



Supplies Inventory Management in a Corporation Context: A Case Study

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Inventories and inventory management are integral in supply chain and logistics activities. This study analyses supplies inventory management in a corporation and the unique challenges in this context. The study is qualitative, and a case study of an organisation's inventory management practices is conducted. The findings highlight the importance of reliable inventory data, documented inventory management practices and unified inventory management organisation. They also illustrate the issues and development needs in supplies inventory management in a corporation. Despite the single case study generalisability limitations, managers can utilise the findings as a reference for inventory management development projects in corporations.

Keywords: inventory, inventory management, corporation, supply chain management (SCM), logistics

Introduction

Inventories are frequently seen as cost centres that act as buffers in supply chains and temporary places for storing items (Richards, 2018). Inventories influence the business, as logistics costs are approximated to be several percentages of the revenue of construction and retail firms, and inventory costs form roughly 50 % of overall logistics costs (Solakivi et al., 2018). In other words, inventories have a direct effect on the supply chain and logistics efficiency (Lummus & Vokurka, 1999; Silver et al., 1998).

Richards (2018) describes different inventory types, such as supply, raw materials, work-in-progress (WIP), maintenance and spare parts inventories. Although inventories are costly for companies, they exist for good reasons. These are often related to, for example, achieving economies of scale, balancing supply and demand and controlling uncertainty in the markets (Krajewski et al., 2019).

When considering the basis of inventory management, questions including 'What items should be stocked?', 'Where should the items be stocked?' and 'How much of and when should the items be ordered?' arise (Muck-

stadt & Sapra, 2010). In addition, three elements are identified from the literature that form the basis for efficient inventory management and its development: supply chain and materials management for achieving overall efficiency (Lambert et al., 1998; Silver et al., 1998), information systems for allowing real-time data and knowledge-based management (Faber et al., 2002; Weske, 2012) and the organisation of management and personnel for controlling and developing the inventory process (Lee & Dale, 1998; Yingling, 1997).

With these factors in mind, this study aims to analyse supplies inventory management challenges in a corporation context. In particular, a diverse corporation environment provides a large variety of needs that should be met, and naturally, more challenges can emerge as a result of this more complex environment, compared to a single inventory and company context. This study focuses only on supplies inventories in the case organisation. The above-mentioned objectives of the study can be condensed into the following research questions (RQs):

RQ1 *What is the current state of and development needs for supplies inventory management in the case organisation?*

RQ2 *How does the corporation context affect supplies inventory management?*

The research questions are addressed through literature findings on efficient inventory management and empirical analysis. The current state analysis is formed by conducting semi-structured face-to-face interviews, collecting inventory data from different information systems and documents and observing the inventory process in the case company's facilities. The paper is structured as follows: First, the elements of efficient inventory management are described. Then, the research method is explained. The case description and analysis are observed in the results section. Finally, the results of the paper are discussed from theoretical and managerial perspectives.

Literature Review

Supply Chain and Materials Management

Supply Chain Management (SCM) can be considered as the integration of business activities from suppliers to end users (Prajogo et al., 2016). Van Weele (2010) highlights that the initial objective of SCM is to satisfy or exceed the needs of the end user. Materials management is, therefore, according to Arnold et al. (2008), a coordination procedure for planning and controlling material flows. Lambert et al. (1998) describe the basic elements of materials management as follows: anticipating material requirements, sourcing and obtaining materials, introducing materials into the or-

ganisation and monitoring the status of materials as a current asset. All these activities should be linked to organisational goals and strategy (Lambert et al., 1998).

SCM and materials management are strongly related to each other. Typically, two basic functions can be found in the supply chain: receiving and shipping materials. In addition, managing information and capital flows is essential in supply chain management (Hugos, 2018). It is important to understand that problems in managing supply chains and materials are visible in the form of wrong inventory levels and overall inefficiency (Lambert et al., 1998; Lee, 2002), and as mentioned, inventories themselves are costly (Krajewski et al., 2019). Hence, these activities should be optimised.

