Factors influencing effective safety stock dimensioning in inventory management

A case study within the automotive industry

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Abstract

Poor inventory management affects many companies today which has a negative impact on both company profits and the level of customer service provided. A critical aspect of inventory management involves maintaining a balance between safety stock levels and customer service level. Implementing appropriate safety stock levels is therefore important for companies, but also challenging given the difficulty in predicting uncertainties. In this thesis, the authors have had the opportunity to examine a specific part of the inventory at Volvo Cars' assembly facility in Torslanda. However, the inventory is affected by inappropriate safety stock levels which have a direct effect on the company's operations and incurring additional expenses. Therefore, the purpose of this thesis was to identify and increase the understanding of factors and challenges that influence the setting of appropriate safety stock levels for items included in the inventory at Volvo Cars Torslanda (VCT). In the literature review section, an introductory overview of inventory management and safety stock dimensioning are presented and three major areas of importance are examined to address the factors, challenges and potential opportunities related to safety stock dimensioning. This study was conducted using a qualitative case study methodology where primary data was collected through semi-structured interviews with the employees at the case company. The findings from the empirical data collection indicate that there are several factors that influence the dimensioning of safety stock levels and a lack of transparency within the departments at VCT, which pose challenges to the setting of safety stock levels. It was further evident that there was a lack of transparency and knowledge sharing between the departments at VCT, preventing the accurate decision-making for their safety stock levels. This, in turn, results in inappropriate safety stock levels, adding additional expenses to the company. Further, the empirical data was analyzed together with the existing literature discussed in this thesis. The main outcome derived from this study indicates that if VCT increased their knowledge sharing by implementing cross-functional teams and continuous improvement practices in the departments, they would be able to increase the effective collaboration between the departments to establish appropriate safety stock levels.

Keywords: Safety stock · Inventory management · Safety stock uncertainties · Safety stock level challenges · Safety stock level factors

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1. Introduction

The following chapter includes an introduction of this thesis' background and problem discussion. Further the case company is presented and their current problem which leads to the purpose of the study and the following research questions. At the end of the chapter, the delimitations of this thesis are presented.

1.1 Background

Supply chains play a crucial role in complex networks that connect the world (Erkayman, Ünal & Usanmaz, 2023). A critical component in supply chain management (SCM) is logistics management, where one of the targets is to improve inventory management (Muniz, Rodrigues, Almeida & Affonso, 2020). Inventory management, which is closely related to the supply chain, is crucial to achieve the objectives of an efficient supply chain, cost management and on-time delivery to customers (Erkayman, Ünal & Usanmaz, 2023). The activities of inventory management varies based on company, industry and sector (Adelwini, Toku & Adu, 2023). Within the manufacturing industry, the main activities include procedures for giving the production department a continuous flow of materials (Adithya, 2022). Inventory management covers different topics such as calculating material requirements at different points in the supply chain, determining the quantity, purchase frequency and levels of safety stock for necessary materials (Erkayman, Ünal & Usanmaz, 2023). However, inventory management is considered as an increasingly important activity and is described as 'the differentiating factor' in the company's success (Wild, 2018). The primary objectives of inventory management are: (i) to increase the profitability of the company through improvements of the inventory management (ii) to predict corporate policies impact on inventory management and (iii) to lower the cost of placing orders, receiving goods, and maintaining inventories (Nirmala, Kannan, Thanalakshmi, Gnanaraj & Apparadurai, 2021; Adithya, 2022). Therefore, inventory management is largely concerned with the planning and controlling of an industry's inventory (Erkayman, Ünal & Usanmaz, 2023).

Manufacturing companies need to dedicate more interest in the area of inventory management in order to make it efficient. In comparison to other assets of a company, inventory stands out as one of the most significant investments since it is crucial for boosting sales and profitability (Cuartas & Aguilar, 2023). High inventory expenses are today a serious problem for businesses and distributors (Nakhaeinejad, Zare, Habibi & Khodoomi, 2023). Furthermore, mismanagement of an inventory can generate a lot of costs for an organization (Abdolazimi, Esfandarani & Shishebori, 2021). In manufacturing companies, inventory costs are the most crucial ones since they account for 40 percent of the entire cost (Nakhaeinejad et al., 2023). Additionally, manufacturing companies are exposed to different sorts of uncertainties such as failures which

makes it even more important to focus on activities in inventory management since it could otherwise lead to high costs for the company (Gharbi, Kenné & Kaddachi, 2022). Nowadays, inventory managers deal with incorrect or unreasonable inventory levels which leads to higher costs (Finco, Battini, Converso & Murino, 2022). Hence, managing inventory and reducing thNine costs is a prior goal for many organizations (Nakhaeinejad et al., 2023).

1.2 Problem discussion

Poor inventory management affects many companies today which has an adverse effect on both the profits of the firms and the level of customer service provided (Niño & Gutiérrez, 2022). A critical aspect of inventory management involves maintaining a balance between safety stock levels and customer service level, as uncertainty is challenging to predict (ibid). For several years, academics have faced the issue regarding safety stock levels in trying to understand which quantities are necessary to order and also at what time to order. Implementing appropriate safety stock levels is therefore important for several companies from different fields (Saldanha, Price & Thomas, 2022). There are however different factors and challenges that affect safety stock levels (Goncalves, Carvalho & Cortez, 2020). For instance, fluctuations in demand can shift in sizes which causes companies to respond to the fluctuation by changing their supply chain strategies or applying the changes in their sales and manufacturing plans (Nenavani & Rajesh, 2021). Uncertainty in demand is considered as a challenge since it can lead to high inventory levels, high carrying costs, higher prices, lower customer satisfaction and ultimately a less profitable company (Munyaka & Yadavalli, 2022). When there is uncertainty in demand, safety stocks are being held to maintain the variations in demand (Rushton, Croucher & Baker, 2022).

Furthermore, time is considered as an important aspect nowadays, and the significance of it has increased (Lumsden, Stefansson & Woxeniues, 2019). In fact, one of the major elements of inventory management is the lead time (Wu, Zhai & Liu, 2015). When lead times are longer, it results in more demand variations which further leads to increased safety stock (Wild, 2018). In the context of time, a challenge is that suppliers have diverse response times to certain criterias which highly impacts the inventory and safety stock levels (Powell, Lodgaard & Dreyer, 2020). While certain suppliers are easy to collaborate with, others pose significant challenges (Wild, 2018). Accordingly, having unreliable suppliers can lead to stockouts which will further add costs for a company (Strohhecker & Gröbler, 2020). Therefore, to minimize the impact of uncertainty within an organization, safety stocks are established. However, maintaining high safety stock levels represent a significant drawback since they tie up capital in the inventory that could be invested elsewhere (Rushton et al., 2022). On the other hand, low safety stock levels will result in stock outs and loss of sales which leads to less profit (Priniotakis & Argyropoulos, 2018). It becomes apparent that management should concentrate on maintaining intermediate safety stock levels in order to reduce stock outs and improve customer satisfaction while lowering inventory costs (ibid). If a company wants to be successful, then it must care for inventory management, since a company may respond more quickly to the changing

environment and reduce expenses, when the inventory is managed more effectively where good decisions are made (Nakhaeinejad et al., 2023).

1.3 Case description

This section provides a concise introduction to the selected case company and the specific area that is examined in this study.

1.3.1 Volvo Cars

Volvo Cars is a global automotive company and dates to 1927 when their first car drove out from the factory in Gothenburg, Sweden. The company has its reputation of producing a range of reliable, high-quality and safe vehicles globally and has evolved to become the leader in the automotive industry over the years. Volvo Cars is known for its commitment to developing innovative safety features. In recent years, the company has set goals to reduce their environmental impact and announced to be climate neutral across their value chain by 2040.

The company has four manufacturing facilities worldwide, situated in Torslanda (Gothenburg, Sweden), Chengdu (China), Ghent (Belgium) and Ridgeville (USA). The chosen case company Volvo Cars Torslanda (VCT) is a comprehensive factory that encompasses press works, body works, painting and assembly, with the scope of this study covering the inventory of the assembly factory. The manufacturing company in Torslanda has been in operation since 1964 and produces a range of vehicles including XC60, XC90, V90 and V60 models. The production process involves approximately 6,500 individuals, with a daily output of around 1,250 vehicles (Volvo Cars, 2023).

1.3.2 The Marketplace

This study focuses on the inventory management of VCT. The inventory at VCT includes different sections of managing items and the focus of this study concerns a specific section of the inventory referred to as the Marketplace. The Marketplace encompasses various items and the aim is to have a seamless flow where items continuously enter and leave the inventory to the assembly lines in the production area. However, the problem lies within the level of safety stock that is kept at the Marketplace where some items are overstocked and understocked resulting in inefficiencies which have a direct effect on the company's operations and incurring additional expenses. The effect of overstocking items has led to unnecessary inventory costs for the company, resulting in tied-up capital. On the other hand, having shortages or an understock of the items have also caused additional issues in the company leading to forced production stops. These challenges erupt the process and the goal of having a seamless flow of items at VCT. Therefore, having appropriate safety stock levels at VCT is crucial as it will contribute to an efficient inventory management.

1.4 Purpose

The main purpose of this study is to identify and increase the understanding of factors and challenges that influence the setting of appropriate safety stock levels for items included in the inventory at VCT.

1.5 Research question

$Q1$: What are the key factors that influence the setting of appropriate safety stock levels in the context of VCT?

$Q2$: What are the main challenges faced by VCT that influence the setting of appropriate safety stock levels?

$Q3$: What are the potential solutions for managing challenges that influence the setting of appropriate safety stock levels in the context of VCT?

1.6 Delimitations

This thesis has considered some delimitations in regard to the timeframe of the thesis. The first one is concerning the safety stocks within the inventory of VCT which is in the Marketplace. The Marketplace consists of items that are categorized in the frequencies of high, medium and low runners. In addition to this, the interviews revealed that the setting of safety stock levels are not considering the frequencies on each item and instead only established based on the suppliers. Therefore, the decision was made to exclude the frequencies of the items in the marketplace and instead focus on the setting of safety stock levels per supplier. Another delimitation is related to the geographical area. Volvo Cars has four manufacturing facilities worldwide, whereas this study has been conducted on the manufacturing facility in Torslanda (Gothenburg, Sweden). This was due to the fact that the authors live in Gothenburg, Sweden and are therefore limited to visiting other facilities of Volvo Cars. Additionally, it facilitated the process of the study where the authors easily could visit the facility and make observations. Further, this study was specifically conducted on the assembly factory of Volvo Cars Torslanda (VCT) where the other facilities were excluded. A third delimitation of this thesis was the exclusion of technical details of the system that VCT are utilizing to determine the safety stock levels or further improvements of the system. The authors decided to exclude this part and only focus on the surrounding factors related to the establishment of safety stock levels. Lastly, this study is limited to the availability of data and people participating in the study, where the people involved were from three different departments that are closely related to safety stock levels namely, Supply Chain Coordinators, Supply Chain Technician, and Lean Management. Other departments and people working at VCT were excluded such as operators within internal logistics and production due to the limited timeframe.

2. Literature review

This chapter includes all the relevant findings from the literature in order to increase the understanding of factors and challenges that influence the setting of appropriate safety stock levels. The findings from the literature will further be compared with the empirical findings in chapter 5.

2.1 Inventory Management

Throughout the past century, inventory management has been improved, where new instruments and technology have been employed to facilitate the procedure (Munyaka & Yadavalli, 2022). Tebaldi, Bigliardi, Filippelli & Bottani (2023) define inventory management as the act of arranging, scheduling, and monitoring stock with the goal of reducing costs and achieving supply and demand balance. Like any other profession, inventory management is built on knowledge and techniques and is the product of 100 years of growth and improvement (Wild, 2018). The term "inventory" refers to materials and finished goods in the supply chain that are used in manufacturing or delivery to final consumers (Ünal et al., 2023). Additionally, inventory is referred to as a supply that is kept in stock in order to meet both present and future demand. It could be everything from raw materials, finished goods, work-in-process, or constituent parts which are kept at a certain area (Munyaka & Yadavalli, 2022).

Inventory makes it possible for organizations to support customer service, logistics or manufacturing, where, in some cases, purchase or manufacturing of the items is unable to meet the demand. This may occur in regard to different reasons such as the rapidity of purchasing, the length of the manufacturing process, or when the demand rate is bigger than the supply rate (Wild, 2018). The objectives of inventory management is to keep the stock balanced, develop and implement strategies, policies and systems (Nemtajela & Mbohwa, 2016). It covers matters like predicting material requirements at several stages of the supply chain, identifying how much material is needed, how often it should be ordered, and also how much safety stock is needed (Ünal et al., 2023). Additionally, in terms of logistics expenses, inventory management represents around half of the expenses that an organization needs to pay (Tebaldi et al., 2023). Munyaka & Yadavalli (2022) also discuss this where the authors explain that many companies consider their inventory to be their most valuable asset, since it accounts for half of all investments. It is therefore important for companies to manage their inventory in an efficient way (Paterson, Kiesmuller, Teunter & Glazebrook, 2011).

2.1.1 Reasons for holding inventory

Rushton., et al (2022) explain that there are different reasons for keeping stock. Lumsden et al., (2019) explain that the reason behind holding inventory is widely known and stem from the ideas

that manufacturers should be provided a high level of functional reliability and customers should always have access to items when they need them. According to Rushton et al., (2022), the main purpose for keeping stock is to produce a buffer among supply and demand (Rushton et al., 2022). Möllering (2019) also discusses several reasons for keeping inventory where some of them are *uncertain demand*, *economies of scale*, *separated operations*, and *transportation*.

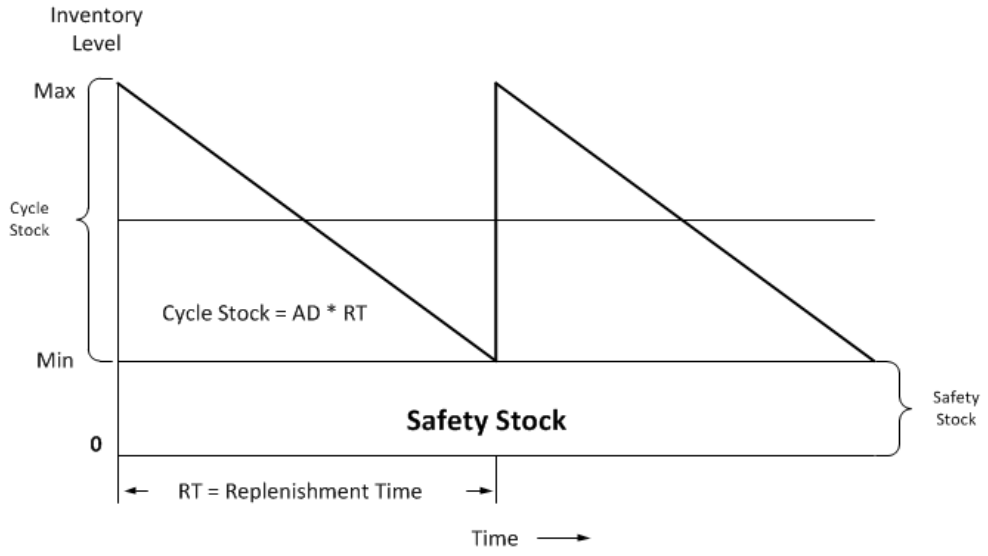
Economies of scale correspond to the potential of saving costs through large order- and production quantities which are then stored as stock until it is needed for utilization. When a product is produced in big quantities or purchased in bulk, fixed costs can be spread across a large number of units (Möllering, 2019). If products are purchased in bulk they may have a smaller unit cost (Rushton et al., 2022). However, purchasing a larger amount of inventory also results in higher costs for holding inventory. Although, there are several reasons why this could be beneficial as well. For instance, suppliers occasionally provide consumers discounts which could lead to companies' buying larger quantities (Sanders, 2012). This is also brought up by Rushton et al., (2022) where the authors explain that a reason for keeping stock is the potential to get quantity discounts. Besides that, Sanders (2012) mentions that companies may also purchase larger quantities in terms of price fluctuations of the items where prices may increase (Sanders, 2012). Rushton et al., (2022) also demonstrates this by explaining that prices for products can vary, which means that companies order larger quantities instead to avoid larger expenses. Furthermore, Möllering (2019) explains that uncertainties may impact different components of a distribution system where the system is not adaptable enough to deal with temporal variations. In this case, demand is the primary cause of uncertainty (Möllering, 2019). Sanders (2012) argues that demand is never completely predictable, therefore keeping additional inventory enables a business to handle unforeseen fluctuations in demand. In order to avoid expensive disruptions or shortages, inventories are stocked (Möllering, 2019). This is also mentioned by Rushton et al., (2022) where the authors explain the need for keeping stocks in relation to demand variations. A product's demand will change per period, because it is never completely consistent. Thus, it is necessary to maintain some amount of safety stock to prevent stockouts (Rushton et al., 2022).

Moreover, in companies with separated operations, the aim is to maintain a seamless flow of production. Separation, which enables independent operation of various production stages, is especially important in manufacturing systems with several stages (Möllering, 2019). Sanders (2012) explains that in order to reduce the reliance of the workstations and ensure that a stop of production at one place will not impact the whole production line, inventory is often positioned between them (Sanders, 2012). Möllering (2019) also discusses this where the author mentions that buffer inventories avoid delays that would otherwise influence all other phases, both upstream and downstream. These delays could be highly costly (Möllering, 2019). It is therefore necessary to hold inventory in companies with separated operations in order for production and distribution processes to operate seamlessly (Rushton et al., 2022). Additionally, Möllering (2019) mentions that transportation is another primary factor for keeping inventory. The reason

behind keeping inventory due to transportation is because it is time consuming, which means that it takes a certain amount of time before the ordered items arrive at the destination (Möllering, 2019). Sanders (2012) explains that items cannot possibly arrive instantly when there are shortages. When items are produced and delivered, a specific lead time comes with it (Sanders, 2012). Rushton et al., (2022) explains that the lead times may also vary, and inventory is kept if any delays would occur during the transportation. This is also brought up by Sanders (2012) where the author explains that lead time variations may occur as a result of delays in shipment, production issues at the supplier facility, missing orders, damaged supplies, and a number of additional issues. Moreover, if the lead times are long it may also result in larger costs for the company (Möllering, 2019).

2.2 Safety stock dimensioning

Safety stock is an important part for businesses in many industries, particularly when determining the appropriate safety stock level (Saldanha, Price & Thomas, 2022). However, safety stock is used in inventory management to prevent an out-of-stock situation (Barros, Cortez & Carvalho, 2021). It serves as an insurance that consists of an extra quantity of inventory to cope with demand and supply uncertainties (ibid). Many businesses view stocks as an additional expense, but they should be viewed as a factor that actively contributes to the growth or maintenance of a particular market through high levels of service (Jonsson & Mattson, 2023).



$AD = Average\ Demand$
$RT = Replenishment\ Time$

Figure 1. *Overview of safety stock estimation with replenishment time and cycle stock (Loucka, 2013)*

The figure above explains the relationship between the replenishment time, safety stock and the cycle stock in a diagram. The replenishment time represents the time from when a replenishment order is placed until the stock is actually placed on the shelves. Stock replenishments are based on estimates since the lead time for the replenishment is often longer than the delivery lead time required by the consumers (Jonsson & Mattson, 2023). These predictions are usually inaccurate which will occasionally cause shortages. When the replenishment time exceeds, then a reorder point (ROP) is being placed to ensure order fulfillment. The average demand represents the line that is between max-min (Jonsson & Mattson, 2023). However, the cycle stock represents the quantity of stock that is available to meet the average demand during a specific time. Use of safety stock is necessary to ensure a consistent and competitive delivery performance (Jonsson & Mattson, 2023). An ideal safety stock strategy would be to reduce inventory-related expenses while meeting demand and high-service level customers' needs. This obviously relies on how to handle varying amounts of demand volatility and how wide the lead time variance is (Gonçalves, Carvalho & Cortez, 2020). For instance, if demand varies to a high level during seasonal sales, safety stocks determined during a low demand period will result in frequent stockouts, whereas safety stocks determined during a high demand period will lead to investing excessively in inventory. Bragg (2004) argues that the solution for this problem is to obtain materials requirement planning (MRP) software that supports varying safety stocks. These systems balance the competing goals of minimizing stockouts and minimizing inventory levels by automatically resetting safety stock levels as predicted demand levels vary (Bragg, 2004).

