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A comparison of manufacturing companies in Sweden and their use of parameters within material planning

Master's thesis in Supply Chain Management

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Abstract

To reach high performance in an effective and efficient way, material planning is an aspect to consider. Material planning has different effects depending on how it is applied within the company's environment. Furthermore, managing parameters within material planning is one way to balance supply and demand in an organization. How manufacturing companies are working and using the parameters within material planning is an interesting theme that is relevant to investigate today and hence this theses project was requested.

This master thesis project was a collaboration with the consultant company Meridion AB who is acting within the area of supply chain management. The focus of this thesis project was regarding the effects of parameters within material planning and how it can be used by companies in order to be more efficient and effective. This thesis project has been divided into two parts, where the first part was a comparative study of 10 manufacturing companies within different industries. The analysis has been done by quantitative analysis in the business intelligence tool Qlik for the comparative part of the study. Furthermore, a deeper investigation was performed, and a qualitative analysis was conducted at the case company KraftPowercon Sweden AB, this was considered as the second part of this thesis project. The findings showed that there is a high variation between the companies and the frequency of updating parameters and conducting changes in their planning data, hence there is potential for development. The items analyzed were purchased items that were considered as active for the companies. During the analysis, different factors were taken into consideration in order to find similarities and differences between the companies. These factors were the items' lead time, material planning method and sourcing strategy. Regarding the second part of the study, where a deeper investigation was conducted at KraftPowercon, it was possible to understand underlying causes of the quantitative data and to understand the findings.

This master thesis aimed to find relevant conclusions and recommendations in order for both customers and consultants to continue the work with parameters within material planning. However, the main conclusion is that there is a need to work more with parameters and to implement a structured way of working with it. Furthermore, due to the high amount of data, a business intelligence tool like Qlik could be used as a helping tool to manage the data.

Keywords*: Material planning, parameters, Qlik*

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We would like to express a specific thank you to our supervisor and examiner at Chalmers, Patrik Jonsson, for the support and knowledge during this project. Both within the specific theme of this study, and with academic guidance to our study.

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Felicia Turesson & Ottilia Bergström, Gothenburg, May 2023

List of words

BI - Business Intelligence

Effective - produce a better result.

Efficiency - produce an intended result

ERP - Enterprise Resource Planning, a business system that handles information and indicates business management.

FIFO - First in, first out

M3 - ERP system

Material planning - Activities and methods used for item planning.

MRP- Material requirement planning

Parameters - Within material planning, e.g., lead time, safety stock and forecast.

Planning environment- Internal and external factors that are influencing the company within their planning

Qlik- A BI tool

Table of content

1. Introduction

The introduction chapter presents the background to the project and why it is relevant based on identified research gaps within the field. This chapter describes the aim and associated research questions and how the project has been delimited around the theme.

1.1 Background

Supply chain management is described according to van Weele (2014) as a description of how the supply chain is handled and coordinated. Furthermore, it regards the material processes handled by the organizations. For several years, manufacturing companies have been developing and improving their material flow, which for instance includes material planning (Jonsson & Mattsson, 2002). The effect of material planning for a company is different depending on the company's specific environment and how it is practically applied. Furthermore, material planning is an important aspect to consider reaching high performance by efficient and effective work (Jonsson & Mattsson, 2002). According to Jonsson and Mattsson (2002), it is a challenge for companies to manage material planning methods in relation to how the methods are applied in the planning environment. There are several reasons of why companies are conducting material planning, however, one main purpose of executing material planning is to balance the demand and supply in the supply chain in an efficient way (Jacobs, Berry, Whybark, and Vollmann, 2018; Jonsson & Mattsson, 2016). Jonsson and Mattsson (2016) argues that in all different kinds of materials flow, some degree of uncertainties will occur. The uncertainties can originate from both the demand and supply side. Parameters within material planning is an important part to consider to be able to manage the balance of the supply and demand in an organization (Jonsson & Mattsson, 2009). However, parameters need to be frequently updated to manage changes in the planning environment and retain efficiency (Jonsson & Mattsson, 2014). Examples of parameters that could be used within material planning are order quantity, lead times, safety stock and forecast (Jonsson & Mattsson, 2014). To manage uncertainties in the material supply, two parameters, lead time and safety stock, plays an important role and would be included in the material planning (Jonsson & Mattsson, 2009). In addition, it is important that companies know how to utilize their capacity, hence, how material planning is managed at a company might affect assets and the tied-up capital (Jonsson & Mattsson, 2009).

