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An inventory optimization toolbox in SMEs

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Abstract

Introduction - The globalization of e-commerce and the emergence of supply chains have allowed SMEs to join in shaping the global economy. Although SMEs contribute a lot to global development, they usually experience a number of challenges in their daily operations affecting their profitability and performance. A general inability of managing inventory normally constitutes a significant challenge and causes increased capital tie-up and total costs.

Purpose - This thesis aims to compile and evaluate an inventory management toolbox for SMEs that incorporates specific tools to reduce capital tie-up and total costs by optimizing inventory levels.

Methodology - A case study with a mixed approach of both qualitative and quantitative data has been applied to fulfill the purpose of this thesis. The collected data consists of both primary and secondary data. Primary data include interviews, meetings, e-mails and raw data while secondary data consist of academically published articles.

Empirical data - Company X admittedly experiences issues with a lack of cash flow, since heavy investments in inventory is causing capital tie-up and increases total costs. Inventory turnover rate is an important key figure for the company and slow-moving items impacts the company's performance massively.

Analysis - By applying theory on the collected empirical data, we give suggestions on and present how to use the compiled toolbox as a framework to increase inventory turnover rate, reduce capital tie-up and total costs.

Conclusion - This thesis has proven the compiled toolbox to be effective in increasing inventory turnover rate, reducing capital tie-up and total costs. Moreover, this thesis has created a foundation of a toolbox and should be seen as a starting point to further develop.

List of abbreviations & definitions

3PL - Third party logistics provider

AI - Average inventory

CI - Closing inventory

COGS - Cost of goods sold

D - Demand

EOQ - Economic order quantity

ITR - Inventory turnover rate

OI - Opening inventory

P - Ordering cost

SKU - Stock-keeping unit

SMEs - Small and medium-sized enterprises

UF - Holding cost for all periods

ABC-analysis - Analysis to classify products into A, B and C categories *(Flores & Whybark, 1987).*

Capital tie-up - Capital tie-up derives from investing in an asset which has a direct impact on a company's cash flow and its ability to make payments *(Lumsden, 2019).*

Economic order quantity - A classic model used to determine ordering quantity and amount of ordering occasions in balance with ordering costs and holding costs *(Kumar, 2016).*

Holding cost - The cost associated with holding inventory *(Kumar, 2016).*

Inventory management - Inventory management is the collective name on activities that organize the availability of items to customers *(Wild, 2018).*

Inventory turnover rate - Inventory turnover rate is a financial key figure used to measure how quickly a company sells and replaces its average inventory over a given time period *(Lumsden, 2019).*

Multi criteria ABC - Classify products in additional categories *(Flores & Whitbark, 1987).*

Ordering cost - The cost associated with placing an order *(Kumar, 2016).*

Third party logistics provider - External company who offers outsourced logistics service *(Jonsson & Mattsson, 2023).*

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Introduction

The introductory chapter begins with a presentation of general information about SMEs and the topic of inventory management, narrowing down to the problem description of the thesis. The problems are described based on previous literature. In connection with the problem description we present the thesis purpose and the research question. The chapter ends with a short introduction of the case study, Company X and the disposition of the thesis.

Background

The globalization of e-commerce and trade has resulted in the inclusion of small and medium-sized enterprises (SMEs) in global supply chains, allowing them to take part in and form the global economy (Mardhiani et al., 2022). According to the World Bank (2021) SMEs usually contribute approximately 40% of national income (GDP) in countries. They are recognized as having an important role in stimulating growth, contributing to employment and alleviating poverty, which makes the development of SMEs a high priority for many governments (Muchaendepi, 2019). Profitability usually constitutes a problem for SMEs and is the most common reason SMEs tend to struggle while developing and maintaining their business successfully. They are often permeated with a lack of financial resources, an inadequacy of management and marketing, lack of qualified workers and weakness in information flows and storing (Ramírez-Solís & Rodriguez-Marin, 2022). In order for SMEs to properly compete with larger companies, a shift from traditional to non-traditional market approaches while adapting to changing market conditions is key (Reardon et al., 2021). Two important key trade-offs that have emerged is adjusting the speed and reliability of transportation and adjusting order quantities, and this is when inventory management became popularized (Martin et al., 2014).

Nowadays inventory management is a well-studied area with many different aspects included (Hançerlioğulları, 2016). Inventory management constitutes an essential part of most businesses and has since the beginning of the retail industry been a critical element of success. The process of inventory management includes a continual comparison of costs and benefits of holding inventory to find an optimal balance (Chopra, 2019). Historically companies have managed inventory replenishment by just walking down the warehouse aisles and ordering based on intuition which more often than not caused unnecessarily high inventory holding costs

and increased capital tie-up (Adunsei & Awunyo-Vitor, 2014). Johnson (2016) claims that competitive pressures in the global marketplace along with technological advancements have developed impeccably accurate supply chain planning and inventory management skills among companies. Martin et al. (2014) also imply that there have been many technological improvements in supply chain management and inventory management which has led to lower inventory levels and higher efficiency. Atnafu & Balda (2018) explain that inventory management skills in SMEs along with the lack of equipment and technology are the biggest latch to increased growth due to inventory management being closely correlated with business performance and profitability. Alam et al. (2023) continue in their article by emphasizing the importance of inventory management in SMEs and its influence on profitability.

Problem description

Although SMEs contribute to global development in several significant ways, they normally face a number of challenges in their businesses and daily operations. Inventory management is a critical challenge facing SMEs since a general inability of managing inventory efficiently and successfully is permeating SMEs (Muchaendepi, 2019; Islam et al., 2019). Rushton et al. (2022) claim that inventory management is the main issue to be addressed within the supply chain due to their close correlation to profitability. As the number of stock-keeping units (SKUs) sold by a business increases, it becomes more difficult to conduct inventory management activities effectively (Zietzman & van Vuuren, 2023). Jonsson & Mattsson (2023) agree in their research that implementing and working with inventory management successfully brings lowered costs, lowered inventory levels and increased profitability. Managing inventory is a decisive factor of a company's liquidity since inventory investments usually is the largest asset for retailers (Rao et al., 2021). The reason inventory management is such a crucial element to profitability is due to its influence on sales and performance. If inventory balance grows at a faster pace than sales, it can be a thorough sign of over-stocking and in turn lowering the inventory turnover rate, which is why improving inventory management can't be overemphasized (Teerasoponpong & Sopadang, 2022).

Fu et al. (2021) claim that demand for shorter lead times, managing a larger number of orders with greater order variety and being more flexible with complex processes are challenges faced by SMEs in dynamic business environments. Kesavan et al. (2016) explain that inventory

management issues grow as a consequence of lengthening supply chains and the ability to manage inventory is crucial. Failure in this department may lead to unsatisfied customers, loss of market shares and excessively high inventory costs. Akindipe (2014) means that the development of SMEs is hampered by a lack of internal managerial capabilities, insufficient equipment and outdated technology. Limited resources are often the barrier to good databases and data management which constitute the foundation for structured inventory management. Furthermore, SMEs have difficulties assessing and analyzing data since the collection and the dissemination of data is too extensive to manage effortlessly. The management often lacks a methodical approach and an establishment of standards which ultimately impair inventory management (Alam et al., 2023).

By managing inventory turnover rate effectively companies reduce the risk of not being able to meet customer needs while simultaneously keeping inventory costs at reasonable levels (Bendavid et al., 2017). Islam et al. (2019) emphasize that SMEs have a tendency to hold excess inventory due to lack of experience, which directly increase holding costs and capital tie-up. This impairs the possibility of using capital for investments or other profitable business projects and forces companies to increase debt. Johnson (2016) continues by explaining possible benefits of implementing effective inventory management in businesses. By applying strategies designed to control inventory, companies enable mitigation of wasteful activities and promote efficient use of capital.

In summary, managing inventory effectively is undeniably a crucial challenge to handle for SMEs as successful management allows companies to reap the benefits of an optimized inventory, meaning reduced capital tie-up, total costs and increased profitability (Atnafu & Balda, 2018). A difference between SMEs and larger companies is that according to theory, larger companies seem to have a good foundation of principles already set in place, while SMEs seem to struggle with that and many do not work with basic tools (Alam et al., 2023). In turn SMEs often struggle with inventory management which causes excess inventory and capital tie-up to weigh down the company. Inventory is often the largest asset a retail company possesses at any given time, so it's undeniably important to manage it efficiently to ensure judicious use of scarce resources and prevent waste (Muchaendepi, 2019). The lack of effective inventory management in SMEs creates a need for a toolbox to be compiled in order to help them optimize inventory management and in extension increase liquidity. By establishing and using inventory management decision making tools, companies are able to optimize activities

and embrace benefits in terms of profitability and improve overall business performance (Zietzman & van Vuuren, 2023).

According to previous literature, the compilation of a toolbox is a necessary step in improving inventory management of SMEs. With this thesis we hope to provide SMEs with practical tools to help them manage inventory efficiently.

Thesis purpose

This thesis aims to compile and evaluate an inventory management toolbox for SMEs that incorporates specific tools to reduce capital tie-up and total costs by optimizing inventory levels.

Research question

How effective is the toolbox in helping SMEs reduce capital tie-up, total costs and optimize inventory levels to enable future development?

Discussion of research questions

Several researchers imply that there is a general lack of data availability and system support permeating SMEs which impairs inventory monitoring and in extension increases capital tie-up and total costs (Alam et al., 2023; Akindipe, 2014; Begg & Caira 2012; Karim et al., 2018; Paluch 2019). The effectiveness of the toolbox is measured by the percentage reduction of capital tie-up and total costs in inventory. The intention is to provide a simplified and pragmatic toolbox to act as a starting point suitable for SMEs. Additionally, the toolbox creates the foundation of how SMEs should approach inventory management to enable future development.

Case study

In order to examine how SMEs work with inventory management and how it could be improved, Patel & Davidsson (2019) suggest the use of a case study. A case study will be able to provide an approach where working together with a company will be possible, which will

give insights that would not be available solely solely through literature (ibid). The case study will be conducted on Company X in order to gain insights in how SMEs work with inventory management. Furthermore, comparing the case study with theory on inventory management in SMEs will provide an interesting perspective. It will then be able to suggest ways for SMEs to further develop in inventory management, thus answering the research question.

Company introduction

Company X is an e-wholesaler operating in the B2B sector. Since its founding in early 2010, the business has consistently expanded with total sales 2022 of approximately 300 million Swedish crowns which since 2019 is an increase of roughly 100 %. The company's inventory has increased by more than 120 % when compared to 2019. On average, the company has 4000 available products, provided by 550 various suppliers in their web shop. The assortment of products is updated continuously from day to day.

Long-term contracts, phone sales and out-in-the-field salespeople constitute the traditional foundation of conventional wholesaling. On the contrary, Company X's foundation is built more on the conviction that using e-commerce as a powerful tool for distribution offers the customer better terms and more affordable prices. Moreover, Company X has no legally binding contracts with their customers deciding how much and when to purchase, but for some large customers, they have established verbal agreements just to make sure they are able to cover their needs in every period. Customers are allowed to purchase whatever quantities they prefer, when they prefer.