2.3 Factors influencing safety stock dimensioning

2.3.1 Demand uncertainty

Uncertainty includes different aspects and are caused by several external factors. Although uncertainty in demand is being taken into account in inventory system models, reality plays a vital role as the demand is dependent on the environment (Nemtajela & Mbohwa, 2016). The reality is unpredictable since changing events can occur rapidly such as weather, machine breakdowns, human mistakes, disasters etc. (ibid). The management of the disasters presents challenges at every stage as the disasters necessarily affect regions (Nagurney, Masoumi & Yu, 2015). Consequently, safety stocks are maintained to mitigate the risk of stockouts caused by uncertainty (ibid). In addition, due to rapid changes in the underlying demand process and the fact that many businesses do not keep extensive histories of demand observations, the number of demand observations that may be used to estimate the demand parameters is frequently constrained in practice (Prak & Teunter, 2019). In other words, the parameter estimates become increasingly unstable as the number of historical demand observations decreases, which amplifies the detrimental effects of neglecting their uncertainty (Prak & Teunter, 2019). On the other hand, the production process is unreliable due to machine breakdowns which causes process uncertainty (Hançerlioğulları, Şen & Aktunç, 2016).

The majority of uncertainties are characterized as excessive inventory, obsolete items, unvalued inventory, poor management skills and ineffective management of inventory control systems (Nemtajela & Mbohwa, 2016). Uncertainties not only impede the supply chain process but also the effectiveness of a manufacturing firm (Nenavani & Jain, 2021). Previous studies show that uncertainty is a critical factor that causes the inventory with the bullwhip effect (Perera, Fahimnia & Tokar, 2020; Croson, Donohue, Katok & Sterman, 2014;Lee, Padmanabhan & Whang, 1997). The bullwhip effect in inventory management explains the phenomenon of order fluctuation amplification in the supply chains (Perera et al., 2020). In other words, the bullwhip effect refers to the phenomenon of demand distortion and variance amplification (Lee et al., 1997). It is important to observe that the enhanced demand patterns will simply mislead the manufacturer who monitors its immediate order data due to the distortion of demand information, which results in financial consequences (Lee et al., 1997). In the study made by Lee et al., 1997) they examined four causes of the bullwhip effect: demand signal processing, the game of rationing, batch ordering and price fluctuations. The results showed that the bullwhip effect can be mitigated through the use of sell through data, exchange of inventory status information, coordination ordering and facilitated pricing schemes. Lee et al., (1997) also stated that in order to overcome the bullwhip effect it is necessary for the manufacturer to be given access to the sales and inventory status data although it is considered to be the retailers proprietary.

Demand is a part of the supply chain, thus the importance of taking into account the nature of supply (Rushton et al., 2022). Demand uncertainty in the supply chain is associated with inaccurate sales predictions and unpredictable customer demand. Fluctuations in demand can shift in sizes which causes companies to respond to the fluctuation by changing their supply chain strategies or applying the changes in their sales and manufacturing plans (Nenavani & Rajesh, 2021). However, if the lead time of the suppliers is long, it will more likely result in surplus inventory or an undersupply (Rushton et al., 2022). As a result of developed and improved consumer information, customer demand tends to fluctuate more instantly compared to the past. Therefore, product demand can shift dramatically within a short time period (Rushton et al., 2022). In a study conducted by Nenavani and Jain (2021) their findings showed that the major source of demand uncertainty is caused by unpredictability in consumers' needs and proved that one way of achieving responsiveness in the supply chain is through customer relationships which positively affects the performance of firms.

2.3.2 Cost

Uncertainty in demand is considered as a challenge since it can lead to high inventory levels, high carrying costs, higher prices, lower customer satisfaction and ultimately a less profitable company. Inventory management has the potential to improve customer service and manage uncertainties in demand (Munyaka & Yadavalli, 2022). Therefore, it is important to strive for

proper inventory management since it ensures a balance between reducing the overall cost of inventory and maintaining the appropriate level of customer satisfaction (ibid).

When demand increases more than expected, safety stocks are implemented in inventory management to prevent stockouts (Munyaka & Yadavalli, 2022). When there is uncertainty in demand or in the lead time, safety stocks are being held to maintain the variations in demand (Rushton et al., 2022). However, high safety stock levels represent a significant drawback since they tie up capital that could be invested elsewhere (ibid). This could also result in obsolete items or deterioration of products that are stored for long periods with expired dates (ibid). Another disadvantage of having high safety stock levels is the cost of adding additional storage space. Obsolete items are time-dependent products that gradually lose value and demand and after a particular period of time, the demand drops to zero (Bajegani & Gholamian, 2022). Although many companies strive to reduce their inventory costs, it is evident that these costs have a tendency to rise. The reasons behind rising inventory costs are caused by several factors such as: product proliferation, high expectations from customers, demand fluctuations, extended supply chains, and just-in-time (Rushton et al., 2022). Product proliferation has a positive impact on market share and sales (Menezes, Jalali & Lamas, 2021). The idea behind this is to offer consumers a variety of their products to increase the demand (Rushton et al., 2022). In fact, many companies have responded to product proliferation in a negative way after realizing its effects. It is considered as a complexity in the product space since it has a negative impact on competitiveness, increased costs and has a complexity that destroys value (Menezes & Pinto, 2022). However, it appears that many companies only realize the negative effects of proliferation after they have already suffered large economic losses (Menezes et al., 2021). In terms of immediate availability on demand, customers are requesting higher levels of service. In order to prevent missed sales and customers turning to other suppliers, suppliers must keep larger inventories on hand (Rushton et al., 2022). In fact, demand variability makes it difficult for companies to assess appropriate levels of safety stock. This is due to the dramatic fluctuations in customer demand during short periods of time (ibid). Another factor is the extended supply chain, where markets can be supplied from far locations as a result of globalization. Delays in the supply chain are now far more likely, and adding extra safety stock to the supply system is the primary solution to address this (Rushton et al., 2022). The main objective of the just-in-time approach is to reduce the inventory level, but when the process is not sufficiently balanced throughout the supply chain, there may be serious consequences. The adoption of just-in-time can also result in pressure on the suppliers to maintain additional inventory ensuring that an appropriate final supply to the consumer is always maintained, also known as ‘just-in-case’ stocks (Rushton et al., 2022).

2.3.3 Lead time

The lead time is considered as one of the major elements of inventory management (Wu et al., 2015). Nowadays, time is considered as an important aspect and the significance of it has

increased (Lumsden et al., 2019). Lead time can be defined in different ways, whereas Wild (2018) defines lead time as the time between the occurrence of a shortage and the arrival of the goods to the customer. Jonsson & Mattsson (2023) and Lumsden et al., (2019), on the other hand, define lead time as the time between a placed customer order until it has been delivered, and it can therefore be referred to as the total time a customer needs to wait. However, Lumsden et al., (2019) argue that lead time is sometimes referred to as the time between need and satisfaction, which is an incorrect definition. The major difference here is that the term 'need' is used instead of 'order placement', which could be misleading (Lumsden et al., 2019). The lead time is commonly expressed in weeks or days (Jonsson & Mattsson, 2023). There are several different activities that are included in the time aspect of a lead time. These activities are among others; order placement, order processing, planning, manufacturing, construction and distribution (Lumsden et al., 2019).

A crucial part in inventory management is to measure the demand uncertainty, which is commonly measured in demand forecasts during the lead time (Kourentzes, Trapero & Barrow 2020). According to Wild (2018), forecasting the demand is crucial when the lead times are longer. Lumsden et al., (2019) states that when lead times are longer, it results in a wider spread of the demand. This is also brought up by Wild (2018) where the author states that longer lead times result in more demand variations which further leads to increased safety stock. The lead time therefore influences the level of safety stock that is held (Wild, 2018). Wu et al., (2015) explain that the level of demand uncertainties that occur during the lead time, the amount of safety stock and the related inventory costs are all influenced by the lead time. Rushton et al., (2022) states that when the lead time is uncertain, as well as the demand, safety stock is kept. The reason behind this is because there is a certain amount of time between the order placement and when it arrives (Rushton et al., 2022). According to Mamani & Moinzadeh (2014), longer lead times additionally result in increased inventory holding costs due to an increased amount of safety stock. It may also result in customer attrition as a consequence of shortages (Mamani & Moinzadeh, 2014). According to Jonsson & Mattsson (2023), longer lead times result in several poor events such as increased response times to order placements which leads to reduced flexibility. It may also result in reduced reliability of the supplier. Therefore, some companies feel the need to decrease the lead time (Wild, 2018). Additionally, lead times may also vary (Rushton et al., 2022). Wild (2018) explains that a crucial problem is that lead times can be unreliable, which is another reason why safety stock levels increase. A solution to this is to have more detailed specifications of the lead times to the suppliers. Instead of requiring that the delivery should arrive in a specific month, companies can be more specific and add the day of the month and time as well. This will potentially lead to better delivery performance from the suppliers (Wild, 2018).

Furthermore, shorter lead times implies that the service is well and ultimately leads to increased profits (Lumsden et al., 2019). The level of uncertainty decreases when lead times are shorter,

and it results in more accurate forecasts of the demand (Sanders, 2012). Shorter lead times may therefore lead to more accurate forecasts and reduced forecasting errors (Wild, 2018). Wu et al., (2015) state that reduced lead times may lead to decreased safety stock levels, reduced inventory holding costs, and more profit. Therefore, several companies value lead time management where they aim to shorten lead times as a strategy towards efficient inventory management (Wu et al., 2015).

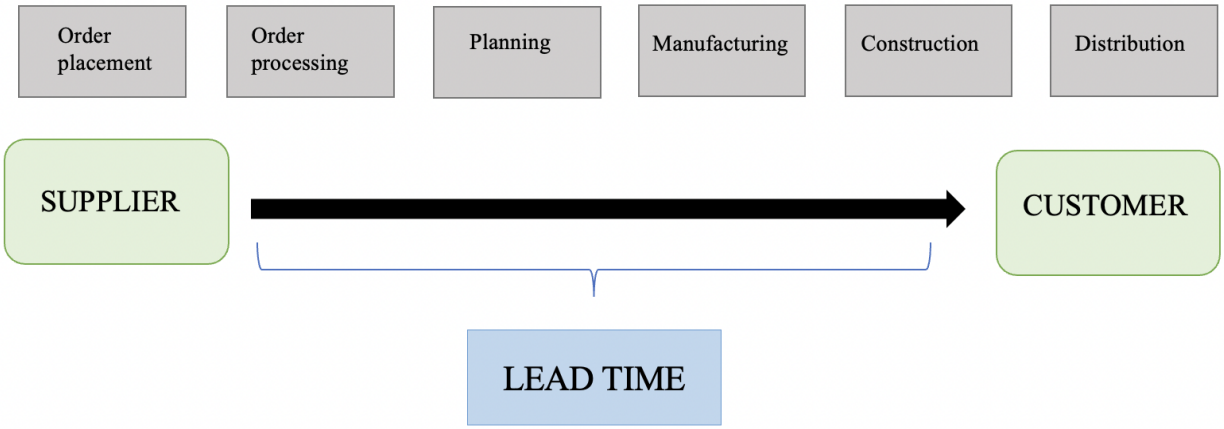


Figure 2. *Lead time process (Own illustration).*

2.3.4 Supplier location

The role of supply chains is to establish collaborative relationships with customers and suppliers to provide end customers with ideal items. However, it is important to consider that while other items are readily accessible ex-stock, some are tough to obtain. Some suppliers are simple to work with, while others are exceedingly challenging (Wild, 2018). Two factors that are important to consider for supplier selection are geographical location and lead time (Sonar, Gunasekaran, Agrawal & Roy (2022). In a study conducted by Sonar et al., (2022) they identified that the most important criteria when choosing the right supplier is to consider the geographical location. A key decision in geographical dimension that managers are required to consider is the physical location of different levels such as the manufacturing plants and the suppliers. Supplier location distances have the ability to increase the expenses and complicate the decisions within production planning and inventory management (Kalchschmidt, Birolini, Cattaneo, Malighetti & Paleari, 2020).

Several authors in the literature suggest that companies have the option to decide to localize their supply networks in a limited geographic area. This has a positive effect since it offers an easier supply network, logistics, inventory, reduction of transportation expenses and the potential to benefit from greater localization advantages that define the area where the suppliers are centralized (ibid). However, supplier distance can be categorized from a logistics perspective into

three dimensions such as: area dimension, time dimension and cultural dimension (Jonsson & Mattsson, 2023). The area dimension refers to the geographical distance between the supplier and the company. Suppliers that are located close to the company result in lower transportation costs and enable more frequent deliveries and in smaller quantities at each delivery period (ibid). According to Wild (2018) it is more beneficial to obtain closer collaboration with fewer suppliers. This also allows for shorter delivery times (Jonsson & Mattsson, 2023). The time dimension refers to the importance of the differences between purchasing and supplying companies. Distances that are located far away from the two parts will differ in time zones and have different work schedules. This restricts the relationship flexibility and communication possibility particularly during extended periods where it may be challenging to contact a supplier and in several cases may even be difficult to get the items delivered (ibid). Hence, delivery times must be adjusted and safety stocks must be implemented with a certain level of efficiency to prevent supply chain deterioration (ibid). Furthermore, the cultural dimension refers to the importance that differences in language may have when conducting business with international companies. However, when there is a lack of language it will complicate the communication and increase the risks of misunderstandings which could for instance cause disruptions in the flow of materials (Jonsson & Mattsson, 2023).

Many companies have expanded their supply chains for a variety of reasons, including access to international manufacturing suppliers that allow them to take advantage of cost benefits, compliance with customs fees and trade concessions (Kalchschmidt et al., 2020). The majority of companies now operate in a customer-led environment rather than one that was driven by suppliers. This is the result of a rise in global trade, global competition, and distribution advancements (Wild, 2018). The rise of the customer-led market has significantly altered supply structures where significant developments have occurred (ibid).

2.3.5 Supplier reliability

According to Wild (2018) the relationship with suppliers may differ where some are simple to work with while others are exceedingly challenging. The relationship between the supplier and the customer is dependent on the deliveries that will be made to the customer which is affected by factors such as delivery precision and delivery reliability. Delivery precision is defined as the reliability of the delivery where the importance lies within delivering at the right time in relation to what has been agreed on with the customer (Lumsden et al., 2019). It can be defined as the amount of deliveries that occur at the scheduled time in relation to the overall total amount of deliveries. In a time interval, some customers accept deliveries that are one day early or one day late. However, it depends on the type of item that is delivered and additionally on how extensive the need for the item is, where if an item is coordinated with other items such as in a manufacturing process, late deliveries are not accepted (Jonsson & Mattsson, 2023). Moreover, according to Lumsden et al., (2019) high reliability is commonly more significant rather than short lead times. In fact, it may be more important to know precisely which day and hour a

delivery will arrive rather than having shorter lead times where the suppliers promise a delivery within 1-2 days (Lumsden et al., 2019). Deliveries that arrive ahead of time or behind the schedule can be referred to as low delivery precision. In fact, low delivery precision may affect companies with low safety stock levels where manufacturing companies might need to stop production if an important component or item is missing (Jonsson & Mattson, 2023).

Having unreliable suppliers can lead to stockouts which will further add costs for a company. It is therefore crucial for companies to have appropriate safety stock levels (Strohhecker & Gröbler, 2020). In fact, Powell et al., (2020) discuss that suppliers respond differently in relation to time which highly impacts the inventory and the safety stock levels. This further leads to an uncertainty in relation to the planning and the level of delivery precision (Powell et al., 2020). Ye, Liu, Li, Lai, Zhan & Kumar (2022) argue that two main factors of good supply chain performance are deliveries that are on time and reduced safety stock levels. Accordingly, deliveries that are on time may lead to reduced shortages, and lower safety stock levels means that the lowest amount of inventory is kept without being exposed to risks of shortages due to supply uncertainties. Therefore, suppliers that deliver on time may lead to reduced safety stock levels (Ye et al., 2022). Similarly, Wild (2018) argues that safety stock is kept in order to compensate for failed deliveries of suppliers.

Delivering the right item in the right amount and quality, on the other hand, is characterized as delivery reliability, which is a crucial aspect that has gained value in recent years (Lumsden et al., 2019). Accordingly, it is of high importance to receive correct deliveries and there is no time for wrong orders considering that inventory items are in most cases decreasing today (Lumsden et al., 2019). Jonsson & Mattson (2023) define the ability of delivering the right item in the right amount as delivery security, where a low delivery security may lead to unnecessary procedures needed to be conducted. The amount of orders placed by customers that have been delivered without any remarks is typically used to define the delivery security. These remarks could for instance be that the amount of delivered items do not align with the amount that was agreed on, or that the delivered items do not fulfill the quality criterias (Jonsson & Mattsson, 2023).

2.4 Challenges within safety stock management

2.4.1 Supplier disruption

Manufacturing supply chains are becoming increasingly vulnerable to disruption as the volatile and unsafe nature of the world exposes them to greater risks (Lai, Chen, Wang & Chiu, 2023). The supply chain is a complex system that encompasses all the entities and facilities involved in the transformation of raw materials into finished products. It includes various stages, like suppliers, manufacturers, distributors, wholesalers and retailers. Disruptions in supplier reliability, uncertainties, and poor performance at any stage can have a significant impact on the

entire supply chain (Islam, Azeem, Jabir, Paul & Paul, 2022). In practice, supply chains exhibit a high degree of uncertainty (Islam et al., 2022). Suppliers have a crucial impact on the profitability of a company, and their services can introduce unforeseen challenges and failures (Pawlak, 2017). Selecting a resilient supplier capable of withstanding disruptions has become an increasingly significant yet highly challenging task (Wissuwa, Durach & Choi, 2022). Suppliers with critical components ensure a consistent performance in supplying their customers to maintain long-term relationships (Chen, Rungtusanatham & Goldstein, 2019). However, it is not realistic to expect these suppliers to operate without any failures or disruptions continuously (ibid). Suppliers play a vital role in establishing a strong and efficient supply chain, as selecting the right and appropriate supplier directly impacts product quality and the competitive advantage of a business (Chang, 2023).

Internationalization offers the potential for revenue growth and cost reduction; however, it also introduces greater complexity to supply chains. As a result, supply chains become more vulnerable to disruptions, and managing these disruptions becomes increasingly challenging (Dias, Hernandez & Oliveira, 2020). Simultaneously, the growing trend of manufacturing outsourcing puts manufacturers in a significant role of managing supplier quality. Manufacturers place significant reliance on external suppliers for a range of various components and services, which consequently increases their dependency on these suppliers for ensuring product quality (Lee & Li, 2018).

Luangkesorn, Klein and Bidanda (2016) argue that traditional approaches that tackle supply chain disruptions primarily concentrate on external suppliers and assume that once the disruption occurs, the external supplier will be responsible for resolving it. The authors mean that the company has its own manufacturing capabilities to produce the required goods when the production is internal to the system. In these cases, when disruptions occur, the company can depend on its internal production capacity to recover and resume normal operations (Luangkesorn et al., 2016).

2.4.2 Production disruption

Production disruptions that temporarily occur present a notable risk for manufacturing companies. In order to mitigate this risk, manufacturing firms have the option to acquire interruption insurance or implement operational strategies, such as safety stocks. Additionally, companies can implement preparedness actions aimed at minimizing the expected duration of the disruption (Dong, Tang & Tomlin, 2018). However, companies utilize safety stock and insurance as strategies to manage the operational and financial challenges that arise from temporary disruption in production. For instance, Cisco Systems, a technology company, adopts a comprehensive approach to address production disruptions. In addition to relying on safety stocks, they prioritize reducing the time to recover (TTR) at various stages of their production chains. By minimizing the recovery times, Cisco Systems enhance the ability to quickly recover

from disruptions and restore normal production (Geraint, 2014). However, research indicates that a significant number of organizations still depend on intuition and experience when addressing disruptions, without actively involving essential participants from production and logistics in the decision making process. Consequently, only suboptimal solutions are implemented lacking a holistic focus on the optimal outcomes for the entire global production network (Peukert, Hörger & Lanza, 2023).