The need for stock can be evaluated by conducting an ABC analysis, which highlights the fact that different items require different control strategies (Chu et al., 2008). Braglia et al. (2004) present that, for example, items with high demand and value should be stored or acquired, utilising the just-in-time (JIT) method in order to minimise inventory costs. By exploiting the JIT philosophy, the need for own stocks is basically zero as the items are supplied at the right time to meet targets, but due to the risk of delivery failure, own safety stocks are compulsory in certain situations (Krajewski et al., 2019). Users demands, the reliability of the supply chain and the relationship between the firm and the supplier all have an effect on which control strategy is implemented and on the amount of stock required. These strategies include, for example, storage in the company's own facilities or letting the supplier take care of inventory activities (Wallin et al., 2006).

Spare parts for maintenance control strategies differ from others because of their different nature (Kennedy et al., 2002; Puurunen et al., 2014). Criticality, value, part speciality and demand should all be taken into account when choosing the right control strategy (Huiskonen, 2001). Huiskonen (2001) observes that the relationship between suppliers and other actors in the field should be deepened by utilising, for example, common inventory pools for spare parts with high value and criticality but often very low demand. Good examples of cooperation with suppliers are consignment stock and vendor-managed inventory (VMI), where, in both cases, the supplier participates in a company storage and inventory management (Beheshti et al., 2020; Lakra & Bedi, 2014).

Naturally, the operative work conducted by the inventory personnel is very important in order to keep the inventory in good shape and well organised. Van den Berg and Zijm (1999) describe the inventory process as follows: receiving, stocking, order picking and shipping. This operative work should include, for example, regular manual inventory verification where the items are manually counted in order to correct inventory records (Kang & Gershwin, 2005).

Information Systems

As competition increases, the importance of information systems in controlling and improving processes grows (Lee, 2002; Weske, 2012). Systems that allow the controlling of inventory levels, such as warehouse management systems (WMSs) and enterprise resource planning (ERP), make it possible to optimise inventory levels and material flow (Faber et al., 2002). In addition, the use of information systems has increased the overall efficiency of supply chains in a remarkable way (Cachon & Fisher, 2000).

Whereas a WMS is a system for controlling an inventory process (Faber et al., 2002), ERP allows an even broader approach as it offers a large variety of new ways to do business and to increase integration inside the company (Ali & Miller, 2017; Krajewski et al., 2019). Furthermore, Umble et al. (2003) state that the benefits of using ERP are not only limited to industrial companies as it can be utilised in any firm that wants to optimise its operations.

The automation of ordering through ERP decreases inventory levels and the amount of orders made (Krajewski et al., 2019). This kind of activity is possible by setting lead times, safety stock, reorder points (ROPs), the economic order quantity (EOQ) and the maximum inventory level in terms of the system variables (Wen-Yong et al., 2011). The data provided by information systems help management in decision-making and allow knowledge-based management instead of the making of intuitive decisions (Jääskeläinen & Luukkanen, 2017; Strijbosch et al., 2000). To aid decision-making, key performance indicators (KPIs) are created to measure the variables that are the most important for the success of the company (Parmenter, 2007). KPIs are essential when the organisation wants to recognise the factors that are vital for developing inventory management practices (Johnson & McGinnis, 2010), and it can be generalised in terms of the fact that information systems and the data provided have a lot of weight when developing business processes in an organisation (Zairi, 1997). It should be remembered that the sub-optimisation of different processes should be avoided (Yingling, 1997). This supports the acquisition and utilisation of common ERP by the organisation in order to achieve transparency and maximum business efficiency.

Organisation of Management and Personnel:

Business Process Management

Business process management (BPM) is a systematic approach that enables the analysis, development and control of processes (Hung, 2006; Lee & Dale, 1998). In essence, BPM is a tool for fulfilling cultural change in an organisation related to the considered process (Zairi, 1997). Dumas et al. (2013) observe that BPM focuses on controlling and developing value-

adding activities as a whole, instead of concentrating on single processes.

To make BPM possible, Yingling (1997) presents the necessary organisation and people in terms of three different levels: at the heart of the management system is the management team, the second level consists of department teams within the organisation and the outer level is formed by the key business process teams. BPM itself is implemented in five steps: identify key processes and related goals, define key cross-functional business processes, form teams and develop a charter, develop measures and continuously manage the process (Yingling, 1997). A systematic approach is vital for success (Lee & Dale, 1998; Yingling, 1997; Zairi, 1997). In the last step, the PDCA method (also known as the Deming circle), discussed by Sokovic et al. (2010), is suitable as the development work requires continuous monitoring and examination by conducting regular meetings within the development team (Yingling, 1997).