Company X has admitted that they are experiencing issues with their cash flow due to a lot of capital tie-up in inventory assets. Inventory turnover rate is a critical performance indicator for the company and slow-moving items cause detrimental impacts on the company's performance. In order to account for their lack of cash flow, they apply for more debt, which in turn leads to them paying more interest and together with high inventory volumes bring unnecessary costs. This can be avoided by optimizing the inventory turnover rate and improving replenishment strategies, which in turn will reduce capital tie-up and total costs.

The contact person from Company X has been with the company since 2021 and works with procurement and logistics equally divided alongside one other employee. A big part of the work is operational duties like shipping bookings and also optimization of several different areas within logistics. Moreover an ongoing analysis of flows, costs and processes constitute the contact person’s daily work.

Disposition

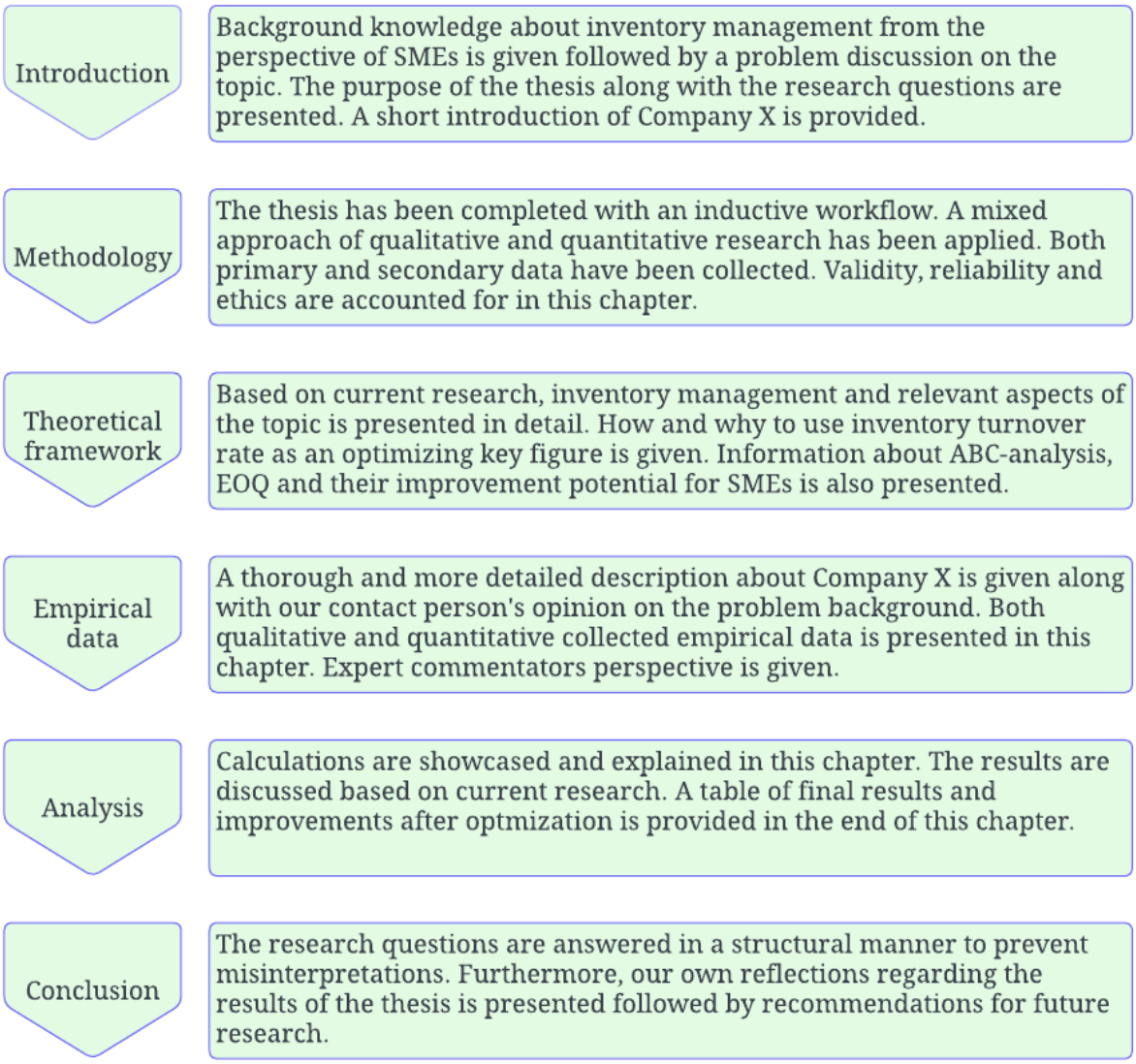

Figure 1: Disposition of thesis. Source: Authors

Methodology

This chapter presents the procedure and approach used to collect empirical data and previous research. The section ends with criticism of applied methods along with a presentation of the sensitivity analysis and a discussion on validity, reliability and ethics.

Research approach

Patel & Davidsson (2019) claim that an important part of the thesis is to choose and define a suitable research approach to increase the possibilities of achieving the purpose of the thesis. The authors state that an inductive workflow has a discovery based nature, where the researchers let the collected and analyzed data select and distinguish suitable theories to apply to the thesis. This thesis is mainly done in an inductive manner due to the fact that the collected data were sorted and analyzed before theories were examined. Using an inductive workflow promotes discovery of patterns within the data and uses the data as guidance to find suitable theory. It's usually appropriate to wait with a proper literature review until after collected data has been examined (Patel & Davidsson, 2019).

In the introductory phase of this thesis an initial interview with Company X was held in order to discuss the experienced problem in detail and get a deeper understanding of the company in general. Blomkvist & Hallin (2014) propose the nature of initial interviews to be unstructured since it facilitates unprejudiced exploration of the topic. After the interview was completed, an initial search for literature was conducted to gain knowledge about the problem area. According to Patel & Davidsson (2019) the introductory phase of a thesis is permeated by gathering deeper knowledge about the chosen topic while simultaneously defining and formulating the problem description. Thereafter a discussion was held about which data was necessary in order to examine and analyze the stated problem.

Case Study

Patel & Davidsson (2019) explain that a case can be anything from an organization to a situation and Ratten (2023) claims that the case study approach is especially useful when examining and analyzing an organization. Case studies are based on real-life context

(Jónasdóttir et al., 2018; Ratten, 2023) and to study it Jónasdóttir et al. (2018) explain that a comprehensive understanding of it is gained. Furthermore Patel & Davidsson (2019) emphasize that it offers a holistic view of the problem. This thesis is written on an organization, i.e. Company X, therefore a case study was chosen as the best approach. Since the thesis is using an inductive workflow a case study is also preferred, because when new information emerges the understanding and theory develops (Ratten, 2023). Furthermore the author explains that a case study typically contains primary and secondary data. Hence the thesis includes both in order to provide the best possible results.

Data collection

Patel & Davidsson (2019) claim that proper data collection essentially creates a foundation for the results of the thesis. According to Williams & Vogt (2014) a mixed approach of qualitative and quantitative data is preferred since it provides the reader with a more comprehensive understanding of the thesis as the two are used to complement one another. Primary qualitative data has been collected through a combination of several meetings, semi structured interviews and e-mail contact with the contact person at Company X. Additionally, supportive interviews with OneMed and Optilon were held in order to provide a different perspective to the problem. The literature review consisting of secondary qualitative data was collected from a large selection of articles retrieved from several databases. Primary quantitative data was received in batches during the thesis from Company X. The data collected mainly include sales data, purchasing data and inventory balance data which all are necessary to examine in order to achieve the purpose of this thesis. At a later stage data was received containing holding costs per day per pallet and a proper estimation of the ordering cost which were taken into consideration.

Qualitative data

As mentioned above qualitative data is divided into primary data and secondary data. Online meetings, interviews and e-mail contact constitute the primary qualitative data in this thesis. Academically published articles create the foundation of applied secondary qualitative data. Qualitative research allows the researcher to become completely immersed in the context (Ratten, 2023). Processing of qualitative data has been permeated by an ongoing analysis

throughout the thesis work, which Patel & Davidsson (2019) explain is an eligible qualitative approach.

Interviews

Three interviews have been conducted in this thesis and all of them were semi-structured since it, according to Patel and Davidsson (2019), provides a greater freedom for the respondent to answer the questions which is why it has been applied in this thesis. The purpose of a semi-structured interview is to discover and identify characteristics in the respondents perception. Regarding the questionnaire, the designed questions can come in an unspecified sequence and the respondent does not need to prepare for the questions beforehandP, although the themes of the interview need to be predetermined (Ratten, 2023). Due to this all the questions were not sent to the respondents in advance. In order to have high quality questions, any unnecessary questions that lacked meaning were removed before the interviews. All interviews began with neutral questions that were not directly connected to the topic, mainly regarding company history and the market. This was done in order to get a deeper understanding of Company X, OneMed and Optilon and to ease into more detailed questions as suggested by Patel and Davidsson (2019). In order to more easily transcribe the interviews they were recorded with permission from the respondents, which is recommended in order to better remember and analyze the interviews afterwards (Bryman & Bell, 2017).

Online meetings

Throughout the thesis regular meetings with the contact person from Company X have been held. These meetings were utilized to discuss the approach, potential data that needed to be obtained as well as any questions further explaining the data. The meetings were seen as follow-up meetings and quick open qualitative interviews where the questions were not composed in advance, which according to Patel and Davidsson (2019) is the most open form of interview.

E-mails

Furthermore, any follow-up questions that did not require a meeting were asked through email, Ratten (2023) explains that collecting data from email can be a good way to provide answers that do not lack clarity. The author goes on to explain that email contact is used together with

other interviewing techniques in order to build upon the information and get more detailed answers.

Literature review

After the data had been handled, sorted and to some extent analyzed, a literature review was carried out. The search words according to *Table 1* were used to find theoretical connections to the empirical data. Ratten (2023) explains that it is a good way to initiate a literature review. Normally it includes typing certain words or phrases into search engines in order to obtain results. The search words presented in *Table 1* were searched for in different combinations with each other.

Literature search words
Inventory management
Inventory optimization
Supply chain optimization
Inventory turnover rate
Average inventory
Capital tie-up
EOQ
ABC-analysis
SMEs
Demand
Demand forecasting
Procurement strategies
Replenishment

Table 1: List of literature search words

Google Scholar was used as the primary search engine, but supplemented with Emerald and Elsevier to identify possible differences between the range of articles and also to minimize the risk of a limited outcome. The articles were limited to newer articles, with exceptions of articles where the concept is still relevant today. When finding a relevant article, the snowball effect

was applied, by looking at the reference list of another study, more relevant articles can be extrapolated (Patel and Davidsson, 2019).

Ratten (2023) states that the literature review is a crucial part to any study as it provides the researcher an overview of current research on the topic. Also, a thorough literature review allows the researcher to demonstrate knowledge of a topic. Ratten (2023) continues by emphasizing the literature review as both supportive and facilitative, meaning that it helps to explain why a topic is important and enables others to read why a particular study is useful.

Quantitative data

Quantitative research is according to Ratten (2023) the process of collecting data in the form of numbers, statistics and facts. A quantitative approach was used to collect numerical data containing inventory levels, demand patterns, replenishment and price information. Furthermore a statistical approach has been applied when examining relationships between the variables. The software used to process the collected data has been Microsoft Excel.