2.4.3 Inventory accuracy

The availability of items is referred to as the quantities that exist in a companys' inventory. In order for material management to maintain control of the inventory it is required to know what quantities exist in the inventory where an inventory accounting must take place. This must be done in order for the material management to monitor the actual inventory balance (Jonsson & Mattsson, 2023). According to Bragg (2004), inventory accuracy is a crucial factor in the management of material. A challenge emerges when there are incorrect balances of the inventory. If the inventory records are incorrect in a manufacturing company it may lead to severe challenges where the material management must seek it and may additionally place an instant order to the supplier, where at the same time, the production lines might need to stop (Bragg, 2004). Inventory record inaccuracy is defined as the discrepancy between the inventory records in the system in contrast to the actual inventory that is kept. Incorrect inventory records is crucial as it may influence how a company performs where it could potentially lead to material shortages (Hassan Zadeh, Sharda & Kasiri, 2016).

According to Lumsden et al., (2019) it should be evident that inventory balances are accounted correctly and represent the actual inventory balance. However, due to different reasons, incorrect inventory balances may occur where items are wasted or different stock changes are unreported (Jonsson & Mattsson, 2023). Hassan Zadeh et al., (2016) discuss different reasons why incorrect inventory records may occur where one of them is that the inventory decreases due to the fact that items may be damaged. Another reason is that items may be misplaced which leads to a current decrease of the inventory (Hassan Zadeh et al., 2016). This is also brought up by Drakaki & Tzionas (2019) where the authors explain that inventory inaccuracy is mainly caused by inventory losses, wrong transactions, non accessible inventory, and wrongly labeled products. According to Lumsden et al., (2019) safety stock is kept to manage different uncertainties where incorrect inventory balances is one of them. However, if this uncertainty is included as a factor for safety stock dimensioning, safety stock levels will further increase (Lumsden et al., 2019).

2.5 Enhancing inventory management through transparency and visibility

When complex situations take place within an organization, it is necessary to have more integration and collaboration. In fact, in order to obtain resilience within the supply chain it is

crucial to maintain efficient collaboration and aligned decisions (Ghasemi, Lehoux & Rönnqvist, 2022). According to Wild (2018) inventory management has shifted from focusing on technical aspects to focusing on good interaction, coordination, communication, hence, collaboration. Collaboration is necessary given that people operate together in the supply chain (Wild, 2018). Additionally, ensuring information transparency is essential for optimizing supply chain performance and minimizing disruptions (Drakaki & Tzionas, 2019).

2.5.1 Cross-functional team collaboration

A company's resilience is determined by how well they manage different disruptions, hence, their ability to perform well during both internal and external disruptions (de Vries, van der Vegt, Scholten & van Donk (2022). According to de Vries et al., (2022), a company's resilience can be improved through cross-functional team collaboration within different departments, where it can guide companies in managing their risks. The definition of cross-functional teams is that people from different departments within a company operate together in order to achieve common goals (Daspit, Tillman, Boyd & Mckee, 2013). The meaning behind cross-functional collaboration is that a company works together and is therefore unified. This enhances the company's ability to identify, understand, share, and use certain information where problems and challenges are managed more effectively (Kang, Ki-Hyun, Shou & Roh, 2022). A cross-functional team has multiple benefits in comparison to a single team, including a wider range and deeper level of information, more innovation, and increased flexibility (Son, Kim, Lee & Ahn, 2019). According to van den Adel, de Vries & van Donk (2023) one of the main objectives behind cross-functional teams is to enhance different knowledge and expertises of people in order to manage different disruptions. Further, Dussart, van Oortmerssen & Albronda (2021) explain that cross-functional collaboration enhances the decision-making due to the fact that different perspectives, competencies, information and assets are combined. This further leads to enhanced communication and has a beneficial outcome on organizational learning and performance (Dussart et al., 2021).

To enhance resilience, cross-functional teams need to collect and analyze extensive volumes of data in order to manage different supply chain disruptions efficiently. Collecting and analyzing extensive volumes of data in order to manage disruptions is referred to as information scouting. A cross-functional team can therefore build a thorough understanding of the disruptive scenario and gain insights into potential responses through information scouting (van den Adel et al., 2023). However, according to Dussart et al., (2021), it is crucial for people involved in cross-functional teams to be committed to the team where a common theme identified in literature is the risk of people not being committed. In fact, it has been evident that support by management is crucial in cross-functional teams (Dussart et al., 2021). Additionally, Tempelaar & Rosenkranz (2019) argue that another challenge within cross-functional collaboration is that the people involved may have different goals due to the diversity of hierarchies, functions and departments included. This is also discussed by Dussart et al., (2021) where the authors mention

that the involvement of different functions and perspectives may be challenging within cross-functional teams. It is therefore crucial for the people involved in cross-functional teams to understand and adapt various interests, opinions and principles in order to trade and unite knowledge among the members (Tempelaar & Rosenkranz, 2019).

2.5.2 Promoting knowledge sharing

Knowledge sharing refers to the exchange of knowledge from one individual to another within a specific department. It is a technique employed in organizations to disseminate knowledge among individuals (Santhose & Lawrence, 2023). Knowledge sharing-activities are recognized as crucial components within companies, as they contribute to the effective organization and utilization of resources (Santhose & Lawrence, 2023). These activities facilitate the dissemination of appropriate information and knowledge within the team, fostering a shared understanding and common interpretations. By engaging in knowledge-sharing, organizations empower their employees to access valuable insights, expertise and experiences, ultimately enhancing overall capabilities and effectiveness (Santhose & Lawrence, 2023). When knowledge is effectively shared within the company, it promotes a collaborative environment where employees are motivated to actively seek collaboration, co-innovation, and co-creating. This is facilitated through transformational leadership efforts and promotes cooperation across departments and organizations (Zhang, Li, Lie & Wang, 2023).

In the perspective of the knowledge-based view of the firm, knowledge is recognized as the key strategic asset that allows organizations to achieve a competitive advantage. This is primarily because the internal and specialized knowledge collected by firms is challenging to replicate, providing them with a distinct advantage in the market (Eslami, Achtenhagen, Bertsch & Lehmann, 2023). Additionally, in addition to utilizing internal organizational knowledge, companies must also actively seek to create and acquire knowledge from external sources to enhance their performance (Eslami et al., 2023). According to Eslami et al., (2023) voluntary knowledge-sharing with direct suppliers and customers is an effective approach to acquire external knowledge. In a study conducted by Chen, Zhao and Lewis (2023) they confirmed that suppliers are more inclined to share knowledge with buyers whom they consider important for their future business. Instead, to promote knowledge sharing from suppliers, buyers can encourage the suppliers in future business plans and provide a long-term relationship vision (Chen et al., 2023). However, it is important to acknowledge that the impact of sharing information on supply chain performance is dependent upon the type of shared information, how it is shared and with whom (Kumar & Pugazhendhi, 2012). The ability to access crucial information throughout the supply chain can also provide additional opportunities. For instance, when information emerges through the supply chain, organizations can take advantage of the enhanced visibility to adapt existing practices or strategize for future operations (Kumar & Pugazhendhi, 2012).

2.5.3 External information sharing

Several organizations aim to improve their supply chain effectiveness where one of the main contributors to achieve that is information sharing among the respective partners involved in the supply chain. Information sharing in the supply chain is seen as an advantage and an efficient strategy in order to improve global performance (Nazifa & Ramachandran, 2019). According to Kumar & Pugazhendhi (2012) efficient information sharing among supply chain partners improves visibility and decreases uncertainties. It contributes to collaboration in different activities of the supply chain such as production and logistics where different partners share and can access data. This further enhances opportunities and decreases uncertainties in the supply chain where available information provides visibility which may lead to improvements in existing processes or planned future processes (Kumar & Pugazhendi, 2012).

In the matter of inventory management, manufacturing companies aim to buy the right quantities at the right time, which may further lead to reduced inventory carrying expenses (Jung & Jeong, 2018). According to Fernando, Abideen & Shaharudin (2020), inventory management can be improved through sufficient information sharing where costs can be reduced. This is also stated by Nazifa & Ramachandran (2019) where they argue that information sharing may contribute to inventory reduction and decreased costs for manufacturers. Additionally, in a study made by Ojha, Sahin, Shockley & Sridharan (2019) the authors state that Dell and Cisco implemented information systems which were shared with external partners which further led to reduced inventory costs and improved order processing and delivery performance. It is crucial to understand how various degrees of information sharing may adjust demand fluctuations, lead times, and volumes (Fernando et al., 2020). Fernando et al., (2020) further state that manufacturing companies often deal with disruptions associated with on-time deliveries and high inventory levels where the focus lies within keeping appropriate inventory levels in order to attain operational proficiency. Non-efficient management of inventory can lead to significant expenses where inappropriate safety stock levels are kept. This further affects the trust and the communication between the partners in the supply chain (Fernando et al., 2020).

However, according to Jung & Jeong (2018) manufacturing companies can attain benefits through real-time information sharing. If a manufacturer provides information regarding their requirements, the supplier can supply the items that are demanded (Jung & Jeong, 2018). In the study made by Fernando et al., (2020) the authors highlight the importance of manufacturers sharing inventory information regarding their demand with suppliers. Accordingly, sharing demand information with suppliers leads to improved inventory performance which will further enhance real-time inventory visibility (Fernando et al., 2020). This is also stated by Pham, Nguyen, Mcondald and Tran-Kieu (2019) where the authors argue that sharing demand information can improve inventory performance in regard to reduced costs and inventory levels. Suppliers can therefore regulate their supply in accordance with the customer's demand which reduces the risk of excess inventory or shortages (Pham et al., 2019).

2.5.4 Continuous improvement

Continuous improvement involves identifying areas that need improvement within an organization. By adopting continuous improvement practices, organizations can maintain their competitiveness in the market while effectively and efficiently meeting customer demands (Khan, Kaviani, Galli & Ishtaq, 2019). These continuous improvement practices facilitate ongoing process improvement within the organization and help organizations in minimizing wastes, leading to increased work productivity and efficiency (Khan et al., 2019). Continuous improvement, also referred to as the Japanese term “Kaizen”, is a philosophy and methodology that emphasizes on implementing small, incremental improvements in processes, systems and work practices over time (Tezel, Koskela & Tzortzopoulos, 2023). Kaizen has been recognized as a key factor in striving for industrial competitiveness measures such as productivity, manufacturing quality, lead time, and flexibility in the automotive industry (Iwao, 2017). In a study conducted by Iwao (2017) the author concluded that Kaizen is seen as a collection of small, individual and incremental process innovations that are made repeatedly by workers and operators in collaboration with their leaders. The focus on Kaizen is on making continuous and gradual improvements to processes, rather than depending on large-scale or disruptive changes. The study by Iwao (2017) confirmed that it is important to involve employees at all levels when identifying and implementing improvements. According to Tezel et al., (2023) Kaizen events are focused on promoting smooth flow of work within a value stream and that senior management should be responsible for overseeing these events.

Furthermore, having daily huddles within a team in an organization is considered important (Tezel et al., (2023). According to Tezel et al., (2023) a daily huddle is a brief and regular stand-up meeting of a work team that refers to 10-15 minutes to share information and keep the focus on important updates and problem-solving. However, employees often waste significant amounts of unproductive time in meetings, leading to substantial work disruptions (Tezel et al., 2023). Therefore, having fast paced meetings will save time. In addition to facilitating work coordination and improvement, daily huddle meetings have been noted to cultivate team building, establish shared mental models and trust among team members, enhance commitment to the chosen course of action, and facilitate prompt decision-making (ibid).

2.6 Conceptual framework

The following conceptual framework presents the identified factors and challenges of safety stock dimensioning from the literature review. This conceptual framework was created to fulfill the purpose of this study and to generate a better understanding of the studied area of factors and challenges influencing safety stock dimensioning. Figure 3 provides a holistic view of the literature review considerations to address research question 1; "*What are the key factors that influence the setting of appropriate safety stock levels in the context of VCT?*" and 2; "*What are the main challenges faced by VCT that influence the setting of appropriate safety stock levels?*". This model will further be analyzed together with the empirical results from the case company and presented in chapter 5 in the analysis.

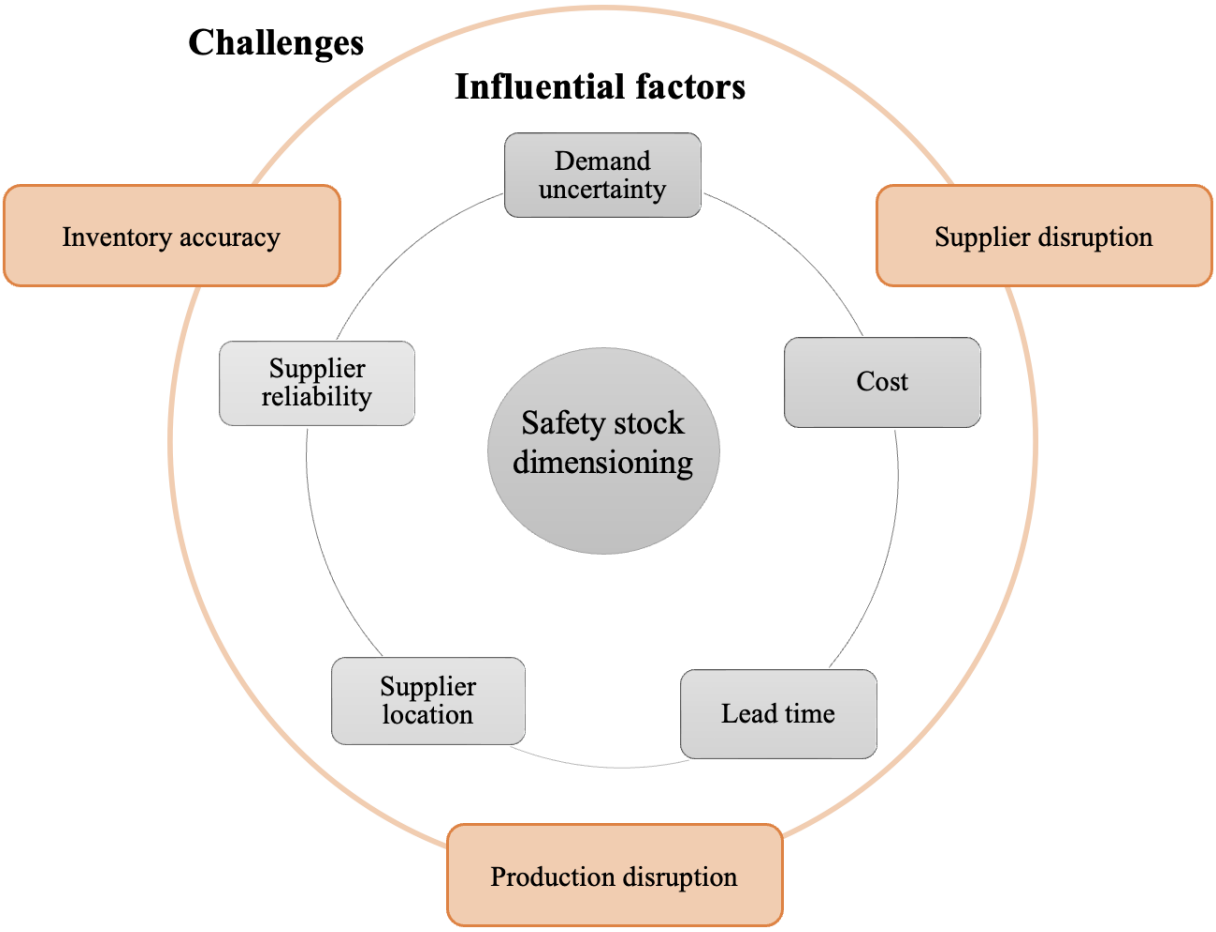


Figure 3. *Conceptual framework of the identified factors and challenges from the literature review (Own illustration).*

3. Methodology

The following chapter includes a description of the chosen methodology of this thesis. It presents the procedural steps undertaken in this thesis and the underlying rationale behind them. This chapter seeks to provide the reader a comprehension of how this thesis has been conducted.

3.1 Research approach

Within research approaches there are two main paradigms that are often followed; *positivism* and *interpretivism*. Research paradigms are defined as philosophical structures that direct the way of scientific research (Collis & Hussey, 2014). Positivism is a paradigm that has an objective perspective on reality where data should be collected through direct observations or measurements. On the contrary, interpretivism is a paradigm that believes that reality is subjective and based on human behavior and generating meaning (Bell, Bryman & Harley, 2022). In consideration of the two paradigms, this study mainly follows the interpretivism approach since the aim is *to identify and increase the understanding of factors and challenges that influence the setting of appropriate safety stock levels for items included in the inventory at VCT*. Accordingly, the data collected and the analysis in this study have been based on subjective phenomena, where interviews have been conducted to understand perspectives and experiences of people, which is connected to the paradigm of interpretivism. The paradigms are further related to two main methodology approaches which are; qualitative and quantitative, whereas interpretivism is more associated with qualitative methods and positivism is more associated with quantitative methods (Collis & Hussey, 2014).

Considering that this study is related to the interpretivism approach, it is therefore based on qualitative methods. Qualitative research involves identifying new issues and opportunities and aims for a more thorough comprehensive assessment of the context, event, or phenomenon being examined. Quantitative research, however, involves measuring real phenomena and linking them with different theories. The focus often relies on examining phenomena that are observable and measurable, hence, objective (Patel & Davidsson, 2019). This study is focused on qualitative methods considering the aim of the study. Additionally, qualitative research is mainly performed in studies that focus on exploring and identifying, which is another reason why the qualitative approach was more concentrated on (Chandra & Shang, 2019). Following the first research question, the focus heavily lied on understanding and identifying the factors that influence the setting of appropriate safety stock levels in the context of VCT, which was conducted through interviews. The aim behind the second research question was to identify and understand the main challenges faced by VCT that influence the setting of appropriate safety stock levels which was conducted through interviews. Lastly, the aim behind the third research question was to identify potential solutions for managing challenges that influence the setting of appropriate safety stock

levels in the context of VCT which was additionally conducted through interviews (Patel & Davidsson, 2019).

Furthermore, different types of logics can be utilized on the interaction between theory and research where the most common ones are; *deductive* and *inductive* approaches (Bell et al., 2022). The deductive approach involves developing a theory which is later evaluated through actual observation which implies that certain situations are concluded from general assumptions. On the contrary, the inductive approach involves developing a theory based on the actual observation which implies that general assumptions are influenced by certain situations (Collis & Hussey, 2014). However, these approaches have some drawbacks where the deductive approach relies on the logic of theory evaluation and falsified hypotheses which is challenging as it is uncertain how the theory should be evaluated. The inductive approach, however, is criticized based on the fact that it is not possible to create a theory regardless of how much actual data is collected. In regard to this, the abductive approach was developed in order to overcome these difficulties (Bell et al., 2022). The *abductive* approach can be considered as a mixture of the two approaches where a continuous discourse is conducted between the researcher, theory and data. Through this approach, unpredicted and new themes can appear besides the predicted ones through the course of data collection and analysis. It is further seen as an appropriate approach for case studies since it provides a deep discourse among the researcher and the studied case as well as among theory and data (Conaty, 2021). The abductive approach was therefore the most suitable approach for this study since a continuous interaction among theory and empirical data was conducted. Through this approach, the researchers had the benefit of discovering new themes throughout the process of data collection and analysis. A case study was also conducted which further aligns with the abductive approach, where discourse between the researchers and the chosen case constantly occurred.

Lastly, research can be classified in accordance with its purpose where four different main classifications exist; *exploratory*, *descriptive*, *analytical*, and *predictive*, whereas this study is mainly related to the exploratory and descriptive approach. The purpose of exploratory research is to identify and develop patterns and concepts where similar previous studies do not exist or simply are a few. It is common to conduct case studies within exploratory research and the approach focuses on collecting large amounts of data as well as perspectives (Collis & Hussey, 2014). The exploratory approach is well aligned with this study since the aim was both to identify and develop patterns and concepts on the studied phenomena of factors and challenges that influence the setting of appropriate safety stock levels. Further, a case study was conducted where large amounts of data was collected through interviews and observations in order to examine different perspectives. The purpose of descriptive research is to define phenomena as they are, where attributes of a certain problem are identified (Collis & Hussey, 2014). The descriptive approach is also well aligned with this study since the phenomena of factors and

challenges that influence the setting of appropriate safety stock levels was defined and related issues were identified.

