knowledge of processes and activities within the department, but they only have limited knowledge about processes move between different departments. the organization has recognized this gap in knowledge, and in a later phase of the project they take this into consideration to raise awareness among employees and managers.

However, it is not easy to achieve for all organizations is evidenced by the following quote: "The definition of processes is a real challenge for people, for the staff here. the employees do not have the habit of thinking in processes. And then step to define a process has turned out to be a real challenge. I think that after the introduction of ERP will be better, but at this moment this is a big challenge. "(Company C, 26/05/2016). In order to create more awareness of employees in processes and systems, the C company provides various training to employees to make them aware of the processes and systems of the organization. The company also offers training to employees, for the purpose of a refresher course of the ERP system, because many employees do not have the basic information about the system. Moreover, in recent years, several developments have taken place in the system, with the result that employees are not always up to date: "We are doing a refresher course of the ERP system for a couple of months with the whole company, because we see a lot of people still lack basic information. In addition, some lots of variables within our company have changed. [...] So we are busy with a course, because we saw that this knowledge was inadequate for many employees. "(Company A, 23.5.2016).

Besides internal and global transparency, flexibility also seems to be an important aspect during the project data in organizations. The interviews reveal that flexibility played only a limited role in the past. Most of the companies was the freedom to deviate from standard limited steps / procedures as designed in the past. However, during the projects it has changed or is going to change. For example, the organization D it is apparent that they have already had a Based on Rules approach in operations, while during the projects they are making a move in the main entrepreneurial sense based on employees more space in its operations: " you see that the organization is again creating extenuating circumstances. [...] What organization is focusing, It is that the employee substantiate from a type of entrepreneurship why he wants to do something in such a way. So this way, creates space for entrepreneurship evolve yourself. So yes, you can make certain decisions, at its option, since you can decent justify these decisions. "(Company D, 31.05.2016).

In organization A, employees have the possibility to deviate steps and procedures. They are allowed to do so if they have the feeling that this is necessary. In practice, this is rarely done due to the fact that when an employee makes a decision outside the system, the employee

may be held accountable to this, when it turns out that this was not the best decision. As a result, employees are mainly thinking of themselves and blindly follow the system because they are afraid that I make a mistake you: "It is often said to us when we decided something and it goes wrong, then you can have blamed himself. And then people think, 'A mistake made by the system does not matter to me, it was at least not my fault "(Company A, 23.5.2016). However, this organization has not yet begun with the implementation of the new ERP system. The respondent hopes that through the project, employees get more insight into the underlying information in the organization, which ensures that they can make more decisions based on their own discretion, as they get a better understanding of the underlying information, "Especially because you has more background information you also know more about what happens and you can make decisions based on something you understand the idea behind. I think that in such a way, it becomes easier to follow the system and may also make it easy to make their own decisions, because you know, so why do you make those decisions. (Company A, 23-05- 2016).

Finally, the results suggest that during the various data design organizations greater emphasis on possibilities of repair procedures, processes and systems. Achieve this, Company D has developed a system in which employees can report bugs or ideas. Also company B has involved its employees more. In this organization, employees can report, for example, comments and possible improvements to key users in the organization. In the past, complaints from employees were often not caught because key users had no time for that. However, during the project these key users are released from their daily work, so they have time to investigate other ideas repair staff. This release of key users was made because the organization has realized that the idea of employees can serve as valuable input to the project. And also the company has realized the importance of employee ideas. Despite the fact that the redeployment of your system has already occurred, the organization will have a moment of assessment of the system with employees several months after the defendant implementation in order to define and make improvements.

6 Conclusion

The experiment results provide new insights into the area of big dates possibilities and changes in management control. These differ from expectations present in the literature, because in contrast with the existing literature the emphasis in this study was about the challenges of big data. In addition, a large amount of literature focuses on theory and formulation of expectations, whereas in this article, the big data challenges and the influence of big data under management control are in practice, through interviews They go more in depth.

All interviewed organizations recognize that several advantages may arise within the organization for the use of data. In line with expectations present in other studies, these improvements are focused on improving the decision-making process improvements and

improvements in customer relations. Nevertheless, organizations can not take full advantage of the big dates at this time. This is mainly derived from the fact that these organizations are in a preliminary stage of the use of big data and the fact that various challenging occur in the data projects within organizations. At first, the interviews show that in many organizations the organization's systems were not sufficient to support the use of more data. Organizations have realized this and has already started with various data projects to improve this: an organization is implementing a new ERP system on a technical basis and organization are renovating your current system, updating and cleaning the master data. In addition, another organization is linking the organization's systems, but still faces many challenges, and fourth organization has successfully redeployed your system, but is in a very early stage to see the strategic effects.