Raw data

In accordance with Patel and Davidsson (2019), statistics is used in many investigation works as a tool to sort, describe, process and analyze data. It is typical to differentiate between two types of statistics, hypothesis testing and descriptive statistics. Through the use of descriptive statistics the problem areas can be highlighted, offer solutions and present data. Through the application of statistics in accordance with Patel and Davidsson's (2019) definition of the tool. Microsoft Excel has been used to sort, process and analyze relevant data, it is also very common for data or descriptive statistics to be presented in tables since it is easily depicted. Before it has been sorted and it is unprocessed it is called raw data (ibid).

Company X provided sales data, purchasing data and inventory data. The sales data and purchasing data came sorted in SKUs and date, afterwards appropriate periods were defined. Since the data started from 2022-08-10 and ended on 2022-02-10 it was necessary to look at one month periods but starting on the tenth of august. In order to organize more easily and prepare the data for analysis, the purchases, sales, opening inventory and purchase prices for

each month were combined in a Pivot table. The toolbox required further data, thus ordering- and inventory holding cost were retrieved. After that the application of the toolbox took place.

Delimitations

The possibility to examine and determine reorder points, optimal levels of safety stock and service level is not explored since the received data is insufficient and does not allow analysis of those elements. Company X acknowledges that every single product has different service levels, but since their system does not allow that function, they are not able to determine precise service levels or safety stocks. Additionally, their website does not notify them when customers cancel purchases because the desired amount is not available momentarily, which prevents them from accurately assessing their service level. Furthermore assumptions on the ordering cost had to be made due to Company X not having that data available, however together with the contact person from Company X a reasonable assumption was made.

As a consequence of the provided time limit and at the same time providing a cost effective solution, a decision to only examine and analyze 20 of their most important products was made. There is not enough time to analyze every single product, and arguably not necessary due to low volumes of the majority of products. Hence, in agreements with the supervisor and with Company X, the decision to focus on products that are always available in their assortment and more importantly have the highest average purchasing value was made.

Criticism of methods

Criticism of used methods has been a central aspect of this thesis. Mainly using primary sources of information, such as interviews, meetings and e-mail exchange increase the credibility of the thesis. Before using secondary data, it has been ensured that an article exclusively is published in a well known journal to confirm reliable and relevant information. However, a general lack of published articles covering inventory management in especially European SMEs has somewhat impaired the literature review process of the thesis. Additional research in this area would be interesting to take part of to further deepen the understanding of the situation of SMEs in Europe. It’s important to state that criticism of applied methods and

collected data has been a constant ongoing process throughout this thesis due the massive amount of available information on the topic (Patel & Davidsson, 2019).

Sensitivity analysis

A sensitivity analysis provides crucial information on the relative importance of input variables and assumptions in a mathematical model (Saltelli et al., 2019). Sensitivity in a model depicts how diverse assumptions contribute to the overall uncertainty of the model. In order to properly estimate the sensitivity, the output of a mathematical model is thoroughly examined in terms of how it moves when the assumption of an input variable is changed. By understanding how variables interact, a sensitivity analysis improves the model's prediction and examines how the model output responds to changes in input (Jacinth Jennifer & Saravanan, 2021). This thesis intends to use a sensitivity analysis in line with above research in order to determine the mathematical model's resilience to other assumptions. In order for the EOQ formula to mathematically work, an ordering cost had to be assumed. By both increasing and reducing the ordering cost assumption with 5, 10 and 15% respectively, the thesis is able to estimate and examine the sensitivity of the EOQ formula and its range of use.

Validity

According to Cohen et al. (2018) validity is an important factor to efficient research. Validity refers to which level the chosen research instrument measures what it is supposed to measure. In this thesis, validity implies being true to the assumptions underpinning the utilized numerical data. Furthermore, the major considerations of validity is whether the collected data is measured accurately and how far the measurement results may be generalized. This thesis applies an ABC-analysis to segment products in order to increase validity and the segmented products are optimized with EOQ. Products with high demand variation are not optimized since EOQ is not applicable, which is explained thoroughly in the thesis. Cohen et al. (2018) state that wide variability in the outcome of measures affects the validity. This thesis explains and accounts for possible research errors in order to be faithful and increase the validity and it does not claim the results to be something they're not. Moreover, due to the fact that the ordering cost is not available, an assumption has been made. The assumption has been made with the contact person on Company X together with a sensitivity analysis to ensure validity. If the

toolbox was applied to another company in the same context, it would work and also enable conclusions to be made. The literature review is fully derived from the problem discussion, the thesis purpose and the research questions which Blomqvist & Hallin (2014) imply is a necessary foundation to high validity.

Reliability

Reliability refers to which extent the utilized measuring instrument is reliable (Cohen et al., 2018). Meaning a performed research should generate similar results if it were to be completed another time. Given the same thesis purpose and the same available data, calculations would still generate the same results. Björkqvist & Paulsson (2014) claim that asking control questions during the interview increases overall reliability, which was done both during and after the interviews. According to Patel & Davidsson (2019) another way to increase reliability is to store collected data and go through it a second time in order to mitigate possibilities of missed data or misinterpretations. Conclusively, when secondary data was collected, several sources were examined to ensure high quality and correct information.

Ethics

According to Patel & Davidsson (2019) the goal of all research is to produce as credible research as possible while simultaneously not compromising general health of people and society. Under no circumstances should people be exposed to mental- or physical harm or abuse to establish research. In order to honor and respect these principles, the thesis follows Patel & Davidssons (2019) list of requirements containing four essential rules of conduct regarding ethics in research. The contact person from Company X has been informed about the purpose of the thesis. The contact person has had the right to decide whether to continue participation or not throughout the thesis. The contact person has stated that the company wishes to remain anonymous, which has been fully realized and respected. The contact person and the other respondents were informed beforehand about recording the interviews. All collected data from Company X is only used for research purposes and nothing else.

Theoretical framework

In this chapter inventory management is presented in more detail, its area of use in SMEs and current research on the topic. Furthermore, theory about inventory turnover rate and account for how selected tools can be helpful to utilize in pursuit of inventory optimization according to current research is presented.

Inventory Management

Inventory management is the collective name on activities that organize the availability of items to customers (Wild, 2018). According to Zietzman & van Vuuren (2023) inventory management aims to resolve the imbalance between supply and demand, minimizing the risk of unavailability of SKUs, while simultaneously minimizing the costs associated with inventory management activities. The authors continue by revealing three definite objectives with inventory management being to maximize customer service levels, minimizing inventory on hand and minimizing operating costs. To optimize and balance these objectives companies need to determine which SKUs to procure, when to place procurement orders and decide the right volumes of SKUs to procure.

In general, companies need inventory to cover for customer demand but the amount of inventory usually varies from business to business. Keeping inventory contributes to increased customer service and is an important activity to optimize in businesses due to its close correlation to profitability and overall business performance (Jonsson & Mattsson, 2023). It can be beneficial to have inventory since it promotes smoother operations and increases flexibility. However, keeping inventory leads to capital tie-up in current assets and various costs arise as a result of keeping inventory which puts a strain on many businesses (Olhager, 2019). The availability of SKUs and the costs associated with holding is the constant balancing act of inventory management (Rushton et. al., 2022).

Muchaendepi et al. (2019) state that inventory management is critical to a company's financial performance due to the fact that inventory often is one of the most valuable assets on the balance sheet. The authors continue by emphasizing the importance of inventory management being well structured and replenishment rules for each item should be established to facilitate

decision making. Ideally, the right stock should be available in the right place, in the right quantity and at the best possible price. This would not only increase inventory management efficiency in itself, but also improve customer service, lowering administration costs, allowing companies to track items and their specific expiration dates, balancing availability and demand (Alam et al. 2023).

Benefits of holding inventory

The goal of a business is to efficiently meet the needs and desires of its customers (Jonsson & Mattsson, 2023). Keeping inventory contributes to a company's internal security as well as action capacity and while inventory is not inherently wrong, the size of it needs to be dimensioned based on established needs and criteria. The size of inventory varies depending on several factors such as product type, which market and customer demand (Lumsden, 2019). Rushton et al. (2022) and Möllering (2018) discuss that inventory build-up can be derived from economies of scale due to companies trying to reduce ordering costs while ordering larger amounts of products to a discounted price.

Olhager (2019) proposes several reasons for keeping inventory; in short, inventory exists as a result of variations in demand and lets businesses accommodate future changes in demand to increase profitability and performance. Demand uncertainties can have significant impacts on many aspects of a business, for example supply chains are not flexible enough and responses to demand fluctuations are delayed and therefore promote inventory build-up. Inventories are thus an aid to facilitate demand changes and prevent costly shortages. Anticipation of seasonal demands may also promote inventory build-up since companies would want to increase sales during a specific season or period of time (Möllering, 2019). Ultimately, balancing holding of inventory with customer orders is the decision process leading to more or less costs (Jonsson & Mattsson, 2023).

Costs and capital tie-up

A company's assets can be divided into fixed assets and current assets. Capital tie-up derives from investing in an asset which has a direct impact on a company's cash flow and its ability to make payments (Lumsden, 2019). Profitability is significantly affected by capital commitment such as investments in current assets (Olhager, 2019). Tying up capital in current

assets with expiration dates might be especially costly due to the risk of not being sold within the time frame. As a consequence products become obsolete and must be discarded at a high obsolescence cost (Jonsson & Mattson, 2023). Capital invested in current assets could have been invested elsewhere to generate income for the business in various ways, which would be more beneficial for the company (Rushton et al., 2022).

Ismail & Mulandi (2019) agree that minimizing ordering and holding costs reduces capital tie-up indirectly, maximizes generated revenues and contributes to company performance. Mehedi et al. (2019) explain that holding excess inventory for a long time generally generates unnecessary costs in form of holding costs, capital tie-up and obsolescence cost. When the demand is unusually high compared to the expected, it may result in a stockout. However when the demand is below expectations, additional holding costs can arise. Given sufficient stock, a stockout can be averted or equivalently by holding lower inventory one can avoid unnecessarily high holding costs (Moscalu et al., 2019).

An excessive amount of SKUs can tie large amounts of capital while simultaneously serving no other purpose than just being a delivery guarantee to customers (Lumsden, 2019). In cases where companies rent warehouse space from a 3PL, the total cost is often determined by the number of used pallet spaces. Furthermore the cost of pallet spaces is affected by requirements for cooling, lighting and heating functions for every spot. For every pallet space rented in a warehouse center the average inventory volume grows and results in increased inventory holding costs (Jonsson & Mattsson, 2023).

Inventory management in SMEs

Historically, decision-making abilities of SMEs regarding inventory management have relied on intuition combined with entrepreneurial experience which results in massive inventory levels and causes inventory management to remain a difficulty (Teerasoponpong & Sopadang, 2022). Paluch (2019) states that the basis of effective inventory management is to have reliable and accurate data on parameters affecting inventory. Alam et al. (2023) explain that many SMEs have difficulties balancing inventory supply and demand to run operations smoothly. Ideally, a company would want to have enough inventory to meet its customers' demands with no lost sales. Then again, because there is a noteworthy cost of carrying inventory, the company

does not preferably want to keep too much inventory on hand either. By adopting the concepts of inventory management tools, SMEs could create conditions to hold sufficient inventory that successfully would meet customer demand (Atnafu & Balda, 2018).