3.1.2 Research design

In order to identify and increase the understanding of factors and challenges that influence the setting of appropriate safety stock levels for items included in the inventory at VCT, a case study was conducted. A case study is an approach used to investigate a specific phenomena (Collis & Hussey, 2014). The studied phenomena may be a person, a group of people, an organization, a situation or a location (Bell et al., 2022; Patel & Davidsson, 2019; Collis & Hussey, 2014). In this study, the case study was conducted at a specific location, a manufacturing facility within the automotive industry referred to as VCT. Bell et al., (2022) argue that a number of the most well-known studies in business and management have been designed upon the case study approach, which is a prominent and commonly utilized research design in the field. The aim behind a case study is to gain an in-depth understanding of the studied case (Bell et al., 2022; Collis & Hussey, 2014). A case study therefore became the most appropriate research design as this study aimed to perform a comprehensive and deep investigation of VCT. During the process of data collection, interviews and observations were conducted, which according to Bell et al., (2022) are preferable methods to use in case studies in order to get detailed and in-depth knowledge of the case.

3.2 Sample selection

In order to collect the data, purposive sampling was conducted where different criterias were taken into consideration that are significant for this study. The snowball sampling approach was additionally applied (Bell et al., 2022). In the snowball sampling approach researchers reach out to a minor range of relevant people that have significant knowledge within the studied subject, and then proceed to make further connections with others through them (Bell et al., 2022). This was conducted by reaching out to our supervisor at VCT to receive significant recommendations regarding which people to include in the interviews. Through these connections, other participants were recommended as well, which further led to including additional people in the interviews. It was important to include people with experience which we made sure by reaching out to them through email before scheduling the interviews. Collis & Hussey (2014) argue that it is crucial to have people with experience of the studied phenomena in snowball sampling. This was taken into consideration before choosing the participants. Three main criterias were established that were followed before selecting the participants for the interviews:

- All of the participants have a minimum of one year experience within the studied phenomena
- Participants that are responsible of setting the safety stock levels

- ❖ Participants with other worktitles who have relevant experience within the studied phenomena

In regard to these criterias in combination with the snowball sampling approach, it resulted in eight participants in total who were interviewed. All of the participants have more than one year of experience within the studied phenomena, where four of the participants are responsible for setting safety stock levels, one participant is responsible for the people who set the safety stock levels, and the remaining three participants have other relevant experience within the studied subject.

3.3 Primary data collection

An exploratory qualitative data collection was utilized in order to identify factors and challenges that influence the setting of appropriate safety stock levels. This method was primarily used to identify factors and challenges that are influencing the setting of appropriate safety stock levels and to provide the study with a broader understanding from different perspectives. When conducting research with the aim of providing explanations and analyzing the reasons behind a specific issue, the exploratory technique is appropriate to use (Collis & Hussey, 2014). This exploratory method is also associated with investigations in which the aim is to assess the extent and generalizability of qualitative findings by conducting quantitative research as a follow-up (Bell et al., 2022). Throughout the research process, both primary data and secondary data were obtained. The primary data was collected through pre-study participant observations and semi-structured interviews. The secondary data was collected by conducting a literature review.

3.3.1 Pre-study participant observations

The initial data collection was conducted through pre-study participant observations where key personnel from the organization explained the entire process flow of the inbound material. Three participant observations were primarily conducted before any other method was used. Each one of them explained different parts of the process flow of their inventory management. Throughout these instruction guides, notes were continuously taken on the mobile phone. The observation approach can be applied in a variety of ways. In association with exploratory studies, it has been used the most scientifically. The collected information from observations serves as the foundation for additional research using different approaches (Patel & Davidsson, 2019). These pre-study participant observations were conducted to receive a better understanding of the process flow and how certain factors are interlinked with the company's inventory management. During these observations we intended to watch and monitor the entire process flow and at the same time evaluate it as it occurred, and it allowed us to have an open-mind about what data we needed to collect.

3.3.2 Semi-structured interviews

In order to identify and increase the understanding of factors and challenges that influence the setting of appropriate safety stock levels for items included in the inventory at VCT, semi-structured interviews were performed. This method allowed the authors to receive a better understanding from different perspectives of the respondents view and opinions. The reason behind the chosen method was because it combines aspects of structured and unstructured interviews. In addition, the semi-structured interviews were pre-formulated with questions that were adapted based on the respondents background. The pre-formulated questions were designed to be precise to encourage the respondents to talk about the main subjects that are of interest and continuously develop supplementary questions during the interviews (Collis & Hussey, 2014). This allowed the interviews to ensure both consistency and to address the core of the primary goal of the study. According to Easterby-Smith, Thorpe and Jackson (2012) semi-structured interviews are appropriate to use in studies that are investigating an area where the purpose is to develop an understanding of a concept and the logic of an unclear situation, which is the case of this study. Therefore, this method was chosen and designed with open questions to act as a supporting tool during the interviews instead of strict questions, which is a favored method by Kallio, Pietilä, Johnson & Kangasniemi (2016). The advantage of this method is that it can address and reveal problems in the studied area that were not taken into account before the interviews were conducted. This allowed us to conduct the interviews more like a conversation and carefully listen to the respondents answers instead of focusing on taking notes and missing key information (Yin, 2018).

The purpose of a qualitative interview is to discover and identify the characteristics and the nature of the research area. This implies that it is impossible to anticipate the respondent's answers or determine the "correct" response to a question (Patel & Davidsson, 2019). In addition, we ensured to clarify our purpose and what information we wanted to receive through our empirical collected data before conducting the interview guide. In total, seven face-to face interviews and one Team interview were performed and conducted in Swedish. The collected information was transcribed consecutively and the quotes were translated to English by the authors. Being present at the company's office provided the opportunity to conduct several interviews in one day which allowed to save some time. The duration of each interview varied between 40-60 minutes each and was held by the authors which consisted of two interviewers. By having two interviewers it will help ensure that every problem, gestures and interruptions are fully covered (Collis & Hussey, 2014). The following table displays the list of the respondents title and details of the semi-structured interview sessions and the pre-study participant observations.

RESPONDENTS	TITLE	FORMAT	DATE OF INTERVIEW	DURATION OF INTERVIEW
R1	Team leader Internal logistics	Pre-study participant observation	2023-01-20	65 min
R2	Team leader Internal logistics	Pre-study participant observation	2023-01-20	50 min
R3	SCC	Semi-structured interviews	2023-03-27	50 min
R4	SCC	Semi-structured interviews	2023-03-27	40 min
R5	SCC	Semi-structured interviews	2023-03-28	60 min
R6	SCC	Semi-structured interviews	2023-03-30	60 min
R7	Senior Material Handling Engineer	Semi-structured interviews	2023-04-11	55 min
R8	Flow Leader	Semi-structured interviews	2023-04-12	40 min
R9	Plant Supply Chain Technician	Pre-study participant observation & Semi-structured interviews	1: 2023-02-01 2: 2023-04-12	1: 60 min 2: 60 min
R10	Senior Manager Supply Chain	Semi-structured interviews	2023-04-13	45 min
	SCC= Supply chain coordinator			**Average= 50 min**

Table 1. *Details of the interviews, observations and respondents (Own illustration).*

3.3.3 Interview guide approach

Before any action was taken for the interview sessions, an interview guide was designed and prepared with questions on specific topics aimed to be covered. It was ensured to attend to gain some knowledge in the studied area in order to formulate relevant questions. This was conducted with the help of the literature review. The questions were prepared based on the respondents title and divided the questions in different themes in a consistent and systematic manner. This was designed to encourage more elaborate responses (Qu & Dumay, 2011). The questions were formulated to be clear and simple to ensure that the respondents easily comprehend the questions.

In order to obtain a successful interview, a list of nine criterias proposed by Kvale (1996) was taken into consideration when formulating the questions for the semi-structured interviews. For the first criteria, the interviews commenced with introducing questions to allow the respondent to get more comfortable and share some background information such as job description, title, experience within the field etc. The next questions were follow-ups to encourage the respondent to provide more detail in response. In order to maximize the information from the respondents it was ensured to probe the respondents by asking questions to encourage them to provide additional information on their initial statement (Bell et al., 2022; Collis & Hussey, 2014; Kvale, 1996). This is to gain a better understanding of the studied area and to obtain an in-depth understanding of the issue. The interview questions were also formulated to be specific and direct, although they were asked towards the end of the session to not limit and influence the respondents answers. Kvale (1996) also proposed in the nine criterias to pose indirect questions which were included in the interviews in order to gain answers from the individual perspective of each respondent. During the interviews it was important to remain silent to allow the respondents to take pauses when the questions were posed to indicate that the respondents had the option to reflect and elaborate on their response (Bell et al., 2022). Overall, the structure of the questions followed a logical order that moved from general questions to specified topics (Collis & Hussey, 2014). It was also ensured that the interviews were conducted in a quiet meeting room that was booked in advance in order to not get disturbed and interrupted by noises from outside the room.

3.4 Secondary data collection

Apart from collecting primary data through observations and semi-structured interviews, secondary data was additionally collected in this study. Secondary data is data that is collected from different sources that already exist (Collis & Hussey, 2014). The secondary data was collected in order to better comprehend and increase the understanding of the studied phenomena of factors and challenges that influence the setting of appropriate safety stock levels and develop the literature review. The collected literature consisted of articles, books, websites, and journals which were mainly collected through the University of Gothenburg's own library platform *ub.gu.se*, the University of Gothenburg's *library at Handelshögskolan* and *Google Scholar*. It was important to ensure that most of the collected literature was peer reviewed which was conducted through the peer reviewed function on *ub.gu.se* where in fact, most of the literature collected was peer reviewed. According to Collis & Hussey (2014) it is important to identify relevant keywords that are connected to the studied phenomena when collecting secondary data. This was conducted by identifying keywords which were used when searching for literature. The keywords used in this study were; *inventory management*, *safety stock dimensioning*, *challenges with safety stock dimensioning*, *factors influencing safety stock dimensioning* among others. This made it easier to find relevant literature related to the studied phenomena of factors and challenges that influence the setting of appropriate safety stock levels.

Furthermore, when searching and collecting literature the aim was to find the most recent published literature as possible, where most of the literature used in this study has been published in recent years. However, there was no specific limit regarding which years the literature were published since both recent and older sources were used in the study. This was considered in order to not exclude any relevant literature that this study could benefit from. When the literature concerned phenomenons that might change and develop through time such as challenges and factors affecting safety stock levels it was important to make sure that the most recent literature was collected. However, when the literature concerned definitions of different phenomena such as the definition of safety stock and inventory management it was not as highly important to include the most recent literature. A more detailed figure of what was included and excluded in this study is shown below.

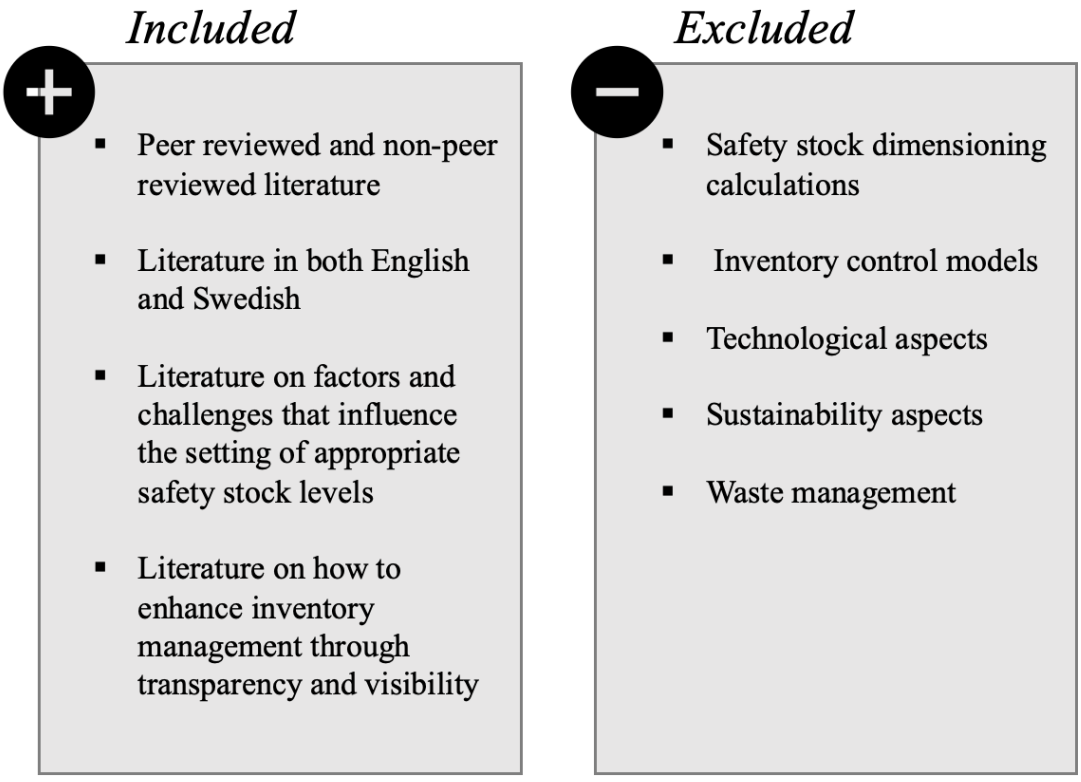


Figure 4. *Included and excluded parts of the literature review (Own illustration).*

3.5 Qualitative data analysis

The following step was to analyze the data once it had been collected. The data analysis was conducted in various different ways such as transcribing, taking notes, recording, and coding. All of the semi-structured interviews were recorded excluding one of them where notes were taken throughout the interview. Considering the interviews that were recorded, it resulted in an entire focus on the interviews and the responses given by respondents. Bell et al., (2022) explain that it

may be disturbing to take notes during an interview where important details may not be apprehended. Recording the interviews is therefore an advantage since all of the answers given by the respondents are fully registered and captured (Bell et al., 2022; Patel & Davidsson, 2019). In regard to the interview where the respondent did not want to be recorded, the interviewers instead took turns in asking questions and taking notes. Bell et al., (2022) explain that it is important to be responsive to the answers provided by the respondent in order to fully comprehend and follow them. When any disruptions occurred during that interview, the interviewers repeated the questions to ensure that every answer was captured in the notes. This was also conducted during the other interviews that were recorded to make sure that every answer was clear and fully comprehended. According to Patel & Davidsson (2019) it is critical to clarify all of the notes taken directly after an interview has been conducted. This was conducted by immediately noting the gathered information after the interviews were completed.

Additionally, Bell et al., (2022) and Patel & Davidsson (2019) argue that the answers provided by the respondent may be affected when an interview is recorded. When an interview is recorded, the respondent may feel uncomfortable or insecure in regard to their answers being recorded (Bell et al, 2022). During the interviews, we made sure that the respondents were ensured that they were anonymous and felt secure on being recorded. On the contrary, Patel & Davidsson (2019) explain that when an interview is not recorded, the respondents may not feel the need to emerge as logical and may answer in a more spontaneous manner. Bell et al., (2022) explain that although most people agree on being recorded, there are some that might disapprove of the request. However, when that occurs, the interview should still be conducted as it is extremely probable that it may provide valid and applicable information (Bell et al., 2022). This was evidential through the interview that was not recorded, where the respondent provided relevant and useful information for the study. After all the interviews were conducted, they were analyzed based on the notes taken and the recordings listened to. In regard to the observations, which were conducted both pre-study and throughout the whole study, they were not recorded, instead, notes were taken throughout the process. The observations were continuously analyzed through the notes taken during every observation. Patel & Davidsson (2019) argue that continuous analysis of qualitative data during the process of observations and interviews is preferable as it may provide the authors with relevant ideas on how to proceed with the study.

Furthermore, after the interviews were conducted they were immediately transcribed in complete detail. After the transcriptions were conducted and processed, a thematic analysis of the collected data was conducted. A thematic analysis is described to be more of an precise explanation of several grounded theory applications (Bell et al., 2022). However, Ryan and Bernard (2003) suggests to consider several criterias when identifying a theme with the application of a thematic analysis. One of the most frequent criteria for determining whether a pattern in the data is significant enough to be considered as a theme is through repetition (Bell et al., 2022). We ensured to carefully follow the six steps that Braun and Clarke (2006) suggests when conducting

a thematic analysis. The initial step was to ***become familiar with the collected data*** by carefully reading the gathered data and taking notes. We also ensured to read through the transcriptions while listening to the recordings at the same time in order to increase the transcription reliability and increase the familiarization of the data (Bell et al., 2022). The second step is to ***generate initial codes*** which were conducted by finding patterns in the collected data which we did by reading through the transcriptions and highlighting various phrases that are relevant and interesting. We highlighted the data in different colors and then put them into codes. The next step is concerned with ***generating themes*** of the collected data which were based on the several codes and then put into themes. We ensured to ***review the themes*** which is the fourth step, and discussed if any changes would be made in order to obtain accurate and relevant thematic analysis. The fifth step is to **define and name the themes** which we conducted by making a categorization of the themes and together discussing relevant definitions to be agreed upon. Lastly, we have documented the gathered information of the thematic analysis and are still in the process of finalizing the report which includes an introduction part, methodology, empirical findings, analysis and conclusion. However, we are making sure to consider the questions "how", "why", "who" and "when" during the ***writing of the report*** in order to describe in detail.

3.6 Ethical considerations

During the process of this study, ethical considerations were taken in order to ensure that integrity was maintained for the company and the respondents that participated in the interviews. Bell et al., (2022) explain that researchers may guarantee that ethical risks are reduced by using ethical standards. In order to ensure that ethical considerations were kept, two main ethical principles proposed by Vetenskapsrådet (2017) were followed; the *research* criterion and the *individual protection* criterion. The *research* criterion implies that research should be conducted based on a valid purpose and be of fundamental value where current knowledge is expanded and broadened, and techniques are strengthened (Vetenskapsrådet, 2017). In this study, it was ensured that the purpose and the aim of our research was of fundamental value and that the information provided can be utilized for educational purposes where the aim was to bring new knowledge to academia. The *individual protection* criterion implies that people who participate in the study need to be shielded from harm and violation. This criterion can further be divided into four different subcategories; the *information* criterion, the *utilization* criterion, the *consent* criterion, and the *confidentiality* criterion (Vetenskapsrådet, 2017).

The four criterions of the *individual protection* criteria were considered during the process of collecting data in the interviews. The *information* criterion implies that participants of the study should be informed of the purpose of the study, the terms of participation, and that it is voluntary for them to participate (Vetenskapsrådet, 2017). All participants were informed of the purpose of the study, what their participation will provide for the study, and that their participation is voluntary. This was conducted by informing the participants by email before the interviews began, where the purpose of the study was presented and that their participation is voluntary and

will only be used for academic purposes where the study will be published online. The participants were additionally informed a second time during the course of each interview, where the purpose of the study was explained, and the participants were informed about their participation and that the interview is voluntary, and also the right of canceling their participation if they want. The *consent* criterion implies that the researchers need to ensure that the participants have provided consent and agreed on participating in the study (Vetenskapsrådet, 2017). During the interview process, all participants gave consent to be involved in the study. This was ensured by asking all participants if they agree on being included in the study and also by asking each participant when they were available for an interview according to their schedule. It was important to make sure that the interviews were prior scheduled according to the participants, where the date and the length of the interview was considered. The participants were additionally asked if the interview could be recorded where everyone gave consent to it except for one participant. It was crucial to ensure that the participants felt comfortable and that no pressure was applied on them.

The *confidentiality* criterion implies that no identifiable information of the participants should be presented in the study, and that the information should be inaccessible for others (Vetenskapsrådet, 2017). It was ensured that no personal information of the participants was provided in the study. During the interviews, the participants were informed that their participation will be kept anonymous where no identifiable information of the participants will be presented in the study. It was therefore important to ensure that no identifiable information was presented in the study. The information that the participants provided was not shared with other people involved nor not involved in the study. The *utilization* criterion implies that data that has been collected for research purposes is not allowed to be used in other contexts other than for academic motives (Vetenskapsrådet, 2017). This was ensured by removing all the collected data once the study was finalized, where the data was only maintained through the process of study.

3.7 Quality criteria of the study

There are four quality criterias that have been considered to ensure trustworthiness in this study; *credibility, transferability, dependability and confirmability* (Lincoln & Guba, 1985; Korstjens & Moser, 2018; Bell et al., 2022).