Despite the fact that the results suggest that large data currently has no direct influence over the management control simply because big data has not been realized yet in organizations, an indirect effect under management control is suggested to exist. These indirect effects suggest that during the organizations data projects can switch from the use of a coercive form of control to a more favorable form of control. This change is because companies are convinced that it is important that employees gain insight into the processes of the organization. This is because during the project data becomes increasingly important to be aware of the processes within the organization: the data are expected to be increasingly driven by processes and procedures may need to be adjusted during the project to make this possible. For this reason, the results suggest that during the project data is important for organizations that employees have a good understanding of these activities, processes and objectives of the organization as a whole. In addition, through the use of more data also systems of organizations that allow employees to obtain data, are becoming increasingly important. which means it is also important that employees get a better understanding of the organizations systems. For these two reasons, both internal and global transparency are changing to a more favorable form of control.

Future research may also focus on the limitation of not taking into account various industries. This can be achieved by focusing on organizations operating in the same industry and comparing them with other industries. However, this distinction can also be made between non-profit and non-profit organizations. For the realization of non-profit organizations only experience (production and financial services) are taken into consideration. It is possible that within non-profit organizations also changes arise in the use of data, which may be based in other situations and / or opportunities than in non-profit organizations.

Finally, the results suggest that during data projects organizations can change the use of a coercive form of control in a more favorable control. So this result is only widely examined and not further analyzed in detail in this article. Therefore, future research can focus on this switch in more detail in order to find more arguments and reasons for this change in organizations.

References list

Vloet, Luuk - Influence of big data and analytics on management control. Radboud University, 2016. Master's Thesis

Abernethy, MA, Chua, W., Luckett, mp & Selto, FH (1999). Research in managerial accounting: Learning from others' experiences.Accounting & Finance, 39(1), 1-27.

Adler, PS, & Borys, B. (1996). Two Types of Bureaucracy: Enabling and Coercive.*Administrative Science Quarterly, 41*(1), 61-89.

Ahrens, T., & Chapman, CS (2004). Accounting for Flexibility and Efficiency: A Field Study of Management Control Systems in the Restaurant Chain *.*Contemporary Accounting Research, 21*(2), 271-301.

Alvesson, M., & Karreman, D. (2004). Interfaces of control. Technocratic and socio-ideological control in the overall management consultancy firm.*Accounting, Organizations and Society, 29*(3-4), 423-444.

Anthony, RN (1965). Planning and control systems: a framework for analysis. Boston, Mass Division of Research, Graduate School of Business Administration, Harvard University.

Asuncion, MD, Calheiros, RN, Bianchi, S., Netto, BUT, & Buyya, R. (2015). Big Data computing and clouds: Trends and future directions.*Journal of Parallel and Distributed Computing, 79-80*, 3-15.

Orgaz-Bello, G. Jung, JJ, & Camacho, D. (2016). Social big data: Recent achievements and new challenges.*Information Fusion 28*, 45-59.

Bharadwaj, A., El Sawy, OA, Pavlou, PA, & Venkatraman, N. (2013). Digital business strategy: Toward the next generation of insights.*MIS Quarterly Management Information Systems, 37*(2), 471-482.

Bleijenbergh, I. (2013).Kwalitatief onderzoek in organisaties. Den Haag: Boom Lemma.

Boeije, HR (2012).Analyseren in kwalitatief onderzoek: Denken en disease. Den Haag: Boom Lemma.

Brynjolfsson, E., Hitt, LM, & Kim, HH (2011). Strength in numbers: how does decision-making data-driven Affect firm performance? Cambridge: Working Paper, Sloan School of Management, MIT.

Caglio, A. (2003). Enterprise Resource Planning systems and accountants: towards hybridization? *European Accounting Review*, 12(1), 123-153.

Chang, RM, Kauffman, RJ, & Kwon, Y. (2014). Understanding the paradigm shift to social computational science in the presence of big data. *Decision Support Systems, 63*, 67-80.

Chen, H., Chiang, RHL, & Storey, VC (2012). Business Intelligence and Analytics: From Data to Big Big Impact.*Management Information Systems Quarterly, 36*(4), 1165-1188.

Chenhall, RH (2003). Management control systems design Within its organizational context: findings from contingency-based research and directions for the future.*Accounting, Organizations and Society, 28*(2-3), 127-168.