The key business process team's job is to supervise and manage the inventory process as they are responsible for ensuring that the process is managed and performed correctly, and as mentioned, sub-optimisation should be avoided (Yingling, 1997). It should be remembered that common policies and goals related to overall business and inventory management result in decreased overall costs and bigger profits and, therefore, support the business overall (Kannan et al., 2013). All the elements that form the basis for efficient inventory management according to the literature review are illustrated in Figure 1.

Research Method

This study is qualitative in nature, and a case study strategy (Eisenhardt, 1989) was employed. The study began by analysing the elements of efficient inventory management, i.e. supply chain and materials management, information systems and the organisation of management and personnel. After that, a current state analysis of the case organisation's inventory management was conducted. The selected case organisation is a Finnish corporation in the energy sector. A current state analysis was created by carrying out semi-structured interviews with twenty people (from top management to the operative level) in the corporation, one group interview, collecting and analysing inventory data from information systems and documents and observing inventory management practices in the corporation's everyday work. The interview questions were divided into six categories according to the interviewee's position: 1. top management, 2. energy producing and maintenance, 3. finance, 4. inventory users, 5. inventory personnel and 6. IT administration. The questions focused on fundamental inventory issues, such as current inventory practices in the company, problems and challenges and different needs based on the interviewee's position. The data analysis fol-

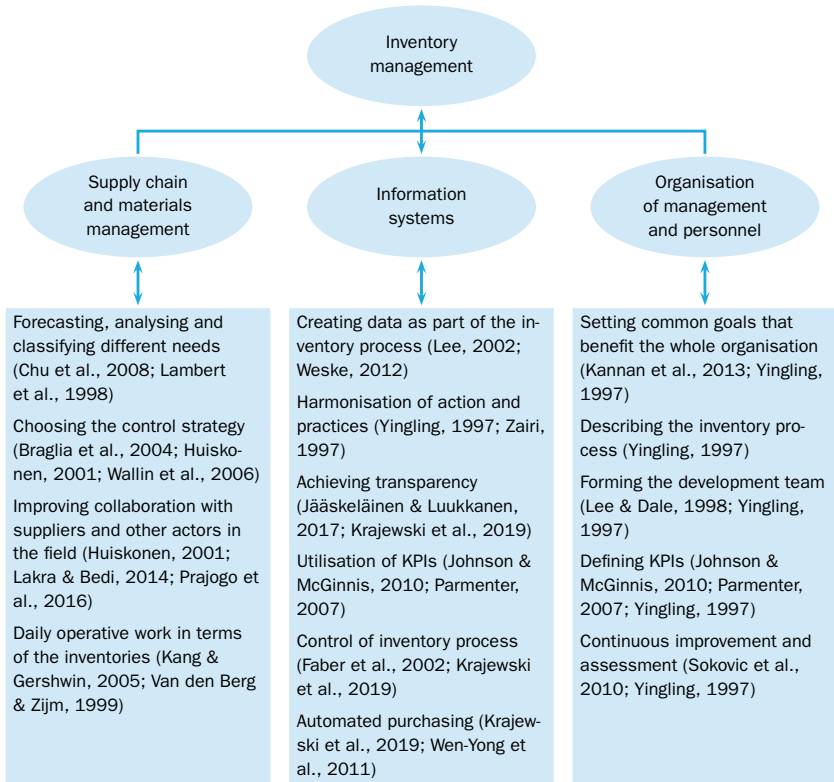


Figure 1 The Elements of Efficient Inventory Management Based on the Literature Review

lowed guidelines by Eisenhardt (1989). The analysis was conducted using a qualitative approach, i.e. reading the interviews several times, each time going deeper into the data to find connections, patterns, and comparisons. Current state analysis is unique to the corporation level, and therefore, it was deemed to be very beneficial for the case organisation. In the last part of the study, the effects of the corporation context related to inventory management were analysed and validated, and the related implications were discussed and concluded.