This master thesis was conducted at the consulting firm Meridion AB, further referred to as Meridion. Meridion is a consultant company within the supply chain business and was founded in 2005 (meridion.se, n.d). They are offering companies support with their supply chains within the enterprise resource planning (ERP) system Infor M3 and furthermore analysis in the Business Intelligence (BI) tool Qlik with different projects, both through large-scale and small-scale projects. Since April 2021, Meridion has started a project called "supply chain for real" which means that they are analyzing their customers supply chain with the analytic BI tool Qlik. The BI tool Qlik is able to

visualize the current state of their customers supply chain and shows, for instance, the material planning processes and material flow. Hence, this gives the customers a transparent view of the process and can therefore view their supply chain for real. The idea and background to the project is based on research by Jonsson and Mattsson (2014) called "Best practice vid lagerstyring i svensk industri". Their research consisted of the use of parameters within manufacturing and distributing companies and how the frequency of updating them has an impact on the outcome of organizations supply chain management (Jonsson & Mattsson, 2014). This was a project presented in 2014 and now Meridion has applied this concept to their customers, however, the project by Meridion includes BI as a source of information. One of the customers that has been included in Meridions project "supply chain for real" among others, is KraftPowercon Sweden AB, further referred to as KraftPowercon. In this master thesis project, 10 of Meridions customers have been included and these companies are furthermore a part of their project "supply chain for real". Meridion has a goal to develop their project of "supply chain for real" and to identify how parameter setting within material planning is used by manufacturing companies. Furthermore, Meridion has the ambition to create a generic framework in relation to this research for how to apply the results within the companies.

1.2 Previous research within the field

When searching for previous research within this field, the main search words were different combinations of parameter settings, material planning and manufacturing. The result was limited within this field, however, the article "Best practice vid lagerstyring i svensk industri" by Jonsson and Mattsson (2014) is relevant. Their research was to conduct a study regarding material planning methods and investigate in different manufacturing and distribution companies how this is applied. Furthermore, parameter settings were included in the study. However, their research was based on a survey, where the included companies answered questions related to the subject. Hence, it could be argued that there is a need for more in-depth research regarding parameter settings within manufacturing companies and more up to date research since Jonsson and Mattsson's study was conducted in 2014. By conducting more in-depth research, with interviews, it is possible to understand the underlying causes to the result. Hence it can complement the current research within the field. The ambition for this master thesis is to, with this background, begin that research. Hence, together with this background, the following aim and scope of this master thesis has been developed.

1.3 Aim

The aim of this master thesis is to develop the project “supply chain for real” and to compare and analyze the current state of manufacturing companies' in Sweden and their use of parameters within material planning. Furthermore, the aim is to identify the effects of parameters within material planning and how it can be used in order to be effective and efficient.

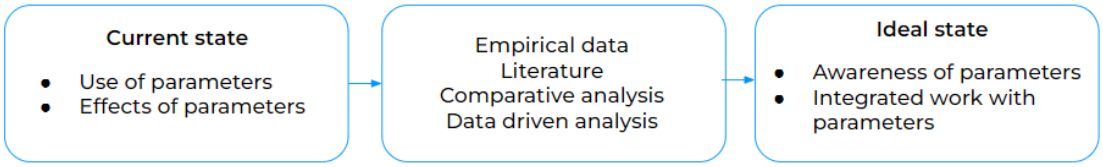

Figure 1.1, an illustration of the aim and how this study will cover the current state and the ideal state and how the gap in between will be bridged.