According to Rao et al. (2021) it's crucial for SMEs to lower debt and increase liquidity because free cash flow is a recurring constraint for them. Increased warehousing costs and more current inventory investments may be facts for SMEs who use 3PL-services and capital tie-up increase as a consequence due to impaired monitoring. SMEs who keep less inventory on hand promote skills in communication and productivity while it's often simultaneously achievable to lower capital tie-up without compromising delivery quality or speed (Muchaendepi et al., 2019). Thus, reducing capital tie-up often leads to a more thorough overview of company operations and frequently trying to lower inventory investments generally improves business performance (Jonsson & Mattsson, 2023).

More often than not SMEs incur unnecessarily high costs in order to provide superior customer service by stockpiling excess inventory. The reason behind this is normally poor planning skills, as well as failure of most SMEs to create a solid balance between efficiency and responsiveness in inventory management (Muchaendepi, 2019). By routinely overlooking inventory management, SMEs stockpile excessive inventory with cash tied to it, resulting in an inability to effectively control the flow of their inventory (Teerasoponpong & Sopadang, 2022). To survive and not least to thrive in today's competitive business environment, the authors suggest that SMEs should focus on utilizing an effective inventory approach which will allow SMEs to manage and minimize inventory and achieve a competitive advantage over other companies in the market. Rao et al. (2021) explain that since SMEs usually do not have an optimal capital structure they prefer not to take decisions that can cause any changes to the business model. In order to optimize inventory levels, SMEs need to acquire financial means which can be done in different ways and choosing the optimal way depends solely on the company, but freeing up capital tie-up is one way a company can acquire finances (Moscalu et al., 2019).

Atnafu & Balda (2018) claim that more consistent and efficient use of inventory management tools can boost competitiveness and business performance in SMEs. Utilization of tools include replenishment decisions, analyzing the costs associated with different inventory levels and

detailed sales forecasting. Even though inventory constitutes a significant portion of total capital, inventory control is one of the most neglected areas in SMEs (Alam et al., 2023). Akindipe (2014) studied negative impacts of inventory inaccuracy and found out that expected inventory levels often differ from actual inventory levels due to a lack of monitoring. Karim et al. (2018) discovered that SMEs usually fail to establish utilization of tools and decision techniques and rely too much on 3PL warehousing services that are beyond the company's control. Le, P. N. M. (2012) discusses influencing and determining factors when accessing data in SMEs and conclusively states that available data usually is very limited which forces his study to remain at an overview level rather than an in-depth analysis. According to Begg & Caira (2012) poor data management is inhibitory for businesses and the effort to gain data governance in SMEs often seems more complicated than the expected benefits.

Inventory turnover rate

Inventory turnover rate is a financial key figure used to measure how quickly a company sells and replaces its average inventory over a given time period (Lumsden, 2019), and is the most frequently used key figure for inventory management (Breivik, 2019). According to Saprudin et al. (2022) inventory turnover provides measurements about liquidity and how well a company converts inventory into revenue. The first step to calculate the inventory turnover rate is done by calculating the cost of goods sold (COGS).

$$COGS = Sales_{tot} \times Purchase\ price \qquad \textit{(Equation 1)}$$

It is calculated by dividing the cost of goods sold (COGS) for a period with average inventory for the same period (Aronsson et al. 2021).

$$ITR = \frac{COGS}{\underline{AI}} \qquad \textit{(Equation 2)}$$

Jonsson & Mattsson (2023) state that in general a high inventory turnover rate, rather than a low, is preferred as it is a powerful indicator that capital tie-up is reduced. Thus, the higher the inventory turnover rate, the lower capital tie up is. Recent empirical findings indicate that

inventory performance is positively related to financial performance measures such as, return on assets and return on sales. Islam et al. (2019) agree that inventory turnover is an accurate tool to measure inventory efficiency and performance in SMEs. This makes inventory turnover rate a popular indicator for evaluating profitability of a smaller firm (Breivik, 2019).

Lumsden (2019) explains that if products were not sensitive to expiration dates a lower turnover rate can be more safe. By calculating the inventory turnover rate, the cost of stocking different products can be reviewed and examined which brings clarity in how much capital can be saved (Rushton et al., 2022). Beside demand, competition and price, working with tools to manage inventory qualitatively increases the inventory turnover rate and ultimately the profitability (Muchaendepi, 2019; Akindipe et al., 2014).

ABC-analysis

The ABC-analysis is derived from Pareto's 80/20 principle, which explains that 80 percent of output is generated from 20 percent of the input (Segerstedt, 2018). Abyad (2021) claims that 80/20 can be applied to inventory management where 20 percent of products generate 80 percent of the revenue and by focusing on 20 percent of the products in the warehouse it makes it more manageable to optimize. Since the Pareto principle is rudimentary, it is further developed to create the ABC-analysis where the concept remains but additional categories are added. The A category represents 20 percent of the products and accounts for 80 percent of the revenue, the B category represents 30 percent of the products and accounts for 15 percent of the revenue and lastly the C category represents 50 percent of the product but only accounts for 5 percent of the revenue. By categorizing them this way and focusing on the A and B categories it is possible to target 50 percent of the products that make up for 95 percent of the revenue and it is therefore a good way to segment the different products (Rushton et al., 2022: Segerstedt, 2018).

However there are drawbacks with using an ABC-analysis, in that it often limits the criterias of application because it is categorized in order of annual sales values (Bilgin & Tanyılmaz, 2021). This can become even more difficult when products have intertwined relationships with each other, for example if a general C-product is often sold together with an A-product, a stock-out situation of that C-product would result in a non purchase of the A-product (Segerstedt, 2018). Therefore it is beneficial looking at a multiple criteria ABC-analysis proposed by Flores

& Whybark (1987), in which the three ABC-categories are instead displayed in a 3x3 matrix. Teplická & Čulkova (2020) carried out a study where they applied multi-criteria ABC-analysis to classify products and found out that it proved to be an adequate tool to solve inventory turnover issues. Bilgin & Tanyılmaz (2021) further developed this and explained that the individual criteria were categorized in order of importance rather than that they were equal. Choosing the criterias is industry specific, however the criterias should reflect the problem areas (Roda et al., 2014). A way to manage inventories with large amounts of SKUs proposed by Zietzman & van Vuuren (2023) is to look at the criterias of volume, value of product, customer, and timing. They go on to explain that there are a multitude of approaches available to reach the criterias, both judgemental and statistical.

Santana et al. (2017) argue that the ABC-analysis is most effective for long term decisions, making it particularly important to SMEs because the size of the company is irrelevant. Therefore the principles will assist the management team to make crucial decisions regarding the approach used in keeping inventory. What is interesting is that many companies with large inventories rely on a "rule of thumb" approach rather than using a quantitative ABC or multiple criteria ABC-analysis (Roda et al., 2014). There is also a slow adoption rate of ABC-analysis for SMEs due to them facing more urgent challenges compared to larger companies (Muchaendepi et al., 2019). It becomes problematic since the purpose of an ABC-analysis is to increase the efficiency of inventories that have a large amount of SKUs and can prove helpful for smaller companies (Abyad, 2021). Muchaendepi et al. (2019) also points to the long term benefits of using an ABC-analysis as a tool for inventory management since it enhances the administration of SKU:s. The authors go on to further explain that it is especially important in SME:s since building a good foundation of principles is crucial.

Economic Order Quantity

The Economic Order Quantity (EOQ) model is a classic model from the early 1900 and was developed by Ford W. Harris (Zeng et al., 2019). It is still considered relevant today, although it has been tweaked since it first came out and R. H. Wilson is credited for continued development of the formula. EOQ provides a calculation of the optimal quantity to order and how many occasions to order. Moreover the model has its uses when a company wants to reduce the costs associated with holding and ordering by finding an equilibrium. The model is

derived from balancing the holding costs and the ordering costs and it's therefore relevant to look at both costs separately to get a better understanding (Kumar, 2016).

The holding costs are associated with costs related to the product, meaning handling and storage costs (Durlinger, 2015). Kumar (2016) explains that the associated costs are often simplified so that every unit of inventory is assumed to be the same. However, this in turn means that the larger the inventory, the larger the cost associated with it is. Holding a large amount of inventory directly results in larger holding costs (Segerstedt, 2018). The second parameter making up the EOQ model is the ordering cost which is a cost related to placing an order (Durlinger, 2015). The ordering cost is constant which means that more frequent orders will result in a larger ordering cost (Kumar, 2016). Segerstedt (2018) clarifies it by saying that lower ordering cost entails larger quantities of product per order. Both the ordering- and holding cost are dependent on the quantity of product but they are affected oppositely by it, in order to lower the ordering cost the purchasing volume needs to increase this in turn contributes to higher holding costs. Finding the optimal order quantity to purchase is the goal of the EOQ model which is visualized in the intersection in the graph below (Kumar, 2016).

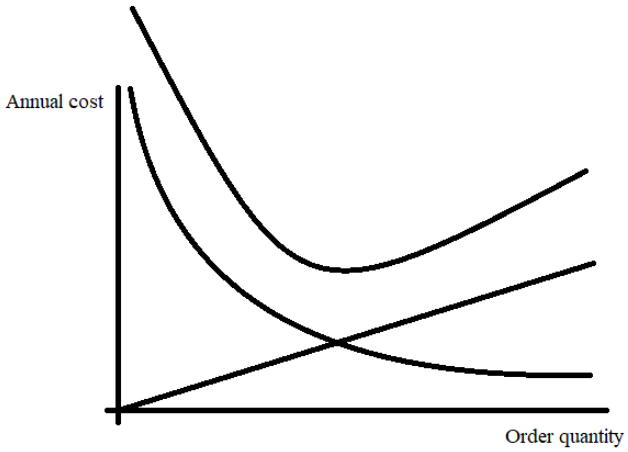

Figure 2: Graph of EOQ. Source: Authors

Prerequisites for the EOQ-formula is, known and stable demand, the ordering cost is known and independent of the quantity and the holding cost is known and constant (Olhager, 2019). The EOQ formula calculates the point where the ordering cost and the holding costs are equal and it is done by the following equation (Zeng et al., 2019).

$$EOQ = \sqrt{\frac{2PD}{UF}}$$ (*Equation 3*)

According to EOQ the average inventory is the optimal quantity divided by two illustrated by *Figure 3*.