Results

Case Description

The case organisation is a Finnish energy company that was established back in the 1880s and is located in Northern Finland. The company’s revenue was approximately 300 million euros, the profit was roughly 30 million euros, and it employed, on average, 400 people in 2018. The company provides energy services and clean energy. Its operations cover the entire

value chain of the energy industry from the production of raw materials to the generation, sale and distribution of energy. In addition, the company provides smart energy services, network management, subcontracting and maintenance services.

The case organisation consists of a parent company and five subsidiaries. The parent company can be divided into two different business areas: energy production and heat services. The main goal of this six-month research project was to create an understanding of the current state of the corporation's supplies inventory management. This kind of research has not been conducted before at the corporation level concerning supplies inventories. The sub-goals were to create and distribute information regarding efficient inventory management practices within the corporation and to find common development needs.

Before the research, the understanding and transparency of different supplies inventory management activities and practices within the corporation were limited. Each subsidiary had its own supplies inventories in different geographical locations. The inventories included a large variety of different items, for example, cables and transformers. This diversity resulted in diffused inventory management practices. In this study, the current state analysis is conducted during the empirical research in order to create a corporation-level inventory management framework.

Current State Analysis

This section presents the findings related to RQ1: What is the current state of and development needs for supplies inventory management in the case organisation? The current state analysis started in May 2019. The researcher observed the inventory management practices within the corporation and investigated data from the available information systems and documents. The first step involved forming the basis of the current state analysis including, for example, the locations of supplies inventories and the types of items that were stored in them. After that, interviews were conducted within the organisation. The interviewees were mostly in management positions because of the insufficient organisation of operative inventory management and the limited number of people allocated to operative work.

Based on the current state analysis, it was obvious that there were shortages and challenges in every element of the theoretical framework presented in Figure 1. The main challenge was the inexistence of real-time and reliable inventory data. Because of the lack of accurate data and the inexistence of KPIs, visibility at the operative level was poor, and as a result, knowledge-based decision-making was difficult. In some inventories, storage workers controlled the daily material flow. In general, the inventory

management organisation and the people responsible, whose main focus was on inventories, were fragmented and defective. In most cases, inventory management and the control of material flow took place as a side task. Daily inventory management, which focused mainly on controlling inventories, did not extend to the biggest part of the corporation's inventories. Also, the supplies inventories were not centralised because each company had their own storage in different locations. Thus, it was difficult to control the inventories.

The lack of process documentation for controlling the materials resulted in subjective decision-making in the inventories. Because of this, the work conducted by the personnel and inventory users was, in most cases, based on each person's own views and experience. The interviewees admitted that there were challenges and uncertainty in the general rules and procedures concerning supplies inventories. The roles of inventory management were unclear, and the basic practices for diffused supplies inventories were incomplete.

The supplies inventories faced problems, such as the shortage of free space and the high number of non-marketable or unknown items. In the worst-case scenario, broken items were mixed with and stored in between intact articles because the rules and positions regarding storage were not generally documented and visible. As a result, it was possible to retrieve broken items in urgent situations. This happened frequently in inventories where storage workers were absent and where overall disorder was high. The lack of free space caused issues when orders were made at the wrong time and when items arrived at the inventory too early. In cases like this, an understanding of the supply chain and ordering at the right time are important in order to maintain optimal inventory levels.

It was notable that the current problems and challenges led to indirect costs and overall inefficiency in the corporation's everyday work, which also resulted in, for example, extra time taken in finding items in the inventories. The current inventory management did not support the corporation's business and was not in line with its strategy. The challenges and related implications can be seen jointly in Table 1.

Inventory Management Challenges in a Corporation Context

This section presents the findings related to RQ2. How does the corporation context affect supplies inventory management? The current state analysis indicated that there were many basic-level challenges concerning the corporation's supplies inventories. The first challenge identified from the current state analysis was the inexistence of a common ERP system, which results in poor visibility between the parent company and subsidiaries. Without accurate and real-time data, it was impossible to make data-driven decisions

Table 1 Issues Based on Current State Analysis

Challenge(s) and development need(s)	Implication(s)
No common ERP system.	Transparency and data-driven business making challenging.
No real-time and accurate inventory data.	No visibility regarding inventory levels, knowledge-based management hard.
No common and documented practices for inventory management and control.	Subjective decision-making, no continuity.
Diffused and defective inventory management organisation.	Daily operative inventory work challenging, defective division of responsibility, collaboration not exploited.
No reporting of inventories.	Visibility regarding operative level and information flow poor.
Shortage of free space and disorder in the inventories.	Extra time spent on finding items, safety risks.
High level of non-marketable items.	High inventory levels, added costs, lack of free space.
Information related to inventories strongly person bound.	Risk of losing information.
Diffused inventory locations.	Travelling between inventories.
A lot of manual work.	Overall inefficiency, no utilisation of technology.

for optimising inventory levels. In the corporation context, the importance of data is essential as there are more needs to be met and, naturally, more information to deal with. Without common ERP, collaboration inside the corporation is harder, and the barriers are higher not only in inventory management but also in other business operations.