3.7.1 Credibility

The measure of credibility establishes if the research findings represent feasible knowledge derived from the participants original data and are an accurate assessment of the participants original perspectives (Korstjens & Moser, 2018). In order to enhance the credibility in the study, we used the triangulation strategy to collect the data. This was conducted through different sources such as the respondents with different levels in the organization in order to develop a

broader understanding from different perspectives. This allows for a higher degree of credibility of our study since the respondents from different levels generate information about the studied area from their own perspective. However, in order to not miss any important information being received, we ensured that the interviews were being recorded to increase the credibility of not leaving any information missing. The interpretation of the collected data from the interviews were transcribed directly and the citations were sent to the respondents to let them review and confirm if the gathered data was correctly interpreted. This strategy set for an increased credibility and is based on Lincoln and Guba's (1985) arguments.

This study employs both a qualitative and a quantitative approach allowing access to several levels of reality (Bell et al., 2022). This triangulation strategy also allows for a higher degree of credibility since it gives a broader scope of different perspectives from different perceptions of the studied area (Korstjens & Moser, 2018).

3.7.2 Transferability

Transferability is concerned with ensuring that the collected data is applicable to other studies which goes in parallel with external validity (Bell et al., 2022). The transferability of the study has been fulfilled by the generalizability of our study and conducting a literature review with existing research. The generalizability of this study is not based on a small group or of individuals and is carefully made on the results. To ensure the generalizability of this study, it was important for the authors to include information from several different perspectives as possible in order to provide a broad picture of the topic without excluding any relevant information. However, qualitative research is more focused on depth rather than breadth and which leads to having contextualized the results. Generalizability in qualitative research can sometimes be difficult to obtain but it should not be excluded in the study (Lincoln & Guba, 1985).

3.7.3 Dependability

The criterion for dependability has its parallel with reliability in qualitative research and obtains a trustworthiness through an 'auditing' approach (Bell et al., 2022). This approach involves a detailed description of the complete process of all the phases in the study, which we ensured to include. Each phase of the research has been clearly described in order to keep track of the study and to measure the consistency of the study's results. This has been carefully made, in order to follow the development of the process of this study and to gain an insight from the initial step of information about what methods that have been chosen for data collection, informative description of the empirical findings and logical links in the analysis between data and theory. To ensure dependability, both of us authors were present during the interview sessions and transcribed the recordings together to confirm that the interpretations were agreed upon.

3.7.4 Confirmability

Confirmability refers to the objectivity of the study ensuring that personal values or theoretical inclinations are not inflicted in the research findings (Bell et al., 2022). This is important to consider since the researcher can have an impact on the interpretation of the empirical findings that could decrease the objectivity of the study and include personal imaginations (Bell et al., 2022). However, a complete objectivity in business research is not always achievable even though the authors have pure intentions (ibid). Therefore, we ensured to admit to our own biases and weakness of the reason behind our methodological choice. This improves and increases the confirmability in the study since our own biases were also acknowledged.

3.8 Critique of the research approach

In qualitative research, participants are questioned about their own experiences which provide academics to comprehend the world from the respondents perspectives. This could be considered as a strength but also as a weakness (Ahrne & Svensson, 2015). However, although qualitative research includes mostly benefits, it also faces criticism that has been carefully considered in this study. Several criticisms of qualitative research have been raised according to Bell et al., (2022). Since qualitative research often starts out relatively open-ended and involves gradually narrowing down research questions or issues, the reader may receive few hints of why the chosen area was selected instead of paying attention to another. This has raised a criticism against qualitative research for being ***subjective*** since it is relying on the researchers preferences about what is considered as important when gathering the data. However, the subjectivity can somehow both be considered as a strength or as a potential weakness, as previously mentioned. In order to overcome the subjectivity in this study, we ensured to collect data from respondents that have different perspectives of the studied area to ensure objectivity and avoid bias in the study. Moreover, qualitative research is also considered to be difficult to ***replicate*** since many qualitative studies are unstructured and dependent on the imagination of the researcher making it difficult to conduct an accurate replication (Bell et al., 2022). Another critique that qualitative research has faced is that ***generalization*** can be considered as a negative parameter and is difficult to obtain since the data collection is mainly unstructured and focused on a particular environment. However, the aim of qualitative research is not to draw empirical generalizations about the whole community based on a case study (ibid). To evaluate generalization, it is important to consider the quality of the theoretical conclusions drawn from qualitative evidence (Bell et al., 2022). A further criticism is that there is a ***lack of transparency*** in qualitative research. This is because it can be challenging to determine what the researcher actually conducted and how they came to the study's conclusions when conducting qualitative research. However, we ensured to describe the details of each respondents and to what extent they were selected for interviews and observations (ibid).

4. Empirical findings

The following chapter presents the empirical findings from the interviews conducted at VCT. The interviews included three different departmental perspectives which are presented in the following order; Supply Chain Coordinator, Lean Management, and Supply Chain Technician.

4.1 Involved perspectives from different departments

Figure 5. Presents three different departmental perspectives; Supply chain coordinator (SCC), Supply chain technician (SCT), Lean management (LM) that were involved and are concerned with optimizing the Marketplace at Volvo Cars in TC. The different perspectives represent each department that has different responsibilities to obtain. However, each department has different views on the Marketplace which has several consequences that will further be explained. The purpose of the segmentation of each department is to provide an overview of how different perspectives of the marketplace can result in different perceptions. This is due to the fact that each department has different objectives to accomplish in the Marketplace. The respondents participating in the survey are identified as R1, R2, R3, and so on. However, when the respondents are mentioned as SCC, it implies that the answers are derived from all the respondents within the SCC. The empirical findings are based on each perspective and presented in different themes to gain a better understanding from different points of views. The quotations represent each department based on the following colors in the figure.

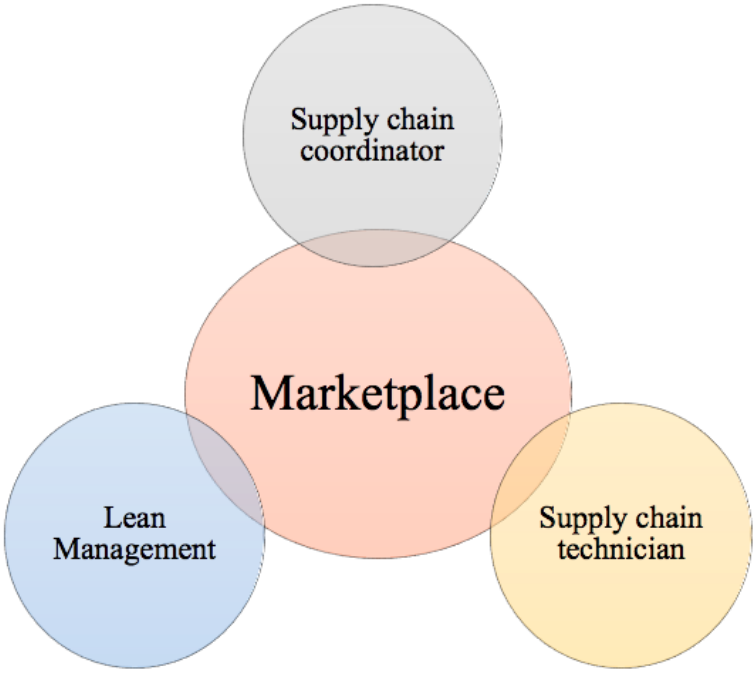


Figure 5. *Three departmental perspectives concerning the Marketplace (Own illustration).*

4.2 Supply Chain Coordinator perspective

When the safety stock levels are being set, several factors are being considered by the SCC's before any action is being taken. The following presented factors are based on the gathered data from the SCC since they are responsible for coordinating and overseeing different factors when setting the safety stock levels.

4.2.1 External factors influencing the safety stock levels

Transportation frequency

The setting of safety stock levels are dependent on different factors that the SCC must consider in order to achieve appropriate safety stock levels and to maintain the inventory replenishment. The transportation frequency is one of the main factors that are considered and refers to the frequency of the materials that are transported from the supplier and to the inventory. Before the safety stock levels are being set, the transport frequency is overlooked by the SCC where they consider the measurement of the amount of deliveries that the supplier has made over a specific time period, such as per day, per week, per month etc. If the supplier delivers frequently per day, it is more likely that the safety stock level will be low since the transport is shipped continuously. R3 and R4 both explain that lower safety stock levels on suppliers that deliver frequently are appropriate because otherwise there will be an issue with space management at Marketplace. Deliveries that occur once per week have a higher safety stock level since the time duration from the supplier to the inventory requires a longer lead time.

> *"As a result of knowing that a new transport is constantly on the way, the chance of lowering the safety stock increases as a transport arrives more frequently" -R3*

R3 explains that other factors are also being taken into account when the SCC are considering the transportation frequency of the suppliers. In some cases, it is required to understand the characteristics of the items since some of them could be crucial to the production if they are highly demanded. These items are also known as critical items since they can create challenges for the company. Further, these critical items are items that need to be assembled immediately and are not able to be assembled afterwards in the process flow. In addition, R3 mentions that these critical items are considered in transportation frequency as well. However, the prerequisites for these items are different even though the transportation frequency occurs several times per day, it is still important to consider if it is appropriate to have low safety stock levels. However, if the deliveries occur for instance once every third day, then it is important to have high safety stock levels due to the uncertainties that may occur. Further, the SCC does not set the safety stock levels on each item since there are numerous things to keep track of, instead the safety stock levels are set on the suppliers. R6 explains that it is possible to set the safety stock level per item but it depends on the characteristics of the item such as if they are highly demanded by the production.

"Our ambition is to always ensure to have material available for the production, and the safety stock levels will be set based on this"-R6

The transportation frequency of the suppliers is also crucial when disruptions in the inventory occur such as lack of materials of a specific item. If the supplier is delivering frequently there is a higher chance that the materials will quickly be replenished since the materials are delivered several times per day. On the contrary, if the transportation frequency of the suppliers are low there is a lower chance that the materials will quickly be replenished which forces the SCC to find other alternative solutions in order to address the issue. Therefore, the transportation frequency is a significant factor that the SCC considers when setting the safety stock levels.

Supplier reliability

Working with suppliers is not only a challenge but also a relationship building process that can impact the setting of the safety stock levels. The suppliers vary in their actions which results in several consequences for the company. The setting of safety stock levels are also dependent on how reliable the suppliers are. R4 explains that some suppliers are delivering according to the agreements that they have made and are reliable since they complete their tasks accurately without any deviations. These suppliers are not being examined daily as much compared to other suppliers that do not deliver according to agreements made such as; scheduled time or ordered material. R6 explains that the suppliers can sometimes send the wrong amount of items that have been ordered or even place the wrong label on the pallets which is crucial. R6 continues by explaining that the pallets are not controlled when they arrive at the facility and it is not until they have reached the production lines that errors are discovered. When such errors occur such as wrong labeled pallets, it leads to several consequences.

"We have to check the items that are wrong, and in the best case scenario you find a replacement pallet. Sometimes we do not find one which leads to material shortages and panic" -R6

R6 further explains that this is crucial as it can lead to disruptions in the production where it might need to stop due to material shortages. Further, the setting of safety stock levels relies on the actions of the suppliers. R5 explains that if the suppliers are reliable and deliver the ordered materials without any disruptions, the safety stock levels can be adjusted to a lower setting.

"The purpose of having safety stock levels are not to cover the deviations made by the supplier, instead our mission is to ensure that the suppliers deliver the right quantity"-R6

R6 explains that safety stock levels should not be set based on the deviations that the suppliers cause. This is because the suppliers must be responsible for their own actions. But it still occurs

in some cases that the SCC must set the safety stock levels based on the deviations caused by the suppliers. R6 also mentions that the purpose of safety stock levels has evolved historically and the aim today is towards managing complex risk situations. Historically, safety stock levels were set to cover the deviations and were set highly. This resulted in having high inventory levels to cover up any disruptions which were not effective. But the ambition today is to obtain a lean management process when setting the safety stock levels.

> *"The safety stock levels that we have today should not intend to only be seen as a tool to buffer against uncertainties, instead it should be considered as a crucial management tool" -R6*

The uncertainties that are caused by the suppliers are managed through different strategies by the SCC. The respondents mention that when a new supplier is added to the company, they have a standard setting of safety parameters. This safety parameter is referred to as the default safety stock level which serves as a starting point for dimensioning an appropriate safety stock level for newly added suppliers. The safety parameter is not considering the frequency of the items. R3 explains that this pre-set safety stock level could be helpful when reviewing the performance of the suppliers and how they are delivering according to what is agreed upon. The SCC are using this to ensure that the supplier is capable of fulfilling its purpose before determining what the actual appropriate safety stock level could be for each supplier. This is only concerning suppliers that are located in Europe, since they are within the same zone. R4 also mentions that this standard setting for new suppliers helps the SCC to develop the relationship they have with them and decides if they are potential suppliers. Further, if the suppliers are delivering according to the agreement and are not causing any disruptions, the SCC then decides if the safety stock level that is set on the potential supplier should be decreased.

> *"It is required to regularly review and adjust the safety stock level until it touches an appropriate level to be set for the supplier" -R4*

When the SCC's are reviewing the suppliers and adjusting the safety stock levels, they are manually adjusting this after they consider that the supplier is approved. The specific time period varies depending on the performance of the supplier and how they operate. This requires them to do it manually according to respondent R4. Since the performance of each supplier varies it occurs that the SCC could forget to adjust the standard setting of the safety stock level for the supplier. Since no adjustments are being made of the standard setting, the suppliers will still continue to deliver according to the safety parameter. R5 also expresses that it is possible to forget to adjust the safety stock levels after the suppliers are approved.

"Since I adjust the safety stock level for new suppliers manually, it occurs that I might forget to decrease the safety stock level. Then I realize six months later that the safety stock level is unmodified, which is not efficient for the stock value"-R5

The supply chain coordinators have recently been required to review four suppliers each month and report it through a scorecard and to the manager. The report should include which suppliers are involved and if any changes or improvements have been modified of the safety stock levels. R4 also explains that this follow up in reporting was implemented several years ago but was not given priority since the SCC stopped using it for some time. However, as previously explained the reporting has been recently established. R5 expresses that it would be better if the technical department was involved in these follow up reporting to discuss and assess whether any adjustments by the SCC have a positive impact.

Geographical location

The geographical location of the suppliers is an important factors when the safety stock levels are being determined according to the respondents. R3 explains that the distance between the supplier and the inventory is crucial when dimensioning the safety stock level. For instance, if a supplier is located far away it will more likely have a safety stock level that is high compared to a supplier that is located close to the manufacturing which would be lower. If any disruptions occur from a supplier that is located close to the manufacturing area it would be easier to solve the problem by accelerating the order process or if a SCC collects the items physically, R6 explains. However, when the safety stock levels are determined based on the geographical location, the SCCs are considering the lead time from the location of the suppliers to the manufacturing area.

"The ideal scenario would be to have suppliers in close proximity to the manufacturing area"

Several respondents agreed that having the suppliers located close to the manufacturing plant would be better than having them located far away like overseas. R5 points out that although it is inexpensive having the suppliers located overseas, dealing with disruptions would become costlier in such circumstances. When disruptions arise from overseas suppliers, it requires more effort to manage the issues by the SCC and incurs higher costs for the company, in contrast to European suppliers according to the respondents. R6 explains that SCCs use alternative modes of transportation such as air freight, to ensure timely delivery of materials when suppliers experience disruptions within europe. In contrast, overseas suppliers necessitates longer lead time to deliver the materials by aircraft which causes inefficiencies, R6 points out.

"It is not feasible to rely on overseas suppliers because it takes time, and sometimes there are unexpected events that require us to have the materials immediately" -R6

Price per unit

Several respondents agreed on considering the cost per item when setting safety stock levels. R5 mentioned that the unit cost of each item determines whether to set a low or a high safety stock level. R5 also points out that the cost per unit of each item is considered to prevent tying up capital in inventory. However, R6 described that since the price per unit of each item varies it is necessary to consider the cost if the item is very expensive. Although the price is considered as a factor, R10 stated that the price per item is not considered as a factor for dimensioning safety stock levels. According to R3 and R4, they do not consider the price per unit as a safety stock factor. Based on the answers given by the respondents, the cost per unit of each item are sometimes considered and sometimes not.

> *"The price per unit of each item is typically not a factor we consider when determining the safety stock levels"-R3 & R4*

The price of each item is usually considered when it reaches an excessive level that catches someone's attention, such as having large quantities of an expensive item in inventory, according to R3. When this occurs, the SCCs have to find other solutions to prevent tying up excess capital in inventory.

4.2.2 Internal factors influencing the safety stock levels

Material handling

Within the company there are some common mistakes that may occur according to the SCCs. According to R10 safety stock has the aim of covering internal deviations as well. For instance, balance differences of the items sometimes occur, which R3 explains is something that appears when the system believes that an item exists when it does not because of deviations that may have occurred somewhere in the company. These deviations could for instance be an item that has been broken on the production line and the individuals who work there have not discarded the item correctly. This leads the system to believe that the item still exists which creates balance differences. R3 explains that there may be items that are crucial and often are thrown in the bin without discarding them in a correct manner which leads to balance differences.

> *"When there is a low safety stock level on supplier level and one of the items of the supplier is crucial and often thrown in the bin without being discarded correctly, then we have balance differences, and then you can simply take this specific item and set a higher safety stock level on it" -R3*

The respondent means that because of these deviations, one might set a higher safety stock level on those types of items. R5 explains that other factors may result in balance differences as well where people in the internal logistics area may drop a box full of items which leads to them

disappearing. According to R3, boxes can also be misplaced in the facility and can not be found which is crucial.

> *"A box can be misplaced somewhere in the factory and can not be found, then it looks like we have shortages" -R3*

Another factor that leads to balance differences explained by R5 may be that the individuals who work in the production line occasionally drop small items which are not discarded at all. Additionally, several SCCs specifically mention that balance differences are crucial when it comes to low running items. R6 explains that if there is a certain amount of a low running item, the SCCs will believe that these amounts exist according to the system. However, if some of these items have been discarded without notifying the SCCs it will lead to material shortage on the production lines. R3 explains that there is a higher risk that a balance difference occurs for items that are low runners due to the fact that they are not shipped to the facility that often. Therefore, when a balance difference occurs due to faulty or no discardings of low running items, it is not often discovered until it reaches the production lines which is crucial since no new material will arrive shortly. The system will therefore not know that the balance has changed due to faulty or no discardings of the items and the SCCs will not order any new ones.

Production disruptions

There are other internal factors that can be crucial as well where R10 explains that disruptions in the production can occur. R4 explains that these production disruptions can be anything from chain breakages or IT issues. When this occurs, R10 explains that the flow of materials keeps coming into the facility although the production has stopped. R10 clarifies that the SCCs system is always frozen for two days in relation to the suppliers, which means that an order of items can not be adjusted in the system within two days. R4 explains that unpredicted production disruptions are crucial due to the fact that material that has been ordered and is being shipped and delivered to the facility. This leads to an overflow of material which has to be placed on the outside of the facility which is crucial. R4 further explains that suppliers overseas are crucial when it comes to adjusting or canceling orders due to the fact that they have longer lead times.

Further, R4 states that it is important to have appropriate safety stock levels due to potential disruptions in the production. If one were to have low safety stock levels on their items, then there is a risk that the production will stop due to material shortages, which leads to tremendous costs for the company.

> *"You should not have too low safety stock levels and you should not have too high either, because it also costs money so you have to find a middle ground" -R4*

When the production stops, there are tremendous amounts of costs that occur for every minute that the production is not running. When disruptions in the production occur, it may result in that the company schedules overtime which also leads to more costs for the company.

4.3 Lean Management perspective

The lean management perspective includes R7 and R8 since both of them have a broad experience in optimizing the Marketplace and work towards a lean Marketplace. Therefore, this section presents several factors addressed by R7 and R8 that could affect the dimensioning of safety stock levels.

4.3.1 Factors contributing to the complexity of safety stock levels

Push system prioritization

The production planning and control system of the inventory in the Marketplace is established through a push system. This requires accurate production planning to make sure that the appropriate quantity of items are produced and allocated into the inventory correctly. R7 who has a broad experience on improving processes and coordinating the development of the logistics strategically believes that the push system in the marketplace is not organized according to priorities. This implies that the items that are produced or transferred through the supply chain are unable to be determined according to a systematic approach. However, R7 also mentioned that they sometimes focus on improving the prioritization by creating several trials to give it some level of attention. Over time, it might fall into oblivion which leads them to forget what they have created. This results in that they need a process to control the trials over time. R7 experiences that this makes it more evident that they do not have a proper prioritization system in place.