1.4 Problem discussion

The theme of this study is relevant for the subject area supply chain management with focus on material planning within manufacturing companies. Supply chains are becoming more complex, and some degree of uncertainties in material flows will always be present (Cheng et al., 2021; Jonsson & Mattsson, 2016). Imbalance in supply and demand can be a factor of uncertainties and one way to manage this in an efficient way is through, for instance, parameter updates within material planning (Jonsson & Mattsson, 2009). This is a master thesis project that supports already existing research and further work on how organizations can use parameters in a more effective and efficient way to be updated about the current state and to manage balance in supply and demand. Due to this, it is relevant to conduct more research within this field. This thesis project aims to deliver research within the field of material planning with a more in-depth focus on parameters and the frequency of updating them. It will further be investigated how to use the parameters in an effective and efficient way for manufacturing companies.

In order to answer the aim of this master thesis, two research questions (RQ) have been developed. For the first research question, RQ1, the aim is to investigate how material planning parameters are applied within manufacturing companies in Sweden. To answer this research question, a comparative analysis needs to be conducted in order to compare the results from the different companies included in the study. The relevance of RQ1 is related to Jonsson and Mattsson’s (2014) research regarding the importance of updating parameters.

The second research question, RQ2 aims to investigate the effects of parameters and parameter settings within material planning and to understand how the use of parameters has an effect on the organization. Moreover, RQ2 aims to investigate whether the work with parameters can be influenced by the planning environment of the company. Jonsson and Mattsson (2014) stress that the planning environment can

include different variables and one of them could be the lead times, which could be seen as one parameter. In addition, this question will focus on how organizations should use parameters in order to be effective and efficient. Jonsson and Mattson (2009) stated that one way to manage uncertainties is through effective parameter settings.

1.4.1 Specification of research questions

RQ1: How are material planning parameters applied within manufacturing companies in Sweden?

RQ2: What are the effects of the use of parameters within material planning?

- How does the planning environment affect the use of parameters?
- How should the work with parameters be conducted in order to be effective and efficient within material planning?

1.5 Delimitations

The delimitations for this project are presented in this chapter divided as delimitations of scope and delimitations of data collection. The delimitations were done due to scope and time allocated to this master thesis.

1.5.1 Delimitations of scope

To be able to answer the research questions for this master thesis in an effective way, some delimitations within the scope have been made. Partly to be able to focus on the relevant parts within the selected research field but also due to the time and resources that have been allocated to the project. The scope of this study was to investigate how parameters within material planning are used in manufacturing companies in Sweden. Furthermore, the focus of the material planning was on purchased material. The scope was further to investigate how parameters could be applied and worked with at companies in order to be more effective and efficient. In addition, the focus was to understand how the work with parameters and parameter settings affects the organization and if the planning environment has an impact.

Regarding the in-depth data collection for this master thesis, it was scoped to focus on the company KraftPowercon's production site in Surte. This selection was made in advance by Meridion. The reason why this thesis project had one case company was to give the ability to investigate the theme in more depth and to give a real-life perspective to the study. However, since this was a comparative study, 9 additional companies were included as well in order to compare the result from KraftPowercon and to identify generic outcomes of how parameter settings were applied in manufacturing companies in Sweden. The 1+9 companies were selected and included in this study because of already existing integration in Meridions "*supply chain for real*" project.

1.5.2 Delimitations of data collection

The observations and interviews were only held at KraftPowercon in Surte since they were the case company for this study. Furthermore, the interviews were delimited to selected participants with in-depth knowledge about the study theme. The BI tool used for the quantitative data collection was delimited to Qlik. Furthermore, the project had delimitations regarding the selected data in Qlik to use in this master thesis. This was done due to the scope of the project but also time and resources. The data used in Qlik was retrieved from all 10 companies' ERP system M3. However, the transmission of the data was not done at the same time and the data were retrieved between 2021 and 2022.

There are several settings to conduct in Qlik. In this study the foundation setting in Qlik was on purchased and active items in the material planning. Furthermore, settings applied on this foundation setting were lead time, material planning method and sourcing strategy. Another setting applied in Qlik without the foundation setting was active and inactive items. The quantitative data collection for this study included 10 companies operating in the manufacturing sector. Furthermore, the size of the companies included in this thesis project are varying.