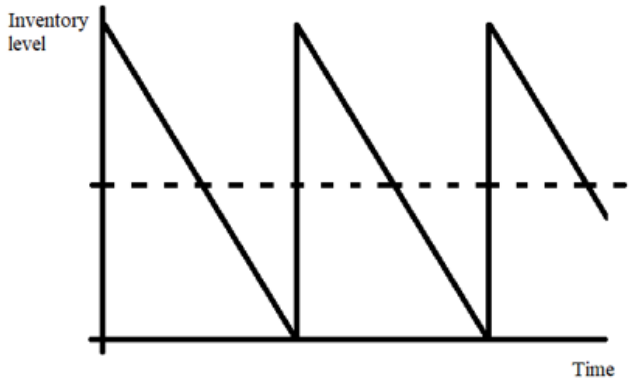

Figure 3: Saw tooth graph with average inventory. Source: Authors

It is calculated in depth using the *Equation 4*

$$AI_n = \frac{OI_n + CI_n}{2}$$ *(Equation 4)*

And when adding together the average inventory for all periods using *Equation 5* the mean average inventory is calculated.

$$\frac{1}{n}\sum_{i=1}^{n} AI_i = \underline{AI}$$ *(Equation 5)*

EOQ works best for products with normal and predictable demand. The optimal quantity for seasonal demands requires further adjustments (Amani & Okdinawati, 2023). Dania et al. (2019) also explain that the EOQ-model does not take quantity discount into account, but is

something that can alter the calculation of the optimal order quantity. Since EOQ has its prerequisites it should be treated as a starting point in the process of optimization and reducing costs (Paluch, 2019).

It is a suggested approach for SMEs when optimizing inventory management since it is simple to use and provides adequate guidelines for optimal order quantities (Muchaendepi et al., 2019). Saprudin et al. (2022) clarify in their article that EOQ plays a significant role in regards to inventory turnover. If EOQ is successfully applied to procurement, the inventory turnover becomes optimal. Furthermore EOQ can be helpful in other areas, such as supplier negotiation since it provides guidelines which order sizes that are interesting to the company (Dania et al., 2019). Also, EOQ can be used as a model to clarify and improve decision making in pursuit of minimizing costs and enhance inventory control (Teplická & Čulková, 2020; López-Yamunaqué et al., 2022).

Empirical data

In this chapter the collected data in the form of Company X is presented, the background and emergence of the given problem and how they currently are working with inventory management. Moreover, we present and explain received raw data and findings collected from expert commentators in inventory management. Paragraphs in italic style represent quotes said by the contact person from Company X and the two external respondents respectively.

Problem background

Company X has admitted that they are experiencing issues with their cash flow due to a lot of capital tie-up in inventory assets. Tying up capital has occurred over a long period of time at Company X but has not been a problem for them since it has cost nothing to borrow money from the bank. Last autumn (2022), when the interest rates increased significantly, interest payments became too heavy to handle compared to before. Inventory turnover rate is a critical performance indicator for the company and slow-moving items cause detrimental impacts on the company's performance. Since a lot of investments have been done in inventory assets, a small amount of capital is available for payments and other purposes. To account for a lack of cash flow Company X applies for loans at the bank. As a consequence they need to pay more interest which admittedly is an unnecessary expense. As interest rates rose in autumn 2022 and Company X felt the lack of cash flow, they tried to negotiate and adjust credit times with their customers as a quick response to increased interest. *"Low inventory turnover rate is undoubtedly the reason for the high capital tie-up. Adjusting payment times is a much quicker fix than optimizing the inventory turnover rate though and we could not just wait for the inventory turnover rate to become better."*

Company X admittedly has too extensive credit times from customers and too short credit times to suppliers, which they feel is a contributing factor to the problem. The best solution would be a combination between an optimized inventory turnover rate along with lowered total costs. *"We have become better in how we solve problems. We solve arising problems more systematically but still have a lot of work to do. We need to stop guessing and solve the problem in the same way for all products so everything is right going forward."*

Sales and procurement are two dependent variables that impact the inventory turnover rate. The company can enhance the inventory turnover rate, which is desirable, by either selling more items or purchasing less. By purchasing large quantities less frequently the inventory turnover rate decreases, while purchasing fewer items more frequently generates a higher inventory turnover rate. The logic behind this is that purchasing fewer items more regularly reduces the average inventory level from period to period and increases the inventory turnover rate.

Current inventory management in Company X

Company X handles inventory management and including activities to a wide extent manually. Before an order is purchased, they go through the entire assortment of every supplier thoroughly, making sure they don't miss procurement of any articles and thus be forced to make a new purchase of missed articles directly afterwards. They calculate when to place an order manually for every product and from those calculations an order proposal to their supplier is created. They use no proper demand forecasting method to determine possible future demands, but which product quantities to order are determined based on intuition and simple calculations every purchasing occasion. They look at historical sales data the last twelve months and based on the average sales each month, they make their own assessment and estimate a quantity with small regards to inventory holding costs and place the order. *"Since everything is done manually with mental math calculations and not in accordance with specific guidelines it becomes hard to describe the exact calculation process for how many procurement occasions and order quantities. Other parameters we took into account when determining order quantities were free-shipping limits, minimum order quantity and product discounts."*

Product segmentation is only performed to monitor high-revenue articles carefully since ignorance causes devastating consequences but no ABC-analysis is utilized. *"Our next step towards more proper inventory management and less capital tie-up is to work harder and more accurately with inventory turnover rate. In the past we have cared more about growth but now we want to focus more on profitability which makes inventory turnover a very important key figure. We have a lot of work to do regarding actively trimming down obsolete, slow-moving and outdated products in order to increase inventory turnover and reduce capital tie-up."*

Raw data

Company X provided their company data for a six-month period between the middle of August to the middle of February. The data included their purchases, sales, inventory holding costs, initial inventory balances and purchasing prices for all SKUs in order to perform calculations on our toolbox**.** Together with the contact person from Company X a reasonable estimate on the ordering cost was concluded, and the estimate arrived at 200 kr. Even though it is an assumption, it will still provide a detailed illustration on how the order quantity can be improved. Inventory holding cost is 825 kr for dry products per pallet the entire period and 931 kr for frozen products per pallet the entire period.

Expert commentators - their perspective on inventory management

In this part empirical findings collected from OneMed and Optilon through semi-structured interviews are presented and interpreted as expert commentators in the field. They give their perspective on inventory management to increase the comprehensiveness of the topic in the thesis.

Presentation of OneMed

OneMed Sverige is a subsidiary of Asker Healthcare Group which operates in 14 different countries around Europe and has around 2 000 employees. Asker Healthcare Group specializes in healthcare and constantly purchases companies that can fill the roles that currently do not exist in the company. However, OneMed Sweden is a large wholesaler of medical supplies and operates in Sweden with around 700 employees. The company was founded in 2008 and in 2021 they realized a turnover of roughly 4 billion Swedish crowns. They have 40 000 different products where 25% of them are SKUs stored in warehouses, whereas the rest are products that are made to order. In their warehouse in Gothenburg are roughly 18 000 items picked every day.

The respondent from OneMed is Annica Miller and she has been with the company since 2010. Annica has worked exclusively with supply chain planning since she started at OneMed. Today

Annica is the team leader for two groups of people, one of them working with supply chain service and the other with supply chain planning. Other daily tasks involve constantly trying to improve OneMed's customer forum called Planning Excellence and also ensure that her teams reach their goals.

Since the healthcare in Sweden is largely run by the government, OneMed needs to work closely with them and procure what they request at the agreed price. *"Since the producers of certain equipment historically have gone directly to the hospitals, they are dependent on that specific machine. It is therefore our job to purchase from that producer in order to provide to the hospital."* Since OneMed is a hospital supplier there are unique factors that need to be taken into consideration. Hospitals require the items in time, meaning that OneMed's most important key figure is their service level. They have requirements from the customer to achieve 98,5% service level and that is negotiated in the procurement agreement.

Inventory management in OneMed

Having full control over their data is enabling OneMed to work efficiently with inventory management. OneMed have different service levels depending on the product and the ABC-analysis is used to determine the correct service level. *"An A article 99,5%, B article somewhere around 98% and a C article 95%."*. This is a generalization, when segmenting OneMed is working with a multiple criteria ABC-analysis that has three categories. The ABC segmentation is dependent on the COGS, the XYZ segmentation is dependent on different levels of demand and lastly FMR segmentation which looks at the picking frequency.

OneMed is about to start working more consistently with inventory turnover rate and it is something that is in discussion at the moment. They will strive to have an inventory turnover rate of 10 turns/year for the whole warehouse. Annica was asked if there would be different prioritizations between the segments and she explained, *"Absolutely, and that is one of the points of discussion right now. How do we segment this? How do we find the right rate? What are we supposed to follow up on?"* A follow up question was asked if it would be the right idea to focus on the AXF segment. She explained that is the best way to approach a problem like this and focusing the resources to where it can be most beneficial. The reason why OneMed has not started to work with inventory turnover rate yet is due to the fact that they still are

experiencing the after effects of Covid-19. OneMed is currently not factoring in cost in the decision making of purchasing, which also is an effect of Covid-19 and they are only focusing on achieving their service level requirements but mainly have not been working with it. However, the respondent explained that in their new system they are able to look at EOQ and it is something that they will be working with going forward. Lastly the respondent was asked about the importance of data and she said *"Having access to good data is essential to any organization, regardless of size and sector. The use of Excel can be a good start for a SME as long as they have control over their data."*

Presentation of Optilon

Optilon is an inventory optimization software provider whose business model consists of making Nordic companies the most competitive in the world by offering tools and guidance within supply chain and planning. The company was founded in 2005, has 60 employees and is based in Sweden but they also have offices in Denmark and Finland. Total sales 2022 amounted to 150 million Swedish crowns. *"Companies in the Nordics are very vulnerable both from the fact that there are a lot of imports, a lot of exports and high wages. Therefore, it is important to use your resources as smartly as possible."*

The respondent's name is Anders Remnebäck and he has worked at the company from the start in 2005. His current position at the company is head of application board and new technology. In more detail his day to day work involves leading a group of people who specializes in finding and implementing new technology to Optilon's technology portfolio. He is product oriented and tries to stay updated on the market and discover new mathematical solutions to traditional logistics problems.

Optilon is a value adding reseller of a number of planning software solutions which they market, sell, establish contracts, implement and support the customers. They work actively with large companies like Ikea, Stora Enso, Carlsberg and Epirock etc. The software is based on three essential modules which are, firstly forecasting of demand and supply, secondly how to dimension the safety stock based on preferred service level and lastly replenishment strategies of inventory. Optilon needs data regarding articles and price, lead time and lead time variability, supplier information, minimum order quantity and incremental quantity to be able

to integrate their software and give support to their customer in terms of inventory optimization. If customers don't have all necessary data available when first integrating the software, qualified and exaggerated assumptions are needed to be on the safe side and over time the customer needs to improve data governance and management.