> *"A push pull system without a proper prioritization increases the risk of incorrect items being included in the inventory" -R7*

R7 also mentioned that the reason for having incorrect items is because there is no defined maximum level of each item, making it difficult to manage the right quantity of items in the inventory. R7 argues that the uncertainties in the inventory are managed by setting safety stock levels that are not anchored with precision. For instance, if the objective is to manufacture an average of 60 cars per hour, but instead, the production output is 54 or 57 cars on average, three cars are considered out of production, causing variation in production. This results in having a lack of accuracy in production which is according to R7 a crucial factor to consider when setting the formula for safety stock dimensioning.

Internal processes

The internal processes of the inventory flow is an important factor to consider in order to set appropriate safety stock levels. The internal processes refers to several activities that are involved within the inventory to manage the flow of goods. This includes activities from the receipt of goods, delivering the materials to store them in the Marketplace and then delivering it to the production lines by trucks. R8 points out that an understanding of the internal processes would facilitate the setting of safety stock levels in terms of efficiency. It is necessary to have a thorough comprehension of the reasons behind the specific dimensioning of safety stock levels. Further, R8 adds that by considering the internal processes when determining safety stock levels, it will ensure more accuracy and make decisions based on relevant arguments. R8 amplifies by referring to the internal lead time that occurs in the company. This includes the lead time that concerns the time from receiving the goods to delivering it to the production lines which was previously explained. R8 indicates that any factor that is causing delays during the internal lead time, should be addressed by adjusting the safety stock levels.

> *"When there is a lack of understanding, it can be tempting to simply add a safety stock level in order to mitigate risks. Doing so without a full comprehension will result in other consequences" -R8*

Another important aspect that R8 points out is to involve the SCCs to the reality of inventory by actively engaging them. This is because they are working behind the scenes and might have another perception of the safety stock levels in reality. R8 exemplifies by referring to the scenario of a supplier that worked with duo sourcing which is a supply chain strategy that sources the same item from two suppliers instead of one. The aim of this strategy is to mitigate the risks by not relying on one single supplier. However, this strategy failed to consider other factors that created challenges for the inventory management since having two suppliers increased the space requirements in the inventory and the transportation flow. This resulted in having the suppliers visiting the inventory to gain a broader understanding of the inventory and how their decisions have an impact.

"It is crucial to understand the decisions made within the walls" -R8

4.4 Supply Chain Technician perspective

4.4.1 Technician's role in managing Marketplace

The technician has a role that covers a wide area including engineering box flows, optimizing the inventory and Marketplace, support the internal logistics team if any deviations occur, participate in various meetings, conduct risk assessments, and also provide data for various calculations that are used in strategic plans. When it comes to the Marketplace which is the technician's main area of responsibility, there are various challenges currently occurring.

Unbalanced safety stock levels

The balance of safety stock levels is another issue in the Marketplace. R9 explains that the reason why there is too much or too little safety stock in the Marketplace is because there is no awareness around it. There is a certain algorithm that the company takes into consideration when setting safety stock levels which revolves around how often the suppliers are shipping to the facility. Additionally, R9 implies that the safety stock level also depends on where the supplier is located. For suppliers that are overseas, the safety stock levels are higher due to potential issues that might occur during the lead time. On the contrary, for suppliers within Europe the safety stock levels are lower. However, R9 states that the issue revolves around that every new supplier has a default safety stock level which is crucial if one were to not adjust it. Further, R9 explains that the consequences with too little safety stock affects the production, since material shortages will lead to production stops. On the contrary, too much safety stock results in consequences for the company in general. This often revolves around inventory costs where the items that are kept results in tied up capital. Additionally, R9 continues to explain that it results in tremendous work for the people who work within internal logistics.

"Storing in and storing out, it is not lean, it is very inflexible" -R9

R9 further explains that if one supplier ships 200 boxes and the inventory has a maximum capacity of 1200 sites of boxes, then these 200 boxes will take up a large amount of space, where at the same time 1400 boxes need to be placed in the inventory. R9 states that this has an impact on the company and a balance therefore needs to be identified. Further, R9 explains that the frequency of deliveries from the suppliers also affects the inventory. Items that are shipped on a daily basis which often are middle and high runners do not take up any space in the inventory due to the fact that they are continuously consumed in the production.

> *"At the same time as one comes in, it also goes out, so the stock level goes up a little and then goes down" -R9*

However, items that are not shipped on a daily basis and have a higher safety stock level take up more space since they are slowly being consumed in the production. The inventory levels are therefore slowly lowered until they have been consumed. R9 clarifies that this is something that one wants to avoid.

Crucial items

In the company, there are some crucial items, which R9 explains are challenging. These items are small and difficult to keep track of where no article number is labeled on them. R9 implies that if one were to take a tour within the facility, one would see several of these items on the floor. These items are crucial since they are shipped in the exact amount that is consumed within the company. R9 explains the process of it where the operators within internal logistics scan the package with the items and afterwards an order is sent to the suppliers that the items have been consumed. However, the crucial part is that if the items are dropped somewhere, not discarded correctly or inventoried it will lead to balance differences, which is crucial. When balance differences occur, R9 explains that it will lead to material shortages, which also results in the need of booking expensive transportations from the suppliers. In the worst case scenario, it could lead to disruptions in the production where the production will have to stop which is expensive for the company. Another challenge explained by R9 is the unstandardized process conducted by the operators who work within internal logistics. When it comes to these crucial items the operators who work within internal logistics scan the packages and order several new ones containing these items in order to fill up the stocks by the production lines.

> *"In effect, what you have achieved, is that you have built up a hidden safety stock against production" -R9*

R9 further explains that the operators within internal logistics buffer up these boxes and pallets containing the crucial items. As a result, the same amount of boxes and pallets that the operators have scanned and buffered by the production lines will be ordered from the suppliers, which is crucial. R9 implies that this leads to a tremendous amount of items shipped to the facility because the system believes that these have been consumed when in reality, they are buffered in a hidden safety stock by the production lines. These boxes and pallets that have been buffered by the production lines will remain there for some time which is why R9 refers to it as a hidden safety stock which is a big problem. Further, R9 explains that because the operators manually conduct orders, they can order how many boxes or pallets they want. Although there is a certain standard in the Marketplace implying that a certain amount of boxes or pallets should be ordered, these standards are not always followed by the operators, which is why R9 refers to it as unstandardized processes.

4.5 Barriers to transparency among the different departments

4.5.1 Excessive stock levels

When new suppliers are added to the company, the SCC uses the default function to ensure that the supplier delivers and performs according to the agreement, as previously discussed. However, there are situations where the SCC's fail to adjust the safety stock level to an appropriate level for each supplier. The reason for this is that they may inadvertently fail to adjust the safety stock level to a lower setting. This can in some cases result in overstock, since the materials are being delivered according to the default setting. By default, the safety stock levels are set to be high. According to R5, they receive notification of the need to reduce the safety stock level for an item only when inventory operators report excessive levels of that item in stock. The SCCs are not able to recognize if there is too much safety stock of an item in their system. Therefore, the only time this is detected is when an overstock occurs. R5 points out that there is a need to enhance the communication between the inventory operators and SCCs.

> *"We need to improve the visibility in identifying and managing overstocked inventory levels"-R5*

The team manager receives a monthly report from the SCCs review of four suppliers as previously mentioned. This is to update if any adjustments or changes have been conducted. However, other departments do not receive the information from the report of the suppliers. R6 also mentioned that it would have been beneficial to cooperate with the technician of Marketplace to receive some feedback on the changes. R9 points out that they are working closely on optimizing the Marketplace with the SCC department but it requires clear communication since they work in parallel.

4.5.2 Damaged items

There are situations when items are damaged in the inventory. These damages should always be registered for the purpose to keep the system updated and improve the quality. However, in some cases when these damaged items are not registered in the system, the SCCs are not informed that the items are damaged since they are notified through the system. Since the items are damaged, they are inoperable. Given that the system has not been updated and does not consider the item that has been damaged in the production, leads to several consequences. R6 exemplifies by referring to a case where a damaged item was not reported by inventory operators to the SCCs, resulting in a shortage of that item. The SCCs believed that there were enough safety stock levels for that item, as it was visible for them in the system. R4 also points out that when damaged items are not registered properly in the system, the SCCs will not have accurate safety stock levels for that item, resulting in a failure to reorder those items.

"It is important to always report when the items are damaged, but one should consider that communication breakdowns can occur between the different shifts, leading to gaps in information" -R4

The system may show the availability of an item that is actually not present due to improper management of registering damaged items.

4.5.3 Communication

When discussing communication, R8 explains that the team the respondent works within is closely seated to the SCCs and the respondent explains that they do not communicate that much.

"We sit really close to each other, so we should talk more. But not on that level as if it is a joint job" -R8

This is also brought up by R7 where the respondent states that a certain degree of communication exists between the respondent's team and the SCCs, however, it is mostly coincidental dialogues. R7 clarifies that these dialogues often occur when someone has a certain question in which they need answers for. Further, R7 explains that there are also daily dialogues between the team and the SCCs.

"Personally, I talk with people who I have known since before, or just because I have an errand" -R7

Further, R8 explains that there is no transparency between the departments and continues to explain that the best possible outcome would be if the respondent would have a dashboard that includes all of the suppliers. Then, the safety stock levels could be shown for both the respondent's team and the SCCs. R8 clarifies that this would lead to a better understanding of the safety stock levels where the SCCs could explain the reasons behind them. However, due to the fact that the communication between the departments is not current, it leads to an invisibility.

"It is so invisible, the communication is nonexistent" -R8

R8 explains that the communication between them and the SCCs should be easier than what one could imagine. Further, R9 explains that in the role as a technician there are several people involved in the improvement processes, which are conducted continuously. R9 clarifies that when a proposal occurs, and there is a need for improvement, the respondent checks who is involved in the proposal.

"I work with everything and everyone because I work continuously" -R9

R9 clarifies that because of the wide role as a technician, the work involves continuous dialogues and cooperation with several different departments including people in the production and SCCs. Due to the fact that SCCs continuously work with suppliers, R9 explains that there is a cooperation between the respondent and them because one of the strategic plans is to optimize Marketplace through box optimization. When such opportunities occur, R9 has a dialogue with the SCCs in order to see if those changes are possible. At the same time, R9 explains that there is a lot of parallel work, however, if the communication is conducted, then there should not be any issues.

5. Analysis

This chapter presents the analysis of the empirical findings discussed with the findings from the literature review. Aligned with the structure of chapter 2 combined with chapter 4, this chapter starts with an analysis of the factors followed by the challenges and suggested improvements. At last, a revised conceptual framework is presented.

5.1 Factors influencing the safety stock dimensioning

5.1.1 Transportation frequency

Nowadays, time is considered as an important aspect and the significance of it has increased (Lumsden et al., 2019). According to Möllering (2019) transportation is one of the main reasons for keeping inventory due to the fact that it is time consuming. In relation to time, transportation frequency was highlighted as one of the main factors influencing safety stock dimensioning by the SCCs. The SCCs consider the frequency of deliveries made by suppliers within certain time intervals such as daily, weekly, or monthly. It was also highlighted by the SCCs that deliveries that occur once per week have a higher safety stock level since the time duration from the supplier to the inventory requires a longer lead time. Although transportation frequency was not identified as a factor influencing safety stock dimensioning in the literature, the lead time is considered as an important factor in this regard (Wild, 2018; Wu et al., 2015; Rushton et al., 2022; Mamani & Moinzadeh, 2014). In the literature, lead time is defined as the time between a placed customer order until it has been delivered, and it can therefore be referred to as the total time a customer needs to wait (Jonsson & Mattsson, 2023; Lumsden et al., 2019).

Additionally, it can be inferred that the transportation frequency is interconnected with lead time where the SCCs explained that infrequent deliveries are associated with longer lead times. According to Wild (2018) and Mamani & Moinzadeh (2014) longer lead times contribute to higher safety stock levels. On the contrary, shorter lead times may result in decreased safety stock levels (Wu et al., 2015). Similarly, R3 and R4 demonstrated that frequent deliveries result in lower safety stock levels, while less frequent deliveries result in higher safety stock levels. R3 further emphasized the importance of having high safety stock levels when deliveries occur, for instance, once every third day due to potential uncertainties. This may imply that less frequent deliveries lead to an exposure of uncertainties which is why the SCCs set higher safety stock levels on those suppliers. This was further recognized in the literature where Jonsson & Mattsson (2023) explain that longer lead times result in several poor events such as increased response times to order placements which leads to reduced flexibility. In regard to this, the uncertainties that emerge from less frequent deliveries at VCT may be similar to those proposed by Jonsson & Mattsson (2023). It is therefore appropriate and evident that the SCCs adjust their safety stock levels in accordance with how often the suppliers deliver to the facility.

5.1.2 Supplier reliability

The relationship with suppliers may differ where some are simple to work with while others are exceedingly challenging (Wild, 2018). In the case of VCT, the suppliers vary in their actions which results in several consequences for the company according to the SCCs. In fact, how reliable a supplier is has an impact on the safety stock dimensioning at VCT. Powell et al., (2020) explains that suppliers varying responses in relation time has a significant impact on safety stock levels. According to R4 some suppliers are delivering according to the agreements that they have made and are therefore reliable since no deviations are made. Lumsden et al., (2019) define this as delivery precision where the importance lies within delivering at the right time in relation to what has been agreed on. R4 further demonstrated that suppliers that deliver according to the agreements are not examined as much as the suppliers that do not follow the agreements, where factors such as scheduled time and ordered material are considered. In relation to ordered material, Jonsson & Mattsson (2023) define the ability of delivering the right item in the right amount as delivery security, where a low delivery security may lead to unnecessary procedures needed to be conducted. This was acknowledged during the interviews where R6 demonstrated that suppliers sometimes send the wrong amount of items or label the pallets wrong which results in unnecessary procedures needed to be conducted. When pallets are labeled wrong at VCT, they need to search for replacement pallets which can be seen as crucial since it is time consuming. Further, if replacement pallets are not identified, it may lead to disruptions in the production due to material shortages (R6, 2023). Jonsson & Mattson (2023) similarly discuss this where they demonstrate that late deliveries are not accepted for items that are coordinated with other items such as those in manufacturing processes. In fact, it can be crucial for manufacturing companies if an important component or item is missing due to the fact that the production might stop (Jonsson & Mattsson, 2023). Although Jonsson & Mattsson (2023) refer to late deliveries, it can be indicated missing items in a manufacturing company such as VCT may result in production disruptions, as mentioned by R6.

It is therefore crucial to have appropriate safety stock levels in relation to unreliable suppliers as it may otherwise result in stockouts (Strohhecker & Gröbler, 2020). In regard to this, the setting of safety stock levels relies on the actions of the suppliers at VCT. R5 demonstrated that when suppliers are reliable and deliver the ordered materials without any deviations, the safety stock levels can be adjusted to a lower setting. This indicates that when no deviations are made by the suppliers such as late deliveries, wrong labeled pallets or wrong amount of items, the SCCs at VCT decrease the level of safety stock on that specific supplier. The SCCs further explained that they have a standard setting of safety stock levels when new suppliers are added to the company which is referred to as the default safety stock level. R4 explained that if the suppliers deliver according to the agreement where no deviations are made, the SCCs evaluate if the safety stock level on the suppliers should be lowered. Similarly Ye et al., (2022) explain that suppliers that deliver on time may lead to reduced safety stock levels. It is therefore evident that the SCCs lower safety stock levels on suppliers that do not make any deviations. However, R6

demonstrated that safety stock levels should not be adjusted based on deviations caused by suppliers due to the fact that suppliers must be responsible for their own actions. Although R6 statement is comprehensible, supplier reliability was identified as a main factor influencing safety stock dimensioning in the literature where Wild (2018) argues that safety stock is kept in order to compensate for failed deliveries of suppliers. It is therefore appropriate that the SCCs adjust their safety stock levels in accordance with the performance of suppliers.

5.1.3 Supplier location

One of the criterias that a company considers when selecting a supplier is the geographical location of the supplier (Sonar et al., 2022). The reason for this is because supplier location distances can significantly impact expenses and add complexity within production planning and inventory management (Kalchschmidt et al., 2020). This was acknowledged during the interviews with the SCCs, addressing that the supplier location is a crucial factor when dimensioning safety stock levels since it determines the quantity of safety stock levels based on the distance and lead time (R3, 2023). The supplier location is also crucial in the event of disruptions occurring by a supplier located close to the manufacturing area, since problem resolution becomes more manageable by, for instance, expediting the order process or utilizing a SCC for physical item collection (R6, 2023). Proximity of suppliers to the company results in lower transportation expenses, allowing for frequent and smaller deliveries during each delivery period (Jonsson & Mattssson, 2023). However, having the suppliers located far away offers opportunities for both revenue growth and cost reduction (Dias et al., 2020). Despite the benefits of having the suppliers located far away from the manufacturing company, R6 argues that when disruptions occur with overseas suppliers, it necessitates increased efforts from the SCCs to address the issues, resulting in higher expenses for the company. R6 emphasizes that having overseas suppliers leads to longer lead times for material delivery via aircraft, resulting in operational inefficiencies.

The SCCs are able to manage supplier issues that are close to the company by using alternative modes of transportations to ensure the materials are delivered quickly. Therefore, having closely located suppliers will benefit the company when disruptions occur (Wild, 2018). However, it is difficult to make a definitive statement that having suppliers in close proximity to the company is advantageous, one could argue that it requires more effort having a close proximity than having the suppliers located far away from the company. Hence, having suppliers located far away from the company will restrict the relationship flexibility and communication possibility due to different time zones and working schedules (Jonsson & Mattson, 2023). R6 emphasizes that having overseas suppliers leads to longer lead times for material delivery, resulting in operational inefficiencies. Additionally, R5 highlights that while sourcing suppliers overseas, managing disruptions in such scenarios leads to increased expenses for the company. It is of great importance that VCT evaluate their suppliers to manage and monitor the risks associated with both overseas and proximity suppliers. A suggestion would be to develop strategies for

disruption mitigations that are related and designed for proximity and overseas suppliers since the VCT deals with both types of suppliers. However, having suppliers located far away may require effective communication to prevent disruptions from occurring.

5.1.4 Inventory Costs

Several implications can arise from having high levels of safety stock in the inventory (Rushton et al., 2022). One of these implications is that the high levels of safety stocks can tie up capital in the inventory adding additional expenses to the company. In connection to the discussion about costs from the interviews, the answers from the SCCs varied regarding the considerations of price per unit when determining safety stock levels. R5 addressed that the price per item is important to consider when setting safety stock levels since it determines whether to set a low or a high safety stock level. Further, R5 stated that by considering the price of the unit will also prevent tying up capital in inventory. On the contrary, R10, R3 & R4 addressed that the price is not considered when dimensioning safety stock levels, indicating a lack of consideration for the price factor among some SCCs when setting safety stock levels. However, it appears that their price per item is not considered as a priority by some of the SCCs when setting the safety stock levels at VCT. Hence, it is vital for all the SCCs to be informed whether the price per item should be considered or not. The perception that the authors experienced from the SCCs interviews about considering price per item was that there is not a clear restriction whether to consider the price per item or not. R6 for instance, stated that the only time when price per item is taken into account when determining safety stock levels is when the item is very expensive. One can therefore argue whether it is important to consider the price per item or not when establishing safety stock levels.

Furthermore, the disadvantage of maintaining high safety stock levels extends beyond increased inventory costs. It can also lead to the risk of obsolete inventory or deterioration of the items that have been stored for an extended period in the inventory (Rushton et al., 2022). VCT should verify whether cost is a significant factor that influences safety stock dimensioning, as it was not explicitly emphasized in the interviews that cost was a primary consideration. Therefore, one might question whether the SCCs follow any guidelines for determining safety stocks.