Chow-White, PA, & Green, SEJ (2013). Data Mining Difference in the Age of Big Date: Communication and the Social Shaping of Genome Technologies from 1998 to 2007. *International Journal of Communication*, 7, 556-583.

Chun, H., Kim, J.-W., & Lee, J. (2015). How does information technology Improve aggregate productivity? The new channel of productivity dispersion and reallocation.*Policy Research, 44*(5), 999-1016.

Cuzzocrea, A. Saccà, D., & Ullman, JD (2013).*Big data: a research schedule*. Paper presented at the Proceedings of the 17th International Database Engineering & Applications Symposium.

Davenport, TH (2014).*Big date at work: dispelling the myths, uncovering the opportunities*. Boston, Massachusetts: Harvard Business Review Press.

Davenport, TH, & Harris, JG (2007).*Competing on analytics: the new science of winning*. Boston, Mass .: Harvard Business School Press.

Davenport, TH, & Patil, DJ (2012). Data scientist: the sexiest job of the 21st century.*Harvard Business Review, 90*(10), 70-76.

Demirkan H, & Delen, D. (2013). Leveraging the capabilities of service-oriented decision support systems: Putting analytics and big data in the cloud. *Decision Support Systems, 55*(1), 412-421.

den Boer, AV (2015). Dynamic pricing and learning: Historical origins, current research, and new directions.*Surveys in Operations Research and Management Science, 20*(1), 1-18.

Denzin, NK, & Lincoln, YS (2011). *The SAGE Handbook of qualitative research*. Thousand Oaks: Sage Publications.

Due B, Kristiansen, M., Colomo-Palacios, R. & Hien, DHT (2015). *Introducing big topics date: the multicourse experience report from Norway*. Paper presented at the Proceedings of the 3rd International Conference on Technological Ecosystems for Enhancing Multiculturality.

Dull, RB, Gelinas, UJ, Jr., & Wheeler, PR (2012).*Accounting Information Systems: Foundations in Enterprise Risk Management*. Mason, OH: South-Western Cengage Learning.

Easterby-Smith, M., Thorpe, R. & Jackson, PR (2008).*Management research*. Los Angeles, CA: SAGE.

Fanning, K., & Grant, R. (2013). Big Data: Implications for Financial Managers.*Journal of Corporate Accounting & Finance, 24*(5), 23-30.

Frizzo-Barker, J., Chow-White, PA, Mozafari, M., & Ha, D. (2016). An empirical study of the rise of big data in business scholarship.*International Journal of Information Management, 36*(3), 403-413.

Goes, PB (2014). Big Data and IS Research.*MIS Quarterly, 38*(3) 3-8.

Granlund M, & Malmi, T. (2002). Moderate impact of ERPS on management accounting: a lag or permanent outcome?*Management Accounting Research, 13*(3), 299-321.

Guesalaga, R. (2016). The use of social media in sales: Individual and organizational antecedents, and the role of customer engagement in social media.*Industrial Marketing Management, 54*, 71-79.

Horst, P., & Duboff, R. (2015). Do not Let Big Data Bury Your Brand.*Harvard Business Review, 93*(11), 78-78.

Jamil, NBCE, Ishak, IB, Sidi, F., Affendey, LS, & Mamat, A. (2015). A Systematic Review on the Profiling of Digital News Portal for Big Data Veracity.*Proceeded Computer Science, 72*, 390-397.

Jorgensen, B., & Messner, M. (2009). Management control in new product development: The dynamics of managing flexibility and efficiency.*Journal of Management Accounting Research, 21*(1), 99-124.

Khade, AA (2016). Performing Customer Behavior Analysis using Big Data Analytics.*Proceeded Computer Science, 79*, 986-992.

Kolomvatsos, K., Anagnostopoulos, C., & Hadjiefthymiades, S. (2015). An Efficient Time Optimized Scheme for Progressive Analytics in Big Data.*Big Data Research, 2*(4), 155-165.

Liu, J., Li, J., Li, W., & Wu, J. (2016). Rethinking Big Data: A review on the data quality and usage issues.*ISPRS Journal of Photogrammetry and Remote Sensing, 115*, 134-142.

Ma, Y., Wu, H., Wang, L., Huang, B., Ranjan R, Zomaya, A., et al. (2015). Remote sensing big data computing: Challenges and opportunities.*Future Generation Computer Systems, 51*, 47-60.