Options perspective on inventory management in SMEs

Anders claims that keeping track of data is essential for every business regardless of its size. In his opinion, SMEs usually run local solutions and calculations in Excel because a proper database costs too much money to invest in. Moreover, SMEs tend to struggle with keeping track of data and managing it which in many cases leads to their downfall. There are no shortcuts to the perfect inventory management and if SMEs don't understand that and are serious about improving the quality and availability of data over time no software system will ever be able to help. SMEs need to realize that investments of money and time are required in order to gain control over inventory and over time a supply chain intelligence database, where data is stored and can be easily extracted, needs to be established. ”*Companies shouldn't focus too much on benchmarking in decision-making, rather having control over their own data and own circumstances should constitute the foundation of every decision. If inventory balances are wrong and can't be trusted, they are always wrong and there is no software system in the world that will be able to calculate which quantity to order. SMEs have to be serious and understand that it will cost money and time to acquire and have good data."*

In Optilon's view, SMEs tend to lack an understanding of simple concepts such as ABC and safety stock. *"If you have a lot of articles, you can't sit and think about what service level each article should have. Then you need to segment, and as a SME you usually do that with the help of a classic ABC calculation, which you can develop into a larger matrix if necessary."* Usually, if SMEs have products with high and stable demand, they tend to overperform on these products. Intermediate or slow moving products tend to underperform and it is therefore difficult to set the safety stock in such a way that enables them to understand the entire variability in demand. According to Anders inventory turnover rate is an effective key figure to measure how fast an inventory is converted to money. *"People need to understand that availability, capital tie-up and inventory turnover rate are connected and are controlled by each other."* As far as seasonal products are concerned, Optilon works with something they call sales windows, which means that a product has high demand between two dates and the

rest of the year the sales are very close to zero. "*A product like this cannot be used with a traditional replenishment formula like EOQ because the product is counted as a slow-mover."*

Analysis & Discussion

In this chapter we account for and explain our optimization calculations. We discuss empirical data and calculations based on current research. We present one example where the applied toolbox works, and one where it does not work. A sensitivity analysis is presented. In the end of the chapter we justify our toolbox based on current research and present a compilation of the total reduction in capital tie-up and total costs.

Teerasoponpong & Sopadang (2021) state that SMEs historically have relied on intuition in their decision making processes regarding inventory management which in combination with inexperience elevates inventory levels and causes inventory management to remain a difficulty. Anders at Optilon states that having control over your data should constitute the foundation of every decision regarding inventory management, rather than decision making on intuition. For Company X not having a well developed procurement strategy and also determining purchasing quantities based on intuition has undeniably resulted in an inability to control their flow of inventory efficiently. Moreover, this has entailed excess inventory and in extension capital tie-up in Company X which has been supported both empirically and through data examination. Alam et al. (2023) explain that even though inventory constitutes a significant portion of total capital, inventory control is one of the most neglected areas in SMEs which the empirical findings for Company X indicate. Hence, that is not an unexpected pattern and is in line with Akindipe's (2014) discovery about consequences of inventory inaccuracy in SMEs where inventory levels often differ from actual levels. Neglected inventory control is not an issue in OneMed due to the nature of larger companies and them constantly trying to improve the availability of data and data governance. Since Company X is a SME, it reflects on Akindipe's (2014) study result and according to Paluch (2019) the basis of effective inventory management is reliable and accurate data. In accordance with the statement from Anders, there are no shortcuts to proper inventory management. SMEs need to be serious about improving availability and quality of data which require investments in both time and capital.

To optimize inventory levels in Company X, an inventory management toolbox is compiled and utilized. Islam et al. (2019) and Breivik (2019) claim that the inventory turnover rate is an accurate key figure to measure efficiency and performance in SMEs and according to Anders a measure of how fast an inventory is converted to money. To make progress in calculating the

inventory turnover rate, the received data had to be sorted and segmented since it enhances administration of SKUs according to Muchaendepi et al. (2019).

According to theory there is a slow adoption rate of ABC-analysis in SMEs and as Anders stated, SMEs tend to lack an understanding of simple concepts like ABC compared to larger companies. As stated by Muchaendepi et al. (2019) SMEs tend to focus on more urgent matters before being able to implement and utilize an ABC-analysis. This statement is in line with the empirical findings of Company X regarding ABC-analysis, which according to Abyad (2021) can be problematic since an ABC-analysis is essential, especially for companies with large inventories. Reaping the benefits of an ABC-analysis as a tool for inventory management enhances various aspects of the business and should therefore be implemented at an early stage to generate long term benefits (Muchaendepi et al., 2019).

Company X has not established an ABC-analysis to segment products into groups advantageously. Instead relying on the "rule of thumb" approach, only monitoring high-revenue articles on a basic level, which is common in SMEs with large inventories (Roda et al., 2014). The purchase data, sales data and the purchase price data were first used to sort the SKUs. Additionally Roda et al. (2014) claim that the criterias of the ABC-analysis need to accurately reflect the problem areas. Since Company X suffers from capital tie-up, examining and calculating the COGS is in accordance with Zietzman & van Vuuren's (2023) proposition about inventory value and volume as the main criterias of the ABC-analysis. Furthermore, as explained by Annica, OneMed's first parameter when segmenting is COGS, thus emphasizing the importance of examining it.

$$COGS = Sales_{tot} \times Purchase\ price \qquad \textit{(Equation 1)}$$

Also taking into account the Pareto principle as suggested by Segerstedt (2018), the SKUs were narrowed down to the 20 in volume and inventory value biggest SKUs which should reflect the Pareto principle accordingly. Santana et al. (2017) claim that company size does not matter, since the Pareto principle will assist the management of both larger and smaller companies to take crucial product decisions more efficiently. The 20 largest selected SKUs accumulated to 25% of the company's total sales and are distributed as seen in *Figure 4*.

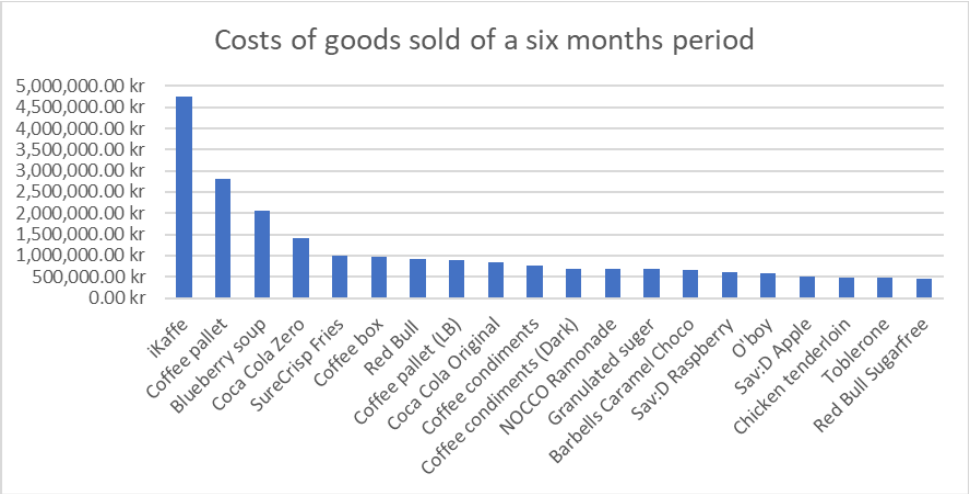

Figure 4: Cost of goods sold for 20 SKUs

Teplická & Čulkova (2020) proved in their study that ABC-analysis is an adequate and efficient tool to solve inventory turnover issues. Moreover, Bilgin & Tanyılmaz (2021) claim that a multiple criteria ABC-analysis can further segment even more important products, which is why the ABC-analysis creates the foundation of this thesis, which is evident in OneMed. Lumsden (2019) claims that inventory turnover rate is a powerful key figure to optimize when there is a need to reduce capital tie-up which is in line with Anders statement about inventory turnover rate being closely connected to capital tie-up. In order to find Company X's inventory turnover rate on their 20 most valuable products, an average inventory value derived from all the periods first had to be calculated and established for every product respectively. This was done by taking the opening inventory balance from period *n* and adding it to the closing inventory balance of the same period *n* and then dividing it by two (Aronsson et al., 2021).

$$AI_n = \frac{OI_n + CI_n}{2} \qquad \textit{(Equation 4)}$$

A total average inventory value was established through adding every period's average inventory value and dividing it by total amount of periods.

$$\frac{1}{n}\sum_{i=1}^{n} AI_i = \underline{AI} \qquad \textit{(Equation 5)}$$

In line with Rushton et al. (2022), calculating the inventory turnover rate can reveal hidden costs associated with different products and brings clarity in how much capital Company X can save. Inventory turnover rate is calculated by taking the cost of goods sold and dividing it with average inventory value, which results in inventory turnover rate for all the periods (Aronsson et al., 2021).

$$ITR = \frac{COGS}{\underline{AS}} \qquad \textit{(Equation 2)}$$

Using the above formula we calculated the inventory turnover rate for each product and this is presented in *Figure 5*.

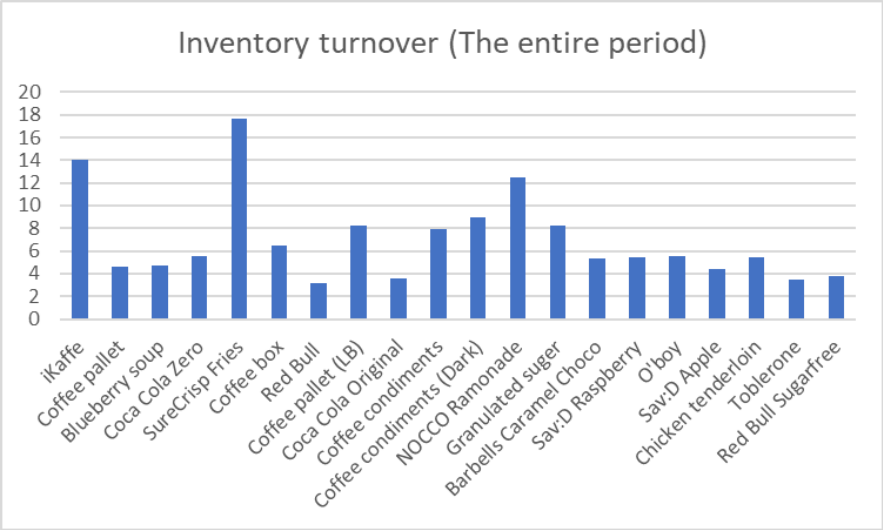

Figure 5: Inventory turnover rate for 20 SKUs

According to Jonsson & Mattsson (2023) a high inventory turnover rate is preferred and the higher the inventory turnover rate, the less capital tie-up occurs. According to Olhager (2019) it's suitable to use EOQ for products with a relatively stable demand, hence it was important to segment them under this parameter as well, which is in line with Bilgin & Tanyılmaz (2021). In order to optimize the inventory turnover rate we had to go back and look at historical purchasing- and sales data including amount of orders and quantity each order. In accordance with Muchaendepi et al. (2019) suggestion that EOQ is a good procurement formula for SMEs to apply when you want to optimize ordering occasions and quantities and also with Saprudin

et al. (2022) who explain that EOQ optimizes the inventory turnover rate. The EOQ formula is used to calculate and distribute quantities and costs optimally and present the differences.

In the tables below we show an example of the product Coca Cola. In the first table the demanded quantity per period and the amount of purchases per period is presented. Furthermore a mean value and a standard deviation for the demand is displayed to illustrate the relatively stable demand.