As inventories were not centralised and their locations were diffused, a lot of travelling and overall effort was required in order to utilise the inventories. In the case company, some of the subsidiaries had to exploit each other's inventories for daily operative work. As the general rules for managing inventories were not properly documented and followed, the disorder in the inventories kept on growing. The lack of documentation and people focusing on inventory management made it difficult to keep the inventories up-to-date and efficient. Development work and efforts were not conducted. Hence, the importance of organisation and jointly approved processes in inventory management cannot be underestimated. This is highlighted in the corporation environment as the users of inventories can vary significantly. When the need to use part of the inventory appears, the overall process for retrieving an item must be visible and clear.

Overall, the inventory management in the case organisation was sub-optimised even though the subsidiaries had a need for collaboration related

to utilising the inventories. The importance of real-time and transparent inventory data, inventory-focused personnel for operative control and development work and commonly agreed upon and visible inventory management practices must be emphasised. In general, all the aspects described in the literature review of this study have effects on inventory management and its development. As the corporation environment has special characteristics, such as a large variety of needs to be met, the shortages in inventory management practices are emphasised and result in overall inefficiency in the corporation's everyday work.

Discussion

This study focused on inventory management challenges in a corporation context. A literature review on the elements of efficient inventory management provided the framework for the study. Next, a current state analysis was conducted, and challenges and development needs related to the case organisation's inventory management were identified. In this section, the study's findings are discussed from theoretical and managerial perspectives.

The results of the study indicated a large number of inventory management challenges in a corporation (Table 1). These challenges were strongly related and divided into three categories according to the literature review: supply chain and materials management, information systems and the organisation of management and personnel. The lack of real-time inventory data, the non-existence of commonly agreed upon and visible inventory management practices and defective inventory management organisation all resulted in disorder in geographically diffused inventories, poor transparency inside the corporation and overall inefficiencies.

The corporation context adds more unique requirements for inventory management as the number of different stakeholders grows, the environment expands and more demands emerge, which all make inventory management more complex. In this context, the importance of common data, processes and people responsible for corporation-level inventory management are highlighted.

Theoretical Implications

The current state analysis identified many challenges related to the case organisation's inventory management practices. The key findings of our study highlight the importance of reliable inventory data, documented inventory management practices and unified inventory management organisation to improve operational efficiency. Inventory management is a key part of supply chain and logistics efficiency (Lummus & Vokurka, 1999; Silver et al., 1998), and therefore, the inventory management impacts the whole

business. In the corporation context, all the inventory types presented by Richards (2018) exist, and as a result, the reasons for building stock are extensive in order to satisfy the different needs within the corporation. Strijbosch et al. (2000) argues that an advanced forecasting and inventory control approach provides a good service level in many circumstances, whereas a simple approach may lead to larger inventories in order to meet the required service level. The findings of our study also indicate that the corporation's inventories contain many types of items with different demand patterns, which may create a need for tailored control approaches.

As the environment and needs expand, the importance of supply chain and materials management, information systems and the organisation of management and personnel grows. The common materials management practices and rules presented by Lambert et al. (1998) and Van den Berg and Zijm (1999) must be documented and standardised. Also, in cases where the inventory data are insufficient, knowledge-based management and decision-making is challenging. Chu et al. (2008) propose an advanced ABC-method that provides high accuracy of classification. However, the findings of our study indicate that insufficient inventory data can make even a simple ABC analysis difficult to execute. Thus, optimising the inventory levels can be difficult.