2. Methodology

In the following chapter, the methodology used for this project will be presented. The different methods that have been applied in this study in order to answer the research questions are literature review, observations, interviews, data collection in the BI tool Qlik, and comparative analysis. All subchapters are structured according to the same structure, first the theory of the specific method presented and then followed by a description of how it has been applied to this project.

2.1 Research process

The research process for this master thesis can be divided into six steps, which are presented in figure 2.1. The first step was to understand and become familiar with the research field by reading scientific articles and having meetings with Meridion. For the second step, the focus was to get knowledge about the case company KraftPowercon in more depth. Since they were selected as the case company of this study, it was important for the researchers to get familiar with their organization and their processes. This was done by meetings and observations at their site. The third step was to create a focus and scope for the study and design relevant research questions. This was possible since observations had been conducted at KraftPowercon and it became clearer where the focus of the study would be. However, the researchers had an open mind during the whole process of data collection if some new information occurred that could impact the scope and research question, i.e., it was an iterative process.

After designing the research questions, the process was followed by the fourth step with more meetings and observations at KraftPowercon where the purpose was to get an even deeper knowledge in order to create relevant interview questions for the interview guide. The fifth step in the process where thereby to conduct data collections by interviews at KraftPowercon and later on data collection in Qlik from all 10 companies. The sixth step in this research process, all data were collected, and it was time for analyzing the collected data which further resulted in a conclusion answering the two research questions for this study. During this phase, a verification meeting with KraftPowercon was conducted in order to verify the collected data. In parallel with these six steps in the process, reading and analyzing literature supporting the findings were conducted.

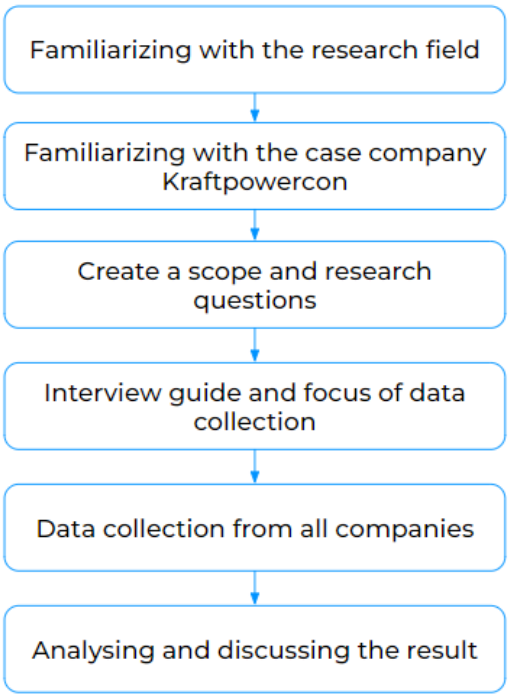

Figure 2.1, an illustration of the different steps in the research process.

2.2 Research design

When conducting a study or research project, it is important to start by forming a research design. Developing a research design is about making a plan, a strategy, with methods and elements to achieve the goal of the study or research project (Denscombe, 2018). Three areas to consider, according to Denscombe (2018) is whether the design is feasible, appropriate for the aim and ethical. Furthermore, aspects to consider are the different research methods to apply to fulfilling the aspects of a research design.

There are different options for choosing a method when designing a research project and it can be categorized as qualitative or quantitative research methods (Bell, Bryman, and Harley, 2022). Furthermore, a common definition is to categorize quantitative research as numbers and qualitative research as words and images (Bell et al., 2022; Denscombe, 2018). However, Denscombe (2018) argues that it is possible to conduct a multiple research design, which refers to a combination of using different methods for the same project. Hence, it is possible to choose methods that are both quantitative and qualitative in one study (Denscombe, 2018). When using multiple research designs, there are different ways of collecting the data and one way is *convergent parallel design* (Bell, Bryman, and Harley, 2019).

This method emphasizes collecting qualitative data and quantitative data separately, and further on in the project, it is compared or merged and then it will be a result of findings. This multiple research design method was applied for this project in order to collect data form different perspectives. The design for the data collection in this master thesis was through observations and interviews, which are referred to qualitative

research methods, and through the BI tool Qlik, which is referred to quantitative research method. Hence, this goes in line with Denscombe (2018) definition of a multiple research design since it is a combination of a quantitative and qualitative study. When all data was collected, it was analyzed and merged, in order to find the result of this research project, which can be seen in figure 2.2.