Coca Cola

Opening inventory balance = 1947

Period	Demand (units)	Amount of purchases
1	1 767	1
2	1 428	1
3	1 441	1
4	1 275	1
5	1 049	12
6	1 012	0
Mean value	1 329	SUM: 16
Standard deviation	257	
Inventory turnover	3,6	

Table 2: Coca Cola demand visualization

By finding an optimal order quantity we have used *Equation 3* (Zeng et al., 2019).

$$EOQ = \sqrt{\frac{2PD}{UF}} \qquad \text{(}\textit{Equation 3}\text{)}$$

EOQ tells us that the optimal quantity to order for this product is 634 units per order and the optimal amount of orders is 13 which is calculated by dividing total demand by the optimal order quantity. By following the same calculations (*Equation 2*) we get an increased value for inventory turnover rate. Since the average inventory is lowered after EOQ optimization we see a significant reduction in both capital tie-up and total costs.

Period	Purchases before EOQ (units)	Purchases after EOQ 634/order	Difference
Amount of purchases	16	13	
Inventory turnover total	3,6	6,3	
Average capital tie up	229 292 kr	33 034 kr	86%
Total holding cost	17 454 kr	2 515 kr	86%
Total order cost	3 200 kr	2 600 kr	19%
Total cost	20 654 kr	5 115 kr	75%

Table 3: Coca Cola key figures

By applying a sensitivity analysis, the thesis is able to examine how the output of the EOQ formula moves when the input assumption for the ordering cost is changed (Jacinth Jennifer & Saravanan, 2021). In the table below we show how the output changes when the input is both increased and reduced by 5, 10 and 15 % respectively.

Coca Cola

Assumptions	Quantity interval	Capital tie-up
EOQ	634	33 034 kr
EOQ +/- 5% Ordering cost	650/618	33 850 kr/32 198 kr
EOQ +/- 10% Ordering cost	665/602	34 647 kr/31 339 kr
EOQ +/- 15% Ordering cost	680/585	35 426 kr/30 456 kr

Table 4: Sensitivity analysis Coca Cola

To observe whether the assumption on ordering cost is sensitive or not in regards to the total output, the table above illustrates the difference in quantity and in capital tie-up. An adjustment of 15% in the ordering cost assumption generates roughly 7% difference in capital tie-up.

Next we showcase an example where EOQ is not adequate in the table below. We have followed the exact same calculation pattern as above.

Christmas soda
Opening inventory level = 0

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	0 0 2 140 79 0 0	0 1 1 1 1 0
Mean value	370	
Standard deviation	792	
Inventory turnover	49,4	

Table 5: Christmas soda demand visualization

In this case the standard deviation becomes a lot higher than the mean value, which indicates a large amount of variation in the data.

Period	Before EOQ	After EOQ	Difference
Amount of purchases	4	6	
Inventory turnover total	46,6	2,8	
Average capital tie up	2 300 kr	9 647 kr	-320%
Total holding cost	265 kr	1 112 kr	-320%
Total order cost	800 kr	1 112 kr	-39%
Total cost	1 065 kr	2 224 kr	-109%

Table 6: Christmas soda key figures

This shows that EOQ works best for products with stable demand and will not give a trustworthy result in the case of christmas soda. Due to the seasonal nature of the product it needs further calculation (Amani & Okdinawati, 2023). This is also stated by Anders, who means that seasonal products require a different formula. In the table below we present total capital tie-up and total costs of their 20 most important products in total for all six periods before and after optimization to illustrate the differences.

Costs (kr)	Before optimization	After optimization	Difference	Difference in %
Total ordering cost	51 800	39 400	12 400	24%
Total holding cost	144 379	39 319	105 060	73%
Total cost	196 179	78 719	117 460	60%
Total capital tie-up	3 581 482	1 101 428	2 480 053	69%

Table 7: Before and after calculations

By limiting our focus to the 20 most important products, improving replenishment quantities and optimizing the inventory turnover rate, Company X will be able to lower total capital tie-up and total costs, ultimately increasing their performance. Atnafu & Balda (2018) claim that more consistent and efficient use of inventory management tools can boost business performance in SMEs which is showcased in the numbers above. This makes EOQ a great tool for any SME to implement and also to work as a starting point in pursuit of inventory optimization (Paluch, 2019).

Conclusion

In this chapter we present the results of the thesis, more particularly we answer the research question in a structured manner. Furthermore we give our own reflections on the workflow and the research process of the thesis. Conclusively recommendations for future research are discussed.

Research Question: - *How effective is the toolbox in helping SMEs reduce capital tie-up, total costs and optimize inventory levels to enable future development?*

Stated by Zietzman & van Vuuren (2023) the lack of effective inventory management in SMEs, creates a need for a toolbox to be implemented. To evaluate the effectiveness of the toolbox we look at *Table 7* in the analysis chapter. The reduction in capital tie-up and total costs argue that there is a clear potential to be extracted from the toolbox. Due to the high inventory values of Company X, a multi-criteria ABC-analysis was applied which generated the 20 most important products and optimizing them provided great value. Currently Company X is inefficiently tying up capital and operates with higher costs than necessary. By not relying on intuition and applying a more accurate replenishment strategy as EOQ, Company X will be able to both reduce capital tie-up and total costs, which will enhance and optimize business performance.

The result represents an effectiveness of the toolbox yet the difference in value can not be considered as entirely realistic nor can the increase of the inventory turnover rate be interpreted as wholly reasonable. Improvements to the thesis could be made if necessary data was available and would allow examination of other critical parameters which are required in order to calculate and provide further accuracy to the result. An assumption had to be made regarding ordering cost, however the sensitivity analysis shows that the result is independent of that variable and clearly demonstrates that the assumed ordering cost arguably is not affecting the output. With more available data the thesis would be able to perform more detailed and accurate calculations in pursuit of inventory optimization.

This thesis has created a foundation of a toolbox and should be seen as a starting point to enable further development. Furthermore the foundation of the toolbox would need to be evolved and

supplemented with more specialized tools in order to achieve accurate and resilient optimization in the future.

This thesis presents significant improvements in capital tie-up and total costs which implies that the toolbox currently is sufficient for Company X to implement into their business. Learning how to utilize the ABC-analysis and EOQ lets Company X gain a proven and considerable upside, which we think is a good starting point for any SMEs. In accordance with Atnafu & Balda (2018), by adopting the concepts of inventory management tools, Company X can enable conditions to hold sufficient inventory and still meet customer demand successfully.

Reflections

Well structured and managed data is a decisive factor in order to create and establish successful research results for a matter like this. The thesis did its best to give suggestions for inventory decisions in pursuit of inventory optimization, enabling future development. More available data would enable analysis of other critical parameters, more particularly safety stock and service level which would directly have contributed successfully to more accurate and substantial results.

Future research & recommendations

This thesis only considers products with stable and known demand and moreover the thesis takes no regard to quantity discounts which would be interesting to examine in future research. To further make the toolbox more developed, parameters such as reorder point, safety stock and service level would be highly interesting to include in the analysis. By doing this Company X can gain even more control of their inventory balance and decision making.

What has been evident during this thesis is that a lack of available data and poor data management in SMEs is impairing the possibility to examine and improve inventory management in full. Research containing suggestions aiming to improve available data and facilitate data management in SMEs would be helpful in order to increase business performance and further promote future development. This area of research would be interesting to explore in order to develop the toolbox further.

A general lack of research regarding inventory management in SMEs located in Europe was experienced during the literature review. This is undoubtedly an area which needs more attention in order to provide research with deeper knowledge to allow future European SMEs to improve.

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Appendix

Collection of tables for all 20 SKUs

iKaffe

Period	Demand (units)	Amount of purchases
1	2 491	1
2	15 089	8
3	14 581	5
4	6 035	6
5	4 941	4
6	13 500	6
SUM	56 637	30
Mean value	9 440	
Standard deviation	5 082	
Inventory turnover	14,1	

Period	Purchases before EOQ (units)	Purchases after EOQ 1815/order	Difference
Amount of purchases	30	31	
Inventory turnover total	14,1	62,4	
Average capital tie up	337 369 kr	76 055 kr	77%
Total holding cost	27 678 kr	6 240 kr	77%
Total order cost	6 000 kr	6 200 kr	-3%
Total cost	33 678 kr	12 440 kr	63%

Coffee pallet

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	4 19 17 6 20 12	3 4 6 3 2 2
Mean value	13	SUM: 20
Standard deviation	6	
Inventory turnover	4,6	

Period	Purchases before EOQ (units)	Purchases after EOQ 6/order	Difference
Amount of purchases	20	13	
Inventory turnover total	4,6	25,4	
Average capital tie up	605 394 kr	110 590 kr	82%
Total holding cost	13 886 kr	2 537 kr	82%
Total order cost	4 000 kr	2 600 kr	35%
Total cost	17 886 kr	5 137 kr	71%

Blueberry soup

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	240 7 261 217 270 417	1 1 2 2 2 2
Mean value	235	SUM: 10
Standard deviation	121	
Inventory turnover	4,7	

Period	Purchases before EOQ (units)	Purchases after EOQ 176/order	Difference
Amount of purchases	10	8	
Inventory turnover total	4,7	16,1	
Average capital tie up	435 205 kr	127 995 kr	71%
Total holding cost	5 470 kr	1 609 kr	71%
Total order cost	2 000 kr	1 600 kr	20%
Total cost	7 470 kr	3 209 kr	57%

Coca Cola Zero

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	2 753 2 288 2 565 2 355 1 472 2 026	1 1 2 1 3 0
Mean value	2 243	SUM: 8
Standard deviation	412	
Inventory turnover	5,5	

Period	Purchases before EOQ (units)	Purchases after EOQ 824/order	Difference
Amount of purchases	8	16	
Inventory turnover total	5,5	32,7	
Average capital tie up	253 961 kr	42 923 kr	83%
Total holding cost	19 332 kr	3 267 kr	83%
Total order cost	1 600 kr	3 200 kr	-100%
Total cost	20 932 kr	6 467 kr	69%

SureCrisp Fries

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	1 000 992 1 085 976 702 1 012	3 1 7 1 2 3
Mean value	961	SUM: 17
Standard deviation	121	
Inventory turnover	17,6	

Period	Purchases before EOQ (units)	Purchases after EOQ 422/order	Difference
Amount of purchases	17	14	
Inventory turnover total	17,6	27,3	
Average capital tie up	56 099 kr	36 244 kr	35%
Total holding cost	4226 kr	2 730 kr	35%
Total order cost	3 400 kr	2 800 kr	18%
Total cost	7 626 kr	5 530 kr	27%

Coffee box

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	266 272 317 603 184 281	0 3 2 4 0 3
Mean value	321	SUM: 12
Standard deviation	132	
Inventory turnover	6,5	

Period	Purchases before EOQ (units)	Purchases after EOQ 259/order	Difference
Amount of purchases	12	7	
Inventory turnover total	6,5	14,8	
Average capital tie up	148 060 kr	64 713 kr	56%
Total holding cost	3 396 kr	1 484 kr	56%
Total order cost	2 400 kr	1 400 kr	42%
Total cost	5 796 kr	2 884 kr	50%

Red Bull

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	593 668 866 818 673 723	3 2 2 2 1 3
Mean value	724	SUM: 13
Standard deviation	93	
Inventory turnover	3,1	

Period	Purchases before EOQ (units)	Purchases after EOQ 450/order	Difference
Amount of purchases	13	10	
Inventory turnover total	3,1	19,3	
Average capital tie up	294 359 kr	47 704 kr	84%
Total holding cost	11 917 kr	1 931 kr	84%
Total order cost	2 600 kr	2 000 kr	23%
Total cost	14 517 kr	3 931 kr	73%