Malachi, RF, Malachi, FFO, & Hwang, Y. (2016). Effects of information technology on corporate social responsibility: Empirical evidence from an emerging economy.*Computers in Human Behavior, 59*, 195-201.

Malmi, T., & Brown, DA (2008). Management control systems as a package-Opportunities, challenges and research directions. *Management Accounting Research, 19*(4), 287-300.

Marsh, G. (2003). Moore's law at the extremes. *Materials Today, 6*(5), 28-33.

McAfee, A. (2002). The Impact of Enterprise Information Technology Adoption on Operational Performance: An Empirical Investigation.*Production and Operations Management, 11*(1), 33-53.

McAfee, A., & Brynjolfsson, E. (2012). Big Data: The Management Revolution.*Harvard Business Review, 90*(10), 60-68.

McNeely, CL, & Hahm, J.-O. (2014). The Big (Data) Bang: Policy, Prospects, and Challenges. *Review of Policy Research, 31*(4), 304-310.

Merchant, KA (1982). The Control Function of Management. *Sloan Management Review, 23*(4) 43-55.

Merchant, KA, & Van der Stede, WA (2012). *Management Control Systems: Performance Measurement, Evaluation and Incentives*. Harlow, England: Financial Times / Prentice Hall.

Park, SH, Huh, SY, Oh, W., & Han, SP (2012). The network-based social inference model for validating customer profile data.*MIS Quarterly Management Information Systems, 36*(4), 1217-1238.

Porche, IR, Wilson, B., Johnson, E.-E., Tierney, S., & Saltzman, E. (2014).*Data_flood: helping the Navy address the rising tide of information sensor*. Santa Monica, CA: RAND / National Defense Research Institue.

Quattrone, P., & Hopper, T. (2005). A 'time-space odyssey': management control systems in two multinational Organizations.*Accounting, Organizations and Society, 30*(7-8), 735-764.

Rao, BBP, Saluia, P., Sharma, N., Mittal, A., & Sharma, SV (2012). Cloud computing is Internet of Things & sensing based applications.*Proceedings of the IEEE Sixth International Conference on Sensing Technology, Kolkata, West Bangal, India*, 374-380.

Redman, CT (2013). Date's Credibility Problem.*Harvard Business Review, 91*(12), 84-89.

Rikhardsson, P., & Kræmmergaard, P. (2006). Identifying the impacts of enterprise system implementation and use: Examples from Denmark.*International Journal of Accounting Information Systems, 7*(1), 36-49.

Ross, JW, Beath, CM, & Quaadgras, A. (2013). You May Not Need Big Data After All.*Harvard Business Review, 91*(12), 90-98.

Salehan, M., & Kim DJ (2016). Predicting the performance of online consumer reviews: The mining sentiment approach to big data analytics.*Decision Support Systems, 81*30-40.

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research Methods for business students*. Harlow, England: Prentice Hall.

Scapens, RW, & Jazayeri, M. (2003). ERP systems and accounting management change: opportunities or impacts? A research note.*European Accounting Review, 12*(1), 201-233.

Shaikh, AA, & Karjaluoto, H. (2015). Making the most of information technology & systems usage: A literature review, framework and future research agenda.*Computers in Human Behavior, 49*, 541-566.

Shao, BBM & Lin, WT (2016). Assessing output performance of information technology service industries: Productivity, innovation and catch-up.*International Journal of Production Economics, 172*, 43-53.

Sharma, S. (2016). Expanded cloud plumes hiding Big Data ecosystem.*Future Generation Computer Systems, 59*, 63-92.

Spenner, P., & Freeman, K. (2012). To Keep Your Customers, Keep It Simple.*Harvard Business Review, 90*(5), 108-114.

Sun, X. Gao, B., Zhang, Y., An, W., Cao, H., Guo, C., et al. (2011). Towards Delivering Analytical Solutions in Cloud: Business Models and Technical Challenges.*Proceedings of the IEEE 8th International Conference on e-Business Engineering (ICEBE 2011)*, 347-351.

Tambe, P. (2014). Big Data Investment, Skills, and Firm Value.*Management Science, 60*(6) 14,521,469.

Teittinen H, Pellinen, J. & Järvenpää, M. (2013). ERP in action - Challenges and benefits for management control in SME context.*International Journal of Accounting Information Systems, 14*(4), 278-296.

Zhou, K., Fu, C., & Yang, S. (2016). Big data driven smart energy management: From big data to big insights.*Renewable and Sustainable Energy Reviews, 56*, 215-225.