As observed by Kannan et al. (2013), developing inventory management can bring many benefits, such as decreased costs and increased profits. Our study indicates that achieving these benefits requires the harmonisation of inventory management practices. This requires corporation-level instructions for handling materials in the inventories and the adoption of the 5S method (i.e. sort, set in order, shine, standardise and sustain) for improved organisation and standardisation. In addition to the 5S method, the use of visual control can be considered (Majava et al., 2019; Majava & Ojanperä, 2017). This would also enable a reduction in the number of inventories and the combining of the items stored in them. In addition, a systematic approach is vital for success, and efficient BPM (Lee & Dale, 1998; Yingling, 1997; Zairi, 1997) requires re-organisation. With re-organisation and new organisational structures focused on developing and executing operative inventory management, the set objectives would be easier to achieve in some cases. Organisations also need KPIs for developing their processes and practices (Johnson & McGinnis, 2010). In addition, information systems and data are very important in the business process development (Zairi, 1997). The findings of our study stress the importance of KPIs, as observed also by Johnson & McGinnis (2010).

The ultimate goal in modern inventory management should be a data-driven organisation, enabled by common ERP, with a definition of its inventory processes and the creation of inventory-focused management. Our

study's results support the findings by Jääskeläinen & Luukkanen (2017) who argue that that middle managers' work is affected by informal controls and relies in many cases on individual intuition and judgment based on experience, rather than performance information or formal instructions. As the corporation context demands more exact information in order to achieve knowledge-based management instead of the making of intuitive decisions (Jääskeläinen & Luukkanen, 2017; Strijbosch et al., 2000), the need for ERP and generic development work are obvious.

Managerial Implications

In this study, the challenges found related to inventory management are quite elementary and result in overall inefficiency in the corporation's everyday work. The current challenges set a good example of the importance of the different elements concerning efficient inventory management introduced in the literature review. For example, if the usage of information systems and exact data regarding inventory levels is defective, knowledge-based decision-making is almost impossible, and therefore, the optimisation of inventory levels is more difficult. This applies to both single companies and corporations where, as mentioned, the needs and motives for storing can vary a lot. Without common rules and procedures, which are followed by inventory personnel, everyday operative work is difficult to perform. In addition, as development work and continuous improvement are essential for ensuring overall efficiency, the importance of inventory-oriented personnel and top management initiatives for improving inventory management practices cannot be underestimated.

The results of this study cannot be directly generalised to other companies and corporations because the challenges and inventory maturity levels can differ a lot from one situation to another. However, this study highlights the fact that without the elements of efficient inventory management, the challenges can lead to diffused inventories, which are ineffective and do not support the business of the organisation. It is also notable that, as the corporation environment is a very broad one, the development work should be given time, and it should be ensured that the moves made during the development project support the set objectives and business strategy.

Conclusions

Inventories have a remarkable effect on companies' businesses as they affect the overall supply chain and logistics efficiency. As inventories themselves add costs, inventory optimisation is vital in order to minimise costs but at the same time ensure a suitable level of service.

In the study, a current state analysis was conducted, and related challenges and development needs were analysed. The literature review acted

as a base for understanding the big picture in terms of the elements affecting efficient inventory management. The main challenges in the studied corporation inventory management were the lack of exact and accurate inventory data, the non-existence of common and visible documented practices for managing inventories and defective inventory management organisation for the daily control and development of inventories. These challenges led to overall inefficiency in the corporation.

In a corporation environment, shortages of the elements needed for efficient inventory management become more visible. Without common inventory data, collaboration between the companies inside the corporation related to the inventories and their use is challenging to execute. As different stakeholders inside the corporation utilise other companies' inventories, transparency and common rules for controlling the inventories should exist. If this is not the case, decision-making is subjective, and operative work performed in the inventories is not uniform. In addition, the lack of corporation-level inventory management personnel may result in the lack of development work at the corporation and subsidiary levels. These types of shortages lead to diffused inventories and overall inefficiency.

This study has the typical limitations of a single case study, for example, generalisability, validity and reliability concerns. The interviews related to current inventory management practices were recorded and validated after the interviews. Information systems data were analysed with great caution as the systems were defective, and therefore, the data were mostly incorrect. Finally, this study illustrated the challenges in terms of a low maturity inventory management level in a corporation context. In addition to studying different types of contexts and business sectors, potential future research could focus on implementing development work in corporations' supplies inventories and its effect on businesses.

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