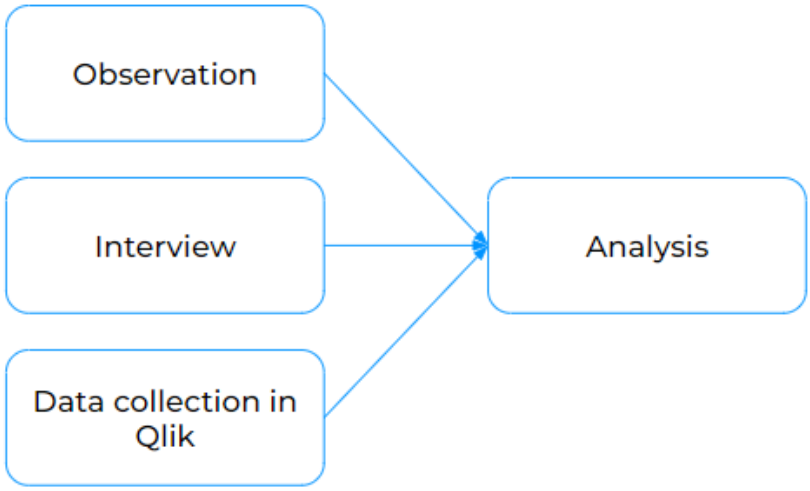

Figure 2.2, a summary of how the qualitative and quantitative data was collected and then merged for the analysis, adopted from Bell et al. (2019).

A method that can be used in a project is to focus on a case company, i.e., using the method case study. Using a case company implies to focus on receiving more in-depth knowledge around the research questions (Säfsten & Gustavsson, 2020). A case study is based on the questions why and how, and further involves the question what and this type of study is conducted in real time. In this master thesis project, KraftPowercon was selected as the case company. The observations and the interviews were performed at KraftPowercon, and this data collection was considered as qualitative. The purpose of using a case company was to give the possibilities for the researchers to investigate the research questions in more depth and be able to visit the production and warehouse to receive more understanding.

2.2.1 Research design aligning to the research questions

When the design for this project was set, the two research questions were taken into consideration. Different methods and strategies were applied in order to have the possibility to answer the questions in a reasonable way. In the following paragraph, the method design for the three research questions will be presented.

RQ1: How are material planning parameters applied within manufacturing companies in Sweden?

For RQ1, mainly a quantitative data collection was conducted. This question was a comparison between how the companies are using their parameters settings and the frequency of updating them. The strategy for answering this question in a suitable way was to compare the data between all companies and to investigate similarities and differences between the companies regarding the use of parameters. Hence, the design for this part of the question was to use Qlik and have the approach of quantitative data collection from all 10 companies. Furthermore, a qualitative data collection was done at KraftPowercon in order to verify data.

RQ2: What are the effects of the use of parameters within material planning?

- *How does the planning environment affect the use of parameters?*
- *How should the work with parameters be conducted in order to be effective and efficient within material planning?*

The method used for RQ2 was mainly qualitative data collection and analysis. The second research question is a deeper investigation of the case company KraftPowercon and was answered by data from KraftPowercon. Hence, qualitative data collection was done by observations and interviews at KraftPowercon to get a broader and deeper perspective and knowledge about how parameters are used from an organizational perspective. In addition, some data from Qlik was used as well, which is referred to as quantitative data collection.

To summarize the strategy of chosen methods that were used in order to answer the research questions, it is a variation of where the different methods are applied. The different methods of data collection in this project were the observations, the interviews, and data collection in Qlik, and as can be seen in this paragraph, a combination of quantitative and qualitative methods are used. Using different methods is a way of confirming the result from different perspectives and goes in line with what Denscombe (2018) describes as triangulation. Furthermore, Bell et al. (2022) defines triangulation as using at least two sources for data collection or using a combination of quantitative and qualitative data collection in a research project. In the following figure 2.3, the different steps in the research design are visualized chronologically.