Coffee pallet (LB)

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	2 1 5 1 1 5	3 0 3 1 0 1
Mean value	3	SUM: 8
Standard deviation	2	
Inventory turnover	8,2	

Period	Purchases before EOQ (units)	Purchases after EOQ 3/order	Difference
Amount of purchases	8	6	
Inventory turnover total	8,2	11,1	
Average capital tie up	107 910 kr	79 372 kr	26%
Total holding cost	1 512 kr	1 112 kr	26%
Total order cost	1 600 kr	1 200 kr	25%
Total cost	3 112 kr	2 312 kr	26%

Coffee condiments

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	180 145 188 147 104 197	2 3 1 5 2 4
Mean value	160	SUM: 17
Standard deviation	32	
Inventory turnover	8,0	

Period	Purchases before EOQ (units)	Purchases after EOQ 130/order	Difference
Amount of purchases	17	7	
Inventory turnover total	8,0	14,8	
Average capital tie up	96 835 kr	51 971 kr	46%
Total holding cost	2 765 kr	1 484 kr	46%
Total order cost	3 400 kr	1 400 kr	59%
Total cost	6 165 kr	2 884 kr	53%

Coffee condiments (Dark)

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	133 150 201 137 77 170	2 2 1 3 2 2
Mean value	145	SUM: 12
Standard deviation	38	
Inventory turnover	9,0	

Period	Purchases before EOQ (units)	Purchases after EOQ 123/order	Difference
Amount of purchases	12	7	
Inventory turnover total	9,0	14,1	
Average capital tie up	77 709 kr	49 392 kr	36%
Total holding cost	2 219 kr	1 410 kr	36%
Total order cost	2 400 kr	1 400 kr	42%
Total cost	4 619 kr	2 810 kr	39%

NOCCO Ramonade

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	443 412 332 289 264 483	3 3 3 2 3 3
Mean value	371	SUM: 17
Standard deviation	81	
Inventory turnover	12,5	

Period	Purchases before EOQ (units)	Purchases after EOQ 275/order	
Amount of purchases	17	8	
Inventory turnover total	12,5	16,2	
Average capital tie up	54 480 kr	41 998 kr	23%
Total holding cost	2 100 kr	1 619 kr	23%
Total order cost	3 400 kr	1 600 kr	53%
Total cost	5 500 kr	3 219 kr	41%

Granulated sugar

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	512 149 763 259 590 403	3 2 1 2 1 4
Mean value	446	SUM: 13
Standard deviation	204	
Inventory turnover	8,3	

Period	Purchases before EOQ (units)	Purchases after EOQ 204/order	Difference
Amount of purchases	13	13	
Inventory turnover total	8,3	26,3	
Average capital tie up	81 766 kr	25 706 kr	69%
Total holding cost	8 354 kr	2 626 kr	69%
Total order cost	2 600 kr	2 600 kr	0%
Total cost	10 954 kr	5 226 kr	52%

Barebells Caramel Choco

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	684 396 383 526 400 1 034	1 2 1 0 0 4
Mean value	571	SUM: 8
Standard deviation	233	
Inventory turnover	5,3	

Period	Purchases before EOQ (units)	Purchases after EOQ 706/order	Difference
Amount of purchases	8	5	
Inventory turnover total	5,3	9,7	
Average capital tie up	122 448 kr	67 356 kr	45%
Total holding cost	1 764 kr	970 kr	45%
Total order cost	1 600 kr	1 000 kr	38%
Total cost	3 364 kr	1 970 kr	41%

SAV:D Raspberry

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	341 361 308 296 319 386	2 2 1 1 2 1
Mean value	335	SUM: 9
Standard deviation	31	
Inventory turnover	5,5	

Period	Purchases before EOQ (units)	Purchases after EOQ 261/order	Difference
Amount of purchases	9	8	
Inventory turnover total	5,5	15,4	
Average capital tie up	111 283 kr	39 566 kr	64%
Total holding cost	4 330 kr	1 539 kr	64%
Total order cost	1 800 kr	1 600 kr	11%
Total cost	6 130 kr	3 139 kr	49%

O'boy

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	144 418 249 462 320 436	1 2 3 1 3 0
Mean value	338	SUM: 10
Standard deviation	113	
Inventory turnover	5,6	

Period	Purchases before EOQ (units)	Purchases after EOQ 281/order	Difference
Amount of purchases	10	7	
Inventory turnover total	5,6	14,5	
Average capital tie up	105 349 kr	40 571 kr	62%
Total holding cost	3 756 kr	1 446 kr	62%
Total order cost	2 000 kr	1 400 kr	30%
Total cost	5 756 kr	2 846 kr	51%

SAV:D Apple

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	280 304 237 254 226 390	1 2 2 1 3 2
Mean value	282	SUM: 11
Standard deviation	55	
Inventory turnover	4,4	

Period	Purchases before EOQ (units)	Purchases after EOQ 240/order	Difference
Amount of purchases	11	7	
Inventory turnover total	4,4	14,1	
Average capital tie up	115 473 kr	36 282 kr	69%
Total holding cost	4 493 kr	1 412 kr	69%
Total order cost	2 200 kr	1 400 kr	36%
Total cost	6 693 kr	2 812 kr	58%

Chicken tenderloin

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	202 127 164 187 196 270	2 2 1 1 1 3
Mean value	191	SUM: 10
Standard deviation	43	
Inventory turnover	5,5	

Period	Purchases before EOQ (units)	Purchases after EOQ 231/order	Difference
Amount of purchases	10	5	
Inventory turnover total	5,5	9,9	
Average capital tie up	89 038 kr	49 009 kr	45%
Total holding cost	1 805 kr	994 kr	45%
Total order cost	2 000 kr	1 000 kr	50%
Total cost	3 805 kr	1 994 kr	48%

Toblerone

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	130 293 234 120 352 184	1 1 0 2 1 3
Mean value	219	SUM: 8
Standard deviation	84	
Inventory turnover	3,5	

Period	Purchases before EOQ (units)	Purchases after EOQ 257/order	Difference
Amount of purchases	8	5	
Inventory turnover total	3,5	10,2	
Average capital tie up	137 343 kr	47 049 kr	66%
Total holding cost	2 979 kr	1 021 kr	66%
Total order cost	1 600 kr	1 000 kr	38%
Total cost	4 579 kr	2 021 kr	56%

Red Bull Sugarfree

Period	Demand (units)	Amount of purchases
1 2 3 4 5 6	319 377 321 442 354 379	1 3 1 1 2 2
Mean value	365	SUM: 10
Standard deviation	42	
Inventory turnover	3,8	

Period	Purchases before EOQ (units)	Purchases after EOQ 319/order	Difference
Amount of purchases	10	7	
Inventory turnover total	3,8	13,7	
Average capital tie up	122 109 kr	33 899 kr	72%
Total holding cost	4 944 kr	1 372 kr	72%
Total order cost	2 000 kr	1 400 kr	30%
Total cost	6 944 kr	2 772 kr	60%

Semi-structured interview questionnaire for our contact person on Company X

- How do you work with inventory management today?
- Approximately when did the problem of tying up too much capital begin?
- What influences/motivates you to place an order? And what quantity?
- What techniques/tools do you currently use?
- Do you work with service level and safety stock?
- Why do you have a large variation in purchase quantities on so many SKUs?
- Why has there been so much capital tie-up?
- What do you think is the next step for the company in inventory management?
- How do you manage purchasing, how is quantity determined and how many orders should be placed in a month?
- Do you have any fixed rental cost to your 3PL every month? You have a price per space/day, but is there any additional cost that you pay monthly or so to keep your goods at the 3PL?
- How do you determine which products are your best/worst? Based on which criterias? Do you use ABC classification?
- When you determine quantities manually, do you look at historical sales for the same month or the same period? And calculate the quantity from there? Or do you look at the previous month's sales plus a percentage increase for growth when determining quantities?
- Can you explain more in detail how the process went?
- How did you arrive at the estimated quantities?
- Do you only buy enough units to cover your calculated demand, or do you buy more to ensure that you wouldn't run out of stock? What is your thinking behind this?
- What items do you have that are very seasonal?
- Do you make manual estimations every time you make a purchase and that you do not work actively with safety stock?

Semi-structured interview questionnaire OneMed

- Can you tell us about the business?
- What do you do?
- What do you sell? How many different items do you have?
- How many suppliers?
- How long have you been active?
- How do you work with inventory management? Own system or external?
- What tools do you use?
- When did you start using inventory management tools? At what size? How did you work before?
- Which key figures are interesting to you and why?
- How do you store your data and statistics? Is it something you are constantly trying to improve?
- How important is data management and data governance?
- How do you handle variation in demand?
- Do you notice variations in demand during different seasons/seasons?
- What incentives do you have to keep stock? What do you see as positive/negative reasons for having volume in stock?
- How does tied up capital in current assets in relation to total capital look to you? How do you see it?
- Is inventory turnover rate an important key figure for you? Why?
- How do you use this key figure?
- What formula do you use to calculate it?
- Are you using ABC segmentation?
- How have you segmented your products? Do you segment into product groups, volume, cost, etc.
- Do you use more segmentation criteria (Double ABC)?
- Do you use EOQ (Economic Order Quantity) to determine your order point and quantity? Why/why not?
- How do you treat the reorder point and quantity for products with higher demand variability?
- How do you determine which products EOQ is applicable to?

- Do you use a combination of several reorder point and quantity formulas? Which in that case?
- How often do you need to use your safety stock to cover variation in demand?
- What level of service do you strive for? Does it vary for products/product groups?
- How do you handle out-of-stock situations?
- What forecasting techniques do you use for demand?
- How important are forecasts to you and how do you work with them?
- How accurate are your forecasts usually?
- How do inventory management tools stay relevant in the market?
- Do you have any opinions on inventory management in SMEs?
- Do you have anything else to add that is important but we missed asking?

Semi-structured interview questionnaire Optilon

- Can you tell us about the business?
- How long have you been active?
- How to use the software?
- Can all companies use it regardless of industry/size?
- How should a potential customer's data and information be stored and structured for your software solution to work?
- What kind of data do you need?
- Does the software need constant or regular entertainment to actively function properly? Do you have to enter information all the time for it to work or does it work completely automatically?
- How accurate is it? Can it vary from company to company?
- What conditions are required for your system to function in the best way according to you?
- Do you have any statistics on how your system improves inventory turnover rate and capital tied up in companies? Do you have an example?
- Is the inventory turnover rate a good key figure to work towards? (Could it act as an indication that a product needs to be optimized)?
- What tools are included in your system?
- What type of forecasting does the system use? One or more different techniques?
- How does the system calculate safety stock/service level?
- How does the system segment products?
- Does the system use EOQ or other calculations for order point and quantity?
- What size of company is the best fit for your solution?
- Approximately how big are your customers (Turnover range)?
- What does a business look like before and after they use your service?
- What is your view on inventory management? At what limit should one consider implementing a software solution?
- What is your opinion and experience about inventory management SMEs?
- Did we miss anything or do you want to add anything?