5.2 Challenges influencing the safety stock dimensioning

5.2.1 Inaccurate inventory balances

Inventory accuracy is a crucial factor in the management of material (Bragg, 2004). According to Lumsden et al., (2019) it should be evident that inventory balances are accounted correctly and represent the actual inventory balance. However, due to different reasons, incorrect inventory balances may occur where items are wasted or different stock changes are unreported (Jonsson & Mattsson, 2023). This was acknowledged during the interviews at VCT, where common mistakes

may occur according to the SCCs. R3 explained that inventory balance differences occasionally occur which is something that appears when the system believes that an item exists when it does not. Hassan Zadeh et al., (2016) define this as inventory record inaccuracy which is the discrepancy between the inventory records in the system in contrast to the actual inventory that is kept. According to R3, these deviations could for instance be an item that has been broken on the production line and the individuals who work there have not discarded the item correctly, which further leads to balance differences. Additionally, there may be items that are crucial which are often thrown in the bin without being discarded correctly which results in balance differences R3 explained. Similarly, Drakaki & Tzionas (2019) explain that inventory inaccuracy is mainly caused by inventory losses and wrong transactions.

R3 further demonstrated that when a supplier has a low safety stock level and supplies an item that is crucial and often thrown in the bin without being discarded correctly at VCT, the SCCs can specifically adjust the safety stock level higher on that item. According to Lumsden et al., (2019) safety stock levels will increase if incorrect inventory balances is included as a factor for safety stock dimensioning, which aligns with the statements made by R3. Furthermore, R9 (*Supply Chain Technician*) also discussed the challenges in relation to crucial items where the respondent explained that there are crucial items that are small and difficult to keep track of with no article number labeled on them. If the crucial items are dropped, not discarded correctly or inventoried, it will result in balance differences which is crucial. R9 further argued that balance differences lead to material shortages which additionally results in the need of booking expensive transportations from the suppliers, or in the worst case scenario it could stop the production which is expensive for VCT (R9, 2023). Similarly, Bragg (2004) mentions that a challenge emerges when there are incorrect balances of the inventory. In fact, if the inventory records are incorrect in a manufacturing company it may lead to severe challenges where the material management must seek it and may additionally place an instant order to the supplier, where at the same time, the production lines might need to stop (Bragg, 2004), which aligns with the challenges and consequences of balance differences argued by R9. It can therefore be interpreted that inventory balance differences are crucial as they may lead to several consequences for VCT.

Additionally, R5 explained that people who work in the production lines occasionally drop small items that are not discarded at all which is crucial. This aligns with what Jonsson & Mattsson (2023) state where the authors mention that incorrect inventory balances may occur due to unreported stock changes. In relation to that, Drakaki & Tzionas (2019) explain that inventory losses are one of the main factors causing inventory inaccuracy. R5 further demonstrated that there are other factors that may result in inventory balance differences. For instance, people in the internal logistics area may drop a box full of items which leads to them disappearing (R5, 2023). Similarly, R3 explained that boxes can be misplaced in the facility which are crucial to find. As a consequence, the misplaced boxes make it appear as VCT has material shortages which is crucial (R3, 2023). Hassan Zadeh et al., (2016) also discuss this where the authors

explain that misplaced items leads to a current decrease of the inventory which is another reason why incorrect inventory records may occur. Incorrect inventory records is crucial as it may influence how a company performs where it could potentially lead to material shortages (Hassan Zadeh et al., 2016), which aligns with the consequences explained by the SCCs. In order for material management to maintain control of the inventory it is required to know what quantities exist in the inventory where an inventory accounting must take place (Jonsson & Mattsson, 2023).

It is therefore important for VCT to discard their items correctly as it may otherwise lead to severe consequences such as material shortages and stops in the production which is costly. A factor contributing to inventory balance differences and material shortages is due to the fact that the SCCs can only see correctly discarded items in their system, where items that are not discarded correctly or not at all will not be seen. This results in that the SCCs will believe that these items still exist at VCT where they will not order any new ones which is crucial. As mentioned before, the SCCs will additionally set higher safety stock levels on crucial items that are regularly thrown in the bin and not discarded correctly or not discarded at all. This is crucial as it has an impact on the dimensioning of safety stock levels, which is why there must be improvements in the discarding of items. However, according to R10, safety stock has the aim of covering internal deviations as well. One could argue whether these internal deviations such as inventory balance differences should be included as a factor for safety stock dimensioning. In relation to this, Lumsden et al., (2019) explain that safety stock is kept to manage different uncertainties where incorrect balances is one of them. However, if this uncertainty is included as a factor for safety stock dimensioning, safety stock levels will further increase (Lumsden et al., 2019). It can therefore be argued whether it is appropriate or evident that inventory balance differences should be included as a factor for safety stock dimensioning due to the fact that it will lead to increased safety stock levels.

5.2.2 Production disruptions

Dong et al., (2018) explain that a notable risk for manufacturing companies is production disruptions. According to R10 disruptions in the production can occur at VCT which R4 explained can be anything from chain breakages or IT issues. Similarly Hançerlioğulları et al., (2016) explain that the production process is unreliable due to potential machine breakdowns which causes process uncertainty. When such disruptions occur in the production at VCT it does not stop the ordered materials from being delivered to the facility. In fact, the SCCs system is always frozen for two days in relation to the suppliers, which means that an order of items can not be adjusted in the system within two days (R10, 2023). This can be seen as crucial for VCT due to the fact that placed orders may not be adjusted in time since the system is frozen for two days. However, R4 explained that this is mostly crucial when it concerns suppliers that are overseas due to the fact that they have longer lead times. In relation to this, Lumsden et al., (2019) discuss that longer lead times result in a wider spread of the demand. This is something

that Wu et al., (2015) also discuss where the authors explain that the lead time influences the level of demand uncertainties. Due to longer lead times on suppliers that are overseas, the demand becomes more uncertain. When production disruptions therefore occur at VCT, the demand for the ordered material has decreased, and the SCCs are exposed to challenges where they might not be able to change the orders due to the fact that the system is frozen for two days and the suppliers with longer lead times might have already sent the requested orders. This is something that Jonsson & Mattsson (2023) discuss where the authors explain that longer lead times can lead to increased response times to order placements and reduced flexibility which aligns with the challenges caused by suppliers with longer lead times at VCT. This further adds extra costs for VCT, where material keeps coming in although it is not demanded due to the fact that the production has stopped. In relation to this, Wu et al., (2015) state that shorter lead times may result in reduced safety stock levels and reduced inventory holding costs, where several companies aim to shorten lead times as a strategy towards efficient inventory management. One could therefore argue whether it is appropriate to have suppliers with long lead times at VCT due to the challenges that arise with production disruptions.

However, there are other factors that may contribute to production disruptions such as the level of safety stock that is kept. R4 stated that it is important to have appropriate safety stock levels due to potential disruptions in the production. In relation to this, Geraint (2014) discusses that safety stock can be implemented to manage operational and financial challenges that arise from production disruptions. R4 further explained that if one were to have low safety stock levels on their items, then there is a risk that the production will stop due to material shortages, which leads to tremendous costs for the company. This is also discussed by Rushton et al., (2022) where they argue that it is necessary to maintain some amount of safety stock in order to prevent stockouts. Accordingly, Möllering (2019) explains the importance of buffering inventory due to potential delays which could be highly costly, which aligns with the statements made by R4. Therefore having low safety stock levels could lead to material shortages and stops in the production which further adds costs for VCT. The authors strongly believe that it is highly important to maintain appropriate safety stock levels due to the risk of potential disruptions in production.

5.2.3 Management of supplier disruptions

Disruptions caused by the suppliers can arise several complexities for the inventory management of a company (Dias et al., 2020). However, selecting resilient suppliers has become progressively complex for companies. This observation was confirmed by the SCC respondents who indicated that they employ a safety parameter for safety stock levels as a customary practice to assess the performance of new suppliers and ascertain their ability to operate without any disruptions. However, the issue in this scenario does not lie in the utilization and function of the safety parameter, but rather in the management of it by the SCCs. For instance, when establishing the safety parameter for new suppliers, no specific due date is imposed that suppliers must adhere to.

The standard setting aims to account for any potential deviations caused by new suppliers and to ensure the timely delivery of materials. However, there is no consideration given to the proximity of suppliers, whether they are located nearby or far away.

The manual adjustment of the safety setting by the SCCs to an appropriate level after reviewing the suppliers is ineffective, as it necessitates the SCCs to continuously stay informed about the suppliers' status and make ongoing updates. This gives rise to inefficiencies, as highlighted in the discussions as there are instances that the SCCs forget to adjust the safety stock levels to its appropriate level, although the suppliers are approved. As Strohhecker and Gröbler (2020) stated, it is important for companies to establish appropriate safety stock levels as failures to do so can result in stockouts and impose additional costs on the company. However, despite the benefits of this pre-set safety stock levels of reviewing suppliers performance, if one does not manage it correctly it would lead to incorrect deliveries of items which is causing additional expenses for the company. This also results in having high safety stock levels in the inventory which could increase the risk of obsolete items. Such obsolescence can have adverse environmental implications. However, correct deliveries of items are of high importance for companies since inventory items are decreasing in recent years (Lumsden et al., 2019). It is noticeable that there is a lack of information sharing between the company and the suppliers. A suggestion in this case would be to increase the visibility for the suppliers by implementing measures such as regular supplier performance review and transparent communication. In connection to this, Jung and Jeong (2018) emphasize the significance of a company sharing comprehensive information regarding their requirements with the supplier, as it directly contributes to enhanced performance. This practice ensures that the suppliers can accurately supply the items in accordance with the specific demands, resulting in improved operational efficiency and successful fulfillment of the company's needs. In relation to this, sharing information among suppliers will contribute to an improved visibility and decrease uncertainties in the supply chain (Kumar & Pugazhendhi, 2012).

Furthermore, by having reports of reviewing four suppliers each month facilitates keeping the team updated whether any changes or improvements have been modified. In this case, the only department that is involved are the supply chain coordinators. A suggestion would be to include different departments such as the lean management team or the technician team to keep everyone updated and suggest their improvements. When knowledge is shared efficiently throughout the organization, it fosters a collaborative atmosphere that encourages employees to actively pursue collaboration, co-innovation, and co-creation (Santhose & Lawrence, 2023). Promoting collaboration between different departments has also been suggested by R5 as a means to facilitate the exchange of improvements and feedback. VCT should engage different departments in order to achieve greater visibility and knowledge sharing between the departments to improve the inventory since every department has different perspectives.

5.2.4 Internal capabilities in managing disruptions

The purpose of having safety stocks is to prevent an out-of-stock situation in the inventory (Barros et al., 2021). It is also described that safety stock levels serve as a form of insurance, providing an additional buffer of inventory to address any uncertainties or fluctuations in demand and supply. However, some of the SCCs mentioned that many problems that occur in the supply chain are caused by the suppliers. In relation to this, R6 argued against using safety stock levels to compensate for the disruptions caused by suppliers, asserting that suppliers should be accountable for their own actions and their consequences. Furthermore, it still occurs in some cases that the SCCs must set safety stock levels to cover up for the deviations caused by the suppliers. In relation to this, Luangkesorn et al. (2015) suggest that companies should shift their perspective from attributing supply chain disruptions solely to external suppliers and expecting them to be solely responsible. On the other hand, the authors recommend that companies recognize the importance of their internal production capabilities and actively utilize them to recover from disruptions. This would reduce the companies reliance on external suppliers and manage their supply chain resilience. Hence, this was acknowledged from the interview with R8 (*Lean management)* that argued that internal factors and processes should be considered when determining safety stock levels. Building on this idea, it becomes clear that a comprehensive approach to safety stock levels should incorporate both internal and external factors. With this in mind, one can consider that disruptions can arise from various sources, including internal factors, and emphasize the significance of having robust internal capabilities to manage such situations. In such cases, the company can utilize its own manufacturing capabilities to overcome disruptions (Luangkesorn et al., 2015).

It becomes evident that there are varying perceptions within VCT regarding the purpose of safety stock levels. While they acknowledge the negative effects caused by the supplier deviations, they still rely on safety stock to mitigate those consequences. However, as mentioned by R6, the objective today is to establish a lean management approach of setting the safety stock levels. In addition, in contrast to the reliance on safety stock levels to compensate for supplier disruptions, proponents of lean management approaches argue for a more proactive and efficient method of determining safety stock levels. This method seeks to improve supplier reliability, minimize waste and optimize inventory management processes. Considering the responsibility of the disruptions, VCT should consider adopting a holistic approach that recognizes both internal and external factors that are contributing to supply chain disruptions. This can enhance their supply chain resilience and manage the disruptions accurately. Furthermore, in order to successfully adopt lean management practices VCT should prioritize knowledge sharing activities for their employees in order to acquire necessary skills and knowledge to adopt lean management practices. In addition to this, Santhose and Lawrence (2023) highlights that knowledge sharing plays a crucial role and contributes to facilitating the effective organization and utilization of resources in an organization.

5.2.5 Lack of transparency and visibility between departments

Considering the different perspectives of the involved departments, it was acknowledged that there is a lack of transparency between them. This lack was further confirmed by the interview respondents, with R8 specifically emphasizing the lack of knowledge in the decision-making of safety stock levels within the inventory. According to R8, it is crucial to involve the SCC department in the reality of the inventory. By actively engaging them it will increase the knowledge and understanding of the decisions made for determining safety stock levels, enhancing more accuracy in the inventory. This observation aligns with R7's statement highlighting deficiencies in proper item management, resulting in operational inefficiencies. In relation to this, Kang et al., (2022) argue that having cross-functional teams within different departments enhances the company's ability to recognize, comprehend, share and utilize specific information, leading to more efficient management of problems and challenges. In order for this to be evident, the authors suggest that continuous improvement should be implemented within VCT. In relation to this, Khan et al., (2019) discuss the benefits of having continuous improvement practices where it may facilitate current process improvements and further contribute to strengthened productivity and efficiency. Tezel et al., (2023) explain that this is referred to as "Kaizen" where the focus lies within implementing continuous improvement practices within an organization. Taking this into consideration, the authors highly believe that by implementing cross-functional teams and conducting meetings continuously, it could improve the transparency among the departments. Additionally, it may contribute to knowledge sharing where the different departments could share their own knowledge and expertise on the area of safety stock levels. By having cross-functional teams regularly, the lean management department and the supply chain coordinator department could discuss and share their knowledge with each other and together attain a more comprehensive understanding of their perceptions and the importance of having appropriate safety stock levels.

Additionally, R5 proposes that involving the supply chain technical department in the monthly supplier reports being reviewed by the SCCs would result in increased efficiency. R5 further elaborated that obtaining feedback from other departments would enhance the ability to assess whether the implemented changes or adjustments have a positive impact on inventory management. By fostering collaboration within the departments, one can build a comprehensive understanding of a disruptive scenario and obtain insights into potential responses from various sources within the departments (Van Den Adel et al., 2023). As addressed by R8, that the SCCs should be engaged in the reality of inventory, proves that there is a poor inventory visibility since the SCCs works behind the scenes of the operations. Moreover, making decisions behind the scenes can result in various inventory disruptions that SCCs may remain unaware of due to the lack of transparency. This notion is supported by R6, who exemplifies a situation where incorrect item deliveries by suppliers are only discovered at the production lines, indicating that SCCs receive the information quite late. This could lead to material shortages, as R6 addresses. One can argue that it is challenging to obtain visibility in the inventory, implementing robust

inventory management systems can enhance visibility and mitigate the challenges effectively. Additionally, R8 further argued that there is a lack of transparency between the departments and proposed the implementation of a dashboard that provides visibility into the suppliers and their performance since the different department teams are situated in the same area. By situating different departments in the same area, this dashboard would foster better collaboration and informed decision-making concerning supplier management and the overall inventory optimization of safety stock levels. Moreover, promoting continuous improvement within an organization is beneficial in minimizing waste and enhancing the work productivity and efficiency (Khan et al., 2019).

Another important aspect that was acknowledged was that there are several internal activities that have an impact on the inventory and safety stock levels at VCT. These activities are not controlled or managed by the SCCs, yet they are the ones responsible for the items and their safety stock levels. One of the internal activities that was identified was the unstandardized process within internal logistics. R9 demonstrated that the operators within internal logistics can order items as well by scanning packages. However, this concerns the crucial items which were discussed before. The complexity emerges when these items are scanned and buffered at the production lines, which R9 explained is conducted by the operators. When these items are scanned, it results in orders sent to the suppliers, which in turn, results in a tremendous amount of items shipped to the facility, which R9 addresses as crucial. Further, the system will believe that these items have been consumed at VCT, when in reality, they have been buffered at the production lines. This can be seen as another factor contributing to inventory balance differences at VCT. As stated earlier, Hassan Zadeh et al., (2016) define the discrepancy between the inventory records in the system in contrast to the actual inventory that is kept as inventory record inaccuracy. This is crucial as the operators have the potential to contribute to inventory balance differences, where VCT is affected.

Another crucial factor was identified when R9 explained that there is no limit regarding how many orders the operators can conduct. Therefore, R9 addresses this complexity as an unstandardized process. This was identified as a crucial complexity, where the authors believe that improvements need to be established as it has an impact on the balance differences at VCT. It could therefore be evident that the operators are educated on what their actions contribute to, where the SCCs or the Supply Chain Technician could share their knowledge with them. Santhose & Lawrence (2023) state that knowledge sharing provides a shared understanding and common interpretations. In relation to that, the operators within internal logistics can attain a more comprehensive understanding of the consequences that come with the unstandardized processes. Additionally, it may contribute to a better transparency and visibility at VCT where the different departments will understand the processes better. As discussed before, the inventory balance differences emerge due to other factors as well such as misplaced items in the inventory and dropped items at the production lines. The authors therefore strongly believe that if

knowledge sharing was implemented at VCT it could contribute to transparency where such challenges may be reduced. For instance, if the SCCs shared their knowledge and experiences about the potential consequences of balance differences such as material shortages, the people who work within production might understand the importance of discarding items correctly. As discussed before, these balance differences have an impact on the safety stock dimensioning at VCT where the SCCs stated that they adjust safety stock levels if an item is crucial and often thrown in the bin without being discarded correctly. The SCCs may therefore adjust the safety stock level on that specific item to a higher setting. This was acknowledged as a crucial factor by the authors since it indicates that the inventory balance differences have an influential impact on the safety stock dimensioning, where, as stated earlier, Lumsden et al., (2019) explains that safety stock levels will increase if incorrect inventory balances is included as a factor for safety stock dimensioning.

5.3 Summary of Analysis

Section	Main findings
	Identified factors influencing safety stock dimensioning at VCT
5.1.1 Transportation frequency	Transportation frequency was identified as one of the main factors influencing safety stock dimensioning at VCT. The SCCs consider the frequency of deliveries made by suppliers within certain time frames such as daily, weekly, or monthly. Depending on the frequency, the SCCs adjust the safety stock levels. It was also identified that transportation frequency is interconnected with the lead time. While transportation frequency may not have been identified as a factor in the literature, the lead time plays a crucial role. It is therefore evident that the Supply Chain Coordinators use transportation frequency as a factor that influences safety stock dimensioning.
5.1.2 Supplier reliability	The reliability of a supplier has a significant impact on the safety stock dimensioning at VCT. The actions of suppliers can have various consequences for the company. Incorrectly labeled pallets and wrong quantities of items disrupt operations, resulting in material shortages. Maintaining appropriate safety stock levels is crucial, and the SCCs adjust them based on the supplier reliability and disruptions. Therefore, aligning with supplier performance is essential for effective inventory management at VCT.
5.1.3 Supplier location	Supplier location was considered a crucial factor in safety stock dimensioning by the SCCs. Depending on the suppliers' distance and lead time, the safety stock levels are set. However, supplier

	disruptions have an impact as well when it concerns the location. When suppliers are located nearby, potential disruptions become more manageable. Conversely, when suppliers are located far away such as overseas, it becomes more complex to manage potential disruptions. The authors therefore believe that effective communication should be implemented as a strategy to reduce the complexities of disruptions caused by overseas suppliers.
5.1.4 Inventory costs	The consideration of price per item when determining safety stock levels differed among the SCCs at VCT. Some respondents highlighted the importance of price per item in setting safety stock levels to prevent capital tie-up in the inventory, while other respondents did not prioritize the price when determining safety stock levels. VCT should assess the significance of cost in safety stock dimensioning and establish guidelines to ensure consistent practices among SCCs.
	Challenges influencing safety stock dimensioning at VCT and potential improvements
5.2.1 Inaccurate inventory balances	A challenge that was identified as crucial at VCT is inventory balance differences. Due to different events, inventory balance differences sometimes appear at VCT. This is crucial as the SCCs address that they adjust the safety stock levels on items that are crucial and often are discarded incorrectly. It can therefore be indicated that inventory balance differences have an impact on safety stock dimensioning at VCT. However, it was demonstrated by a respondent that safety stock should cover internal deviations as well. Although including inventory balance differences a factor for safety stock dimensioning will further increase the safety stock levels at VCT. It can therefore be argued whether it is appropriate or evident that inventory balance differences should be considered as a factor for safety stock dimensioning.
5.2.2 Production disruption	Production disruption was identified as another challenge at VCT. When production disruptions emerge such as stops in the production, the ordered materials are still delivered to VCT. It was specifically identified as crucial when it concerns suppliers with longer lead times since it is challenging for the SCCs to adjust the orders sent to such suppliers. One could therefore argue whether it is appropriate for VCT to have suppliers with long lead times due to the challenges that arise with production disruptions. Additionally, it was acknowledged that the level of safety stock is crucial as it may impact production disruptions. It is therefore important for the SCCs to set appropriate safety stock levels due to the risk of potential disruptions in production.