Appendixes

Appendix I. Company overview

Company	Industry	Employees*		Function
Company A	Production	± 300	± 2.300	Proces Engineer / Supervisor Assembly & Packaging
Company B	Production	± 450	± 1.300	Project manager data + Manager Purchasing & Manager Plant Equipment
Company C	Production	± 150	± 2.800	IT director
Company D	Financial services	± 125	± 27.000	Consultant Financial Logistics and Treasury
Company E	Production	± 75	± 22.000	Customer Development Finance Manager

* At interviewed location and world wide

Appendix II. Dimensions and indicators

Dimension	Indicator	Concretization	Question
General	Use of data*	To what extent within the organization	G I
	Changes*	Are there noticeable changes	G II
	Thoughts*	Advantages and disadvantages	G III
Benefits (big) data	Benefits from literature	Cost reduction/margins	B I
		Decision making	B I
		Optimization processes and products	B I
	Disadvantages*	Open question	B II
	Future benefits*	Thoughts on future use of data in the organization	B III
Challenges (big) data	Technological	IT infrastructure	CT I
		Other technological	CT I
		Privacy/ security	CT II
	Managerial	Leadership	CM I
		Skills of employees	CM II
		Decision making/culture	CM III, CM IV
	Other	Open question	O I
Enabling control / coercive control	Internal transparency	Do employees know how equipment works	C I
	Global transparency	Do employees know their operations in the bigger picture of the organization	C II
	Flexibility	Flexibility in using systems	C III
	Repair	Are employees allowed to resolve defects in processes	C IV

* No aspect of literature review

Appendix III. Interview questions

The interview questions are the guideline that has been used during the interviews. Depending on the answers given by the interviewee, the one aspect is discussed more in detail than the other aspect during an interview.

Questionnaire interviews data

General

I. To what extend do you make use of different forms of data or information in your daily work?
   a. What kind of data do you use in this and where does this data comes from?
II. Have you seen changes in the use of these data/information in the past few years, and if so what has changed?
III. How do you think about the use of data in the organization yourself?

Benefits

I. What benefits do you see for the use of data in your operations?
   - What could the use of more data provide to your organization?

   a. To what extent do you think that data can contribute to faster completing of operations and processes in the organization?
   b. To what extent do you think that data can play a role in the decision making of employees?
   c. To what extent do you think that data can play a role in improving/optimizing processes and/or products?
   d. To what extent do you think that the use of data can contribute to better opportunities towards customers?

II. What disadvantages do you see for the use of data in the organization?

III. To what extent do you think that data can play a role for the organization in the future?
   - What developments are possible herein for the organizations?

Challenges

Technological

I. To what extent are the possibilities and the use of data in the organization supported by the current systems of the organization?
   a. When focusing on the collection of data, how do you ensure that you make use of reliable, valid information?
   b. To what extent is rapid access to data in the organization possible?
   c. To what extent are systems available in the organization to analyze data?
      - What role plays the ERP system in this? Are systems equipped adequately to promote the use of data?

II. To what extent is access to this data protected/secured?

Managerial

I. To what extent is the use of data stimulated/inhibited by management/supervisors?
   a. What is their standpoint about the use of data?
   b. How do they support/stimulate that employees make more use of data analyzes, make

more use of data systems etc.?

II. To what extent are employees able to handle data?
   a. Can they get the right information from the systems, can they deal with the large amounts of data, etc.?
   b. Are there people in the organization that are specifically focused on the data?

III. To what extent prevails a culture of making use of data in the organization?
   a. How does communication of problems with data with the people who can solve these problems take place?

IV. To what extent is intuition still important in operations?
   a. To what extent are activities of employees (e.g. decision making) based on intuition, and what role does data play in this?
   b. Have you seen changes in the use of intuition in operations in recent years?
   c. What advantages/disadvantages do you see for the use of intuition in operations?

Other

I. Do you see other challenges in making use of data in the organization?

Control

I. To what extent do you know how the systems you work with are constructed and work, do employees have insight in the processes, and do they know what the utility of the rules is?

II. To what extent do you know how your work is related to the activities, processes and the goals of the organization as a whole?

III. To what extent are employees able to deviate from standard steps/procedures as they are drafted?
   - Do they have to comply with organizational rules or are they allowed to make choices based on their own understanding of their work?

IV. To what extent are employees able to restore/improve shortcomings/practical problems in procedures by themselves? Are they free to suggest improvements?
   - At the moment someone sees flaws in procedures/systems, can they solve it by themselves, can they report it somewhere, or something like that.