5.2.3 Management of supplier disruptions	The SCCs at VCT employ a safety parameter to assess the performance of new suppliers and ensure uninterrupted operations. The management of this parameter by the SCC lacks specific due dates and proximity considerations for suppliers. Manual adjustments of the safety setting parameter can increase the risk of potential errors and high safety stock levels. By involving different departments, VCT can foster a collaborative environment and achieve improved visibility and efficiency in their inventory processes.
5.2.4 Internal capabilities in managing disruptions	VCT should recognize the importance of their internal production capabilities in managing disruptions and build robust internal capabilities. A comprehensive approach to safety stock levels should both consider internal and external factors when determining safety stock levels. Knowledge sharing among employees is crucial for successfully adopting lean management practices and efficiently utilizing organizational resources.
5.2.5 Lack of transparency and visibility between departments	There is a lack of transparency and knowledge sharing between departments at VCT, particularly in the decision-making process for safety stock levels. Continuous improvement practices, such as implementing lean management approaches, can optimize inventory processes and mitigate disruptions. Additionally, it was identified that internal activities have an impact on the inventory and safety stock levels at VCT. One of these internal activities was the unstandardized processes conducted by operators within internal logistics which result in inventory balance differences at VCT. Further, as mentioned before, the inventory balance differences emerge due to other factors as well. The authors therefore strongly believe that knowledge sharing could contribute to transparency at VCT where such challenges may be reduced.

Table 2. *Summary of Analysis*

5.4 Revised conceptual framework

The conceptual framework in figure 6. presents the revised version of the identified factors that influence the dimensioning of safety stock levels at VCT and challenges that were acknowledged from the interviews and potential improvements to cope with the challenges. This revised framework offers a deeper understanding of the correlation between factors and challenges, as well as the impact of improving factors on these challenges. Through this updated conceptual framework, the reader gains clarity on how the challenges at VCT impact the processes involved in determining safety stock levels.

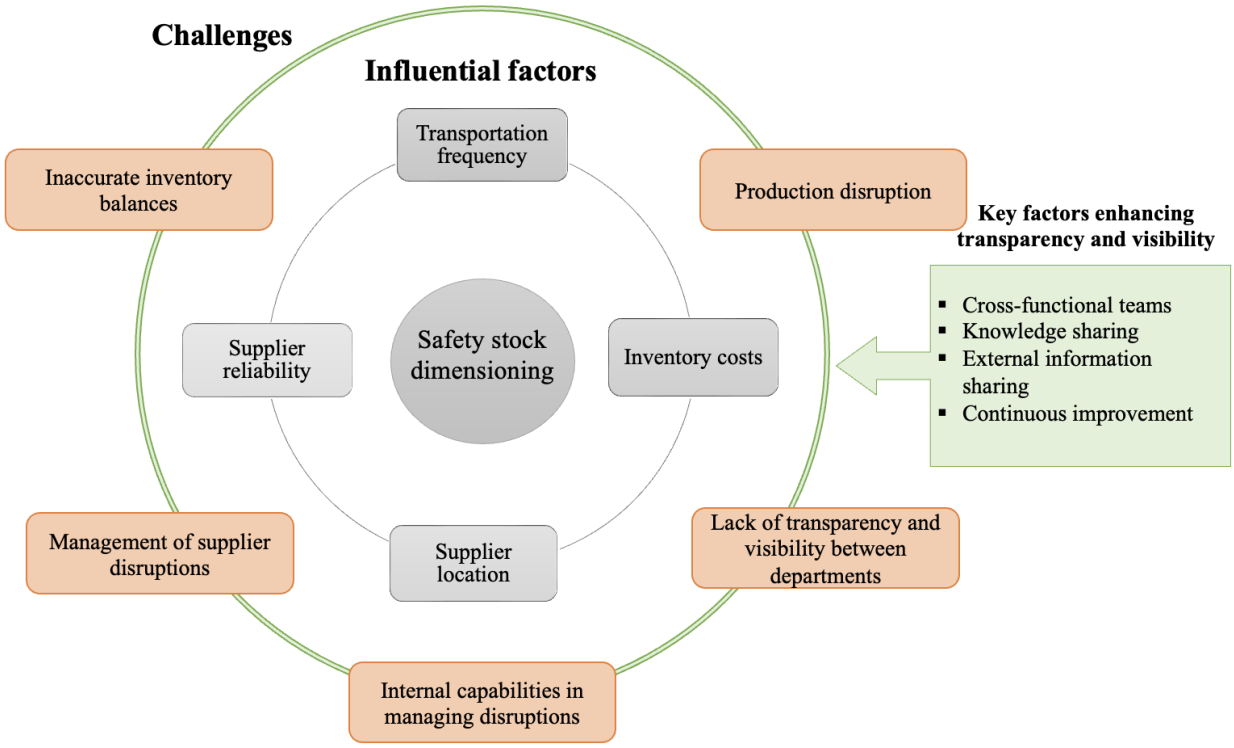


Figure 6. *Revised conceptual framework (Own illustration).*

6. Conclusion

This chapter concludes the findings derived from the analysis with the purpose and research questions in context. The main purpose of this study was to identify and increase the understanding of factors and challenges that influence the setting of appropriate safety stock levels for items included in the inventory at VCT. In regard to the purpose, three research questions were developed which are answered below.

- What are the key factors that influence the setting of appropriate safety stock levels in the context of VCT?

In the findings from the literature, five factors were considered influential on safety stock dimensioning, including *Demand uncertainty, Cost, Lead time, Supplier location,* and *Supplier reliability*. However, upon analyzing empirical results, it became apparent that the findings deviated slightly, highlighting four factors as influential on safety stock dimensioning, namely *Transportation frequency, Supplier reliability, Supplier location*, and *Inventory costs*.

To begin with, *Transportation frequency* was identified as a main factor influencing the setting of appropriate safety stock levels at VCT. It is pointed out that the frequency of deliveries made by suppliers impact the level of safety stock where certain time intervals are considered such as daily, weekly, or monthly. It was further addressed that the safety stock levels are set higher when deliveries are less frequent since the time duration from the supplier to VCT requires a longer lead time. It was therefore acknowledged by the authors that transportation frequency is interconnected with lead time which is one of the factors identified in the literature. Secondly, *Supplier reliability* was identified as another main factor influencing the setting of appropriate safety stock levels at VCT. The reliability of suppliers has a crucial impact on the setting of safety stock levels where it is demonstrated that they vary in their actions, resulting in several consequences. Deviations in delivery time and accuracy of quantity and labels impacts the setting of safety stock levels. Suppliers that are reliable and comply with the agreements obtain lower safety stock levels, while suppliers that are unreliable receive higher safety stock levels in order to mitigate potential material shortages. Difficulties such as late deliveries, wrong labeling, and missing items increase the risk of production disruptions and require procedures that are time-consuming. It is therefore appropriate for VCT to adjust safety stock levels based on supplier performance. Thirdly, *Supplier location* was identified as a third main factor influencing the setting of appropriate safety stock levels at VCT. The location of the suppliers plays a vital role in determining the amount of safety stock levels since the distance and lead time have an impact on the delivering process. The proximity of the supplier to the manufacturing area is vital in case disruptions arise, as it allows for easier problem resolution through measures such as expediting orders. Consequently, the decision to have suppliers located close or far away requires careful consideration, as it entails both benefits and challenges. While close proximity facilitates

relationship flexibility, communication and easier management of disruptions, it also demands additional effort. Alternatively, suppliers located far away restrict flexibility and communication due to time zones and working schedules, resulting in longer lead times and increased expenses. Lastly, *Inventory costs* was identified as a fourth main factor influencing the setting of appropriate safety stock levels at VCT. Maintaining high levels of safety stock in inventory can have implications such as tying up capital and incurring additional expenses. The considerations of price per item in determining safety stock levels vary among SCCs, indicating a lack of consensus. High safety stock levels also pose risks of obsolescence and inventory deterioration. Further evaluation is needed to establish the significance of cost and determine consistent safety stock practices at VCT.

- What are the main challenges faced by VCT that influence the setting of appropriate safety stock levels?

The literature findings identified three challenges that were considered influential on setting appropriate safety stock levels, including *Supplier disruption, Production disruption,* and *Inventory accuracy*. However, empirical analysis results revealed that the findings deviated slightly, highlighting five challenges as influential on setting appropriate safety stock levels, namely *Inaccurate inventory balances, Production disruptions, Management of supplier disruptions*, *Internal capabilities in managing disruptions* and *Lack of transparency and visibility between departments*.

To begin with, *Inaccurate inventory balances* caused by factors such as incorrect discardings of items or no discardings at all can lead to crucial consequences such as material shortages and production disruptions at VCT. It is demonstrated that the safety stock levels are adjusted on suppliers that obtain items that often result in balance differences. Issues such as misplaced items, dropped items, and incorrect discardings all contribute to inventory balance differences. It is therefore crucial that items are discarded correctly and the internal deviations are addressed in order to mitigate material shortages. However, including inventory balance differences as a factor in safety stock dimensioning raises the question of whether it is appropriate, as it will result in increased safety stock levels. Secondly, *Production disruptions* were identified as a crucial challenge at VCT. Issues such as chain breakages and IT issues can result in production disruptions. The system at VCT freezes for two days which results in complexities for the SCCs in adjusting orders, specifically when it concerns overseas suppliers that obtain longer lead times. Further, appropriate safety stock levels are important in order to mitigate the risk of potential disruptions in production, where low safety stock levels may result in costly production stoppages. Thirdly, it became apparent that *Management of supplier disruptions* introduce complexities at VCT. As a result, the standard setting of safety stock levels that is employed to evaluate new suppliers, proves to be advantageous in accounting for potential deviations caused by them. However, manual adjustments to the safety parameter raise the risk of inefficiencies,

incorrect deliveries and increased expenses due to no strict deadlines. Fourthly, *Internal capabilities in managing disruptions* was another identified challenge that Safety stock levels serve to prevent inventory stockouts and act as insurance against demand and supply uncertainties. However, it became evident that divergent perceptions of the purpose of safety stock levels exist within VCT. It is crucial for VCT to consider a holistic approach that incorporates internal and external factors in managing disruptions. Lastly, *Lack of transparency and visibility between departments* was highlighted as a significant challenge at VCT. Considering that different departments were involved in this study, various perspectives emerged, where a lack of transparency appears between them. It is demonstrated by the Lean Management department that it is crucial to involve the SCC department in the reality of the inventory as it will contribute to knowledge and comprehensive understanding for determining safety stock levels. Further, it is proposed that the Supply Chain Technician should be involved in monthly reports conducted by the SCCs. The authors therefore conclude that there is a lack of transparency, visibility, and collaboration among the different departments which has an influence on the setting of appropriate safety stock levels at VCT. Additionally, internal activities were identified as crucial challenges that influence the setting of safety stock levels where one of them is the unstandardized processes within internal logistics. These processes further contribute to inventory balance differences which is crucial.

- What are the potential solutions for managing challenges that influence the setting of appropriate safety stock levels in the context of VCT?

To begin with, inventory balance differences were seen as a crucial challenge at VCT. Issues such as unstandardized processes within internal logistics, misplaced items, dropped items, and incorrect discardings of items or no discardings at all contribute to inventory balance differences. Further, inventory balance differences influence the setting of safety stock levels where adjustments are made on suppliers that obtain items that often result in balance differences. The authors therefore consider *knowledge sharing* as a potential solution to manage inventory balance differences. In regard to the unstandardized processes within internal logistics the SCCs or the Supply Chain Technician could share their knowledge with the operators within internal logistics. This may provide the operators within internal logistics a more comprehensive understanding of the consequences that come with the unstandardized processes. Additionally, it may contribute to a better transparency and visibility at VCT where the different departments will understand the processes better. Additionally, if the SCCs were to share their knowledge and experiences about potential consequences of balance differences such as material shortages with the people who work within production, they might understand the importance of discarding items correctly. The authors therefore strongly believe that if knowledge sharing was implemented at VCT it could contribute to transparency where such challenges may be reduced. Further, production disruptions were also identified as a crucial challenge at VCT. It is mostly crucial when it concerns overseas suppliers with longer lead times. Therefore, the authors

suggest that a potential solution could be to *reduce the amount of suppliers with longer lead times* in order to decrease potential challenges that come with production disruptions. Additionally, the level of safety stock may contribute to production disruptions. It is therefore vital to *maintain appropriate safety stock levels* in order to prevent production disruptions from emerging. The safety parameter for evaluating new suppliers proves to be advantageous in assessing their performance. However, manual adjustments by the SCCs can result in high safety stock levels if they are mismanaged. *Implementing deadlines* for supplier reviews would ensure timely updates and proper adjustment of safety stock levels. This solution would prevent oversight and promote more effective inventory management at VCT. Additionally, *sharing external information* with suppliers enhances visibility and strengthens the relationship between VCT and its suppliers. By providing comprehensive information regarding specific demands, suppliers can accurately supply items, leading to improved operational efficiency. This practice will promote effective collaboration and optimize supply chain performance.

In conclusion, the lack of transparency and lack of knowledge sharing between departments at VCT hinders accurate decision-making for safety stock levels. *Involving the SCC department in inventory management* increases their understanding and improves accuracy. By *implementing cross-functional teams* and *continuous improvement practices*, such as kaizen enhances transparency, knowledge sharing, and problem-solving capabilities. *Regular meetings* between the lean management and supply chain coordinator departments promote comprehensive understanding and appropriate safety stock levels.

7. Limitations and Future recommendations

This chapter presents the limitations of the thesis and future recommendations for further research.

The main purpose of this study was to identify and increase the understanding of factors and challenges that influence the setting of appropriate safety stock levels for items included in the inventory at VCT. Therefore, this study was conducted at a case company to gain a more comprehensive and deeper understanding of the studied phenomena. Due to the fact that this study is conducted at a case company, the findings of this study are specific to the case company in the automotive manufacturing industry located in Gothenburg, Sweden. This impacts the transferability of the findings, highlighting the importance of conducting future studies. Thus, caution should be exercised when generalizing these findings to companies in other industries and locations. Therefore, in order to increase the generalizability of the findings in this study, the authors suggest that other industries and locations could be considered in further research. This could be considered in order to identify and understand similarities and variations in factors and challenges influencing the setting of appropriate safety stock levels. Additionally, as this study concentrated on a single manufacturing company, it may constrain the diversity and representativeness of the findings. Therefore, increasing the sample size and broadening the scope would contribute to a more comprehension of the factors and challenges associated with safety stock levels.

Furthermore, this study was constrained by a specific timeframe, which potentially have limited the extent of analysis and exploration into certain factors and challenges that influence the safety stock levels. Conducting a longitudinal study that monitors the changes and impacts of implemented solutions over an extended period would provide a more comprehensive understanding of the efficacy and sustainability of various strategies in managing safety stock levels. Additionally, as this study is limited to the qualitative approach it would be interesting to see how a quantitative approach could be conducted with the same phenomena studied and if potential similarities and differences would emerge. It would further be interesting if future research considered including external actors such as suppliers in the empirical findings to receive a more thorough and deeper comprehension of the relationship,visibility and transparency between VCT and their suppliers. This would provide valuable insights from the perspective of the suppliers and their experiences.

Lastly, having the limitations addressed and future recommendations for further research suggested, factors and challenges that influence the setting of appropriate safety stock levels may further be enhanced providing a deeper understanding of the studied phenomena. This may result in efficient inventory management procedures at VCT as well as in other industries and companies.

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Appendix. Interview guide

Supply Chain Coordinators

Background:

1. What is your job role?
2. What are your responsibilities?
3. Which department do you work in?
4. How much experience do you have in your role?

Safety stock levels:

5. How does the process of setting safety stock levels look like?
6. What is the function of safety stock? What does it contribute to, and do you consider it important?
7. What factors do you consider when determining the appropriate safety stock level for each item?
8. What factors do you believe are important to consider when setting safety stock levels?
9. Do you align with the company's goals regarding the intake of safety stock?
10. Is there a system that takes all the factors into account when determining safety stock levels?
11. Do you make the decision on what safety stock levels to set, or does your decision need to be approved?
12. Have there been instances where too much safety stock has been taken for an item? What consequences did it have for the company?
13. Have there been instances where too little safety stock has been taken for an item? What consequences did it have for production?
14. What are the consequences of a shortage of your items in the Marketplace?
15. Do you have any performance metrics? If yes, what are the specific metrics that are being evaluated?

Senior Manager Supply Chain

Background:

1. What is your job role?
2. What are your responsibilities?
3. Which department do you work in?
4. How much experience do you have in your role?

Safety stock levels:

5. What is the function of safety stock? What does it contribute to, and do you consider it important?
6. What is the goal of implementing safety stock, and what perspective do you have on it?
7. Is there any system or standard that the SCCs rely on when determining safety stock levels?
8. Who is responsible for approving the SCCs decisions regarding safety stock levels?
9. What factors are important to consider when setting safety stock levels?
10. Is there a system that takes all the factors into account when determining safety stock levels?
11. Have there been instances where too little safety stock has been taken for an item? What consequences did it have for production?
12. Do you have any performance metrics in your team? If yes, what are the specific metrics that are being evaluated?

Lean Management

Background:

1. What is your job role?
2. What are your responsibilities?
3. Which department do you work in?
4. How much experience do you have in your role?

Marketplace:

5. How does your job role intersect with the Marketplace?
6. What are the biggest challenges with the Marketplace today?
7. What is important to improve within the Marketplace, and are there any goals?
8. How do you work towards improving the Marketplace to achieve these goals?
9. How would the Marketplace look if it were lean?

Safety stock levels:

10. Which factors do you believe influence safety stock levels?
11. What factors do you think are important for the SCC to consider when setting safety stock levels?
12. If you have any suggested improvements regarding the Marketplace, do you present them within the organization?
13. What is the process like when proposing an improvement suggestion for safety stock in the Marketplace?
14. Do you believe there is effective communication between your team and the SCCs?
15. What do you think is the cause of having too much or too little safety stock? How can this be mitigated? How do you think it affects the company in the long run?
16. What internal factors do you believe impact safety stock levels that cause potential challenges in the Marketplace?
17. Is there any inventory control to detect if there is an excess or shortage of safety stock?

Supply Chain Technician

Background:

1. What is your job role?
2. What are your responsibilities?
3. Which department do you work in?
4. How much experience do you have in your role?

Marketplace:

5. How does your job role intersect with the Marketplace?
6. What are your specific goals for the Marketplace? How do you work towards improving the Marketplace to achieve those goals?
7. What do you believe are the biggest challenges with the Marketplace today?
8. What do you think is the cause of having too much or too little safety stock for certain items? How does it affect the company?

Safety stock levels:

9. Which factors do you believe influence safety stock levels?
10. What factors do you think are important for the SCC to consider when setting safety stock levels?
11. If you have any suggested improvements regarding the Marketplace, do you present them within the organization?
12. What is the process like when proposing an improvement suggestion for safety stock in the Marketplace?
13. Is there any collaboration with others in the company to achieve these improvements within the Marketplace?
14. How is the company affected when issues arise with safety stock?
15. What internal factors do you think contribute to safety stock problems in the Marketplace?
16. Is there any control in place to detect whether there is an excess or shortage of safety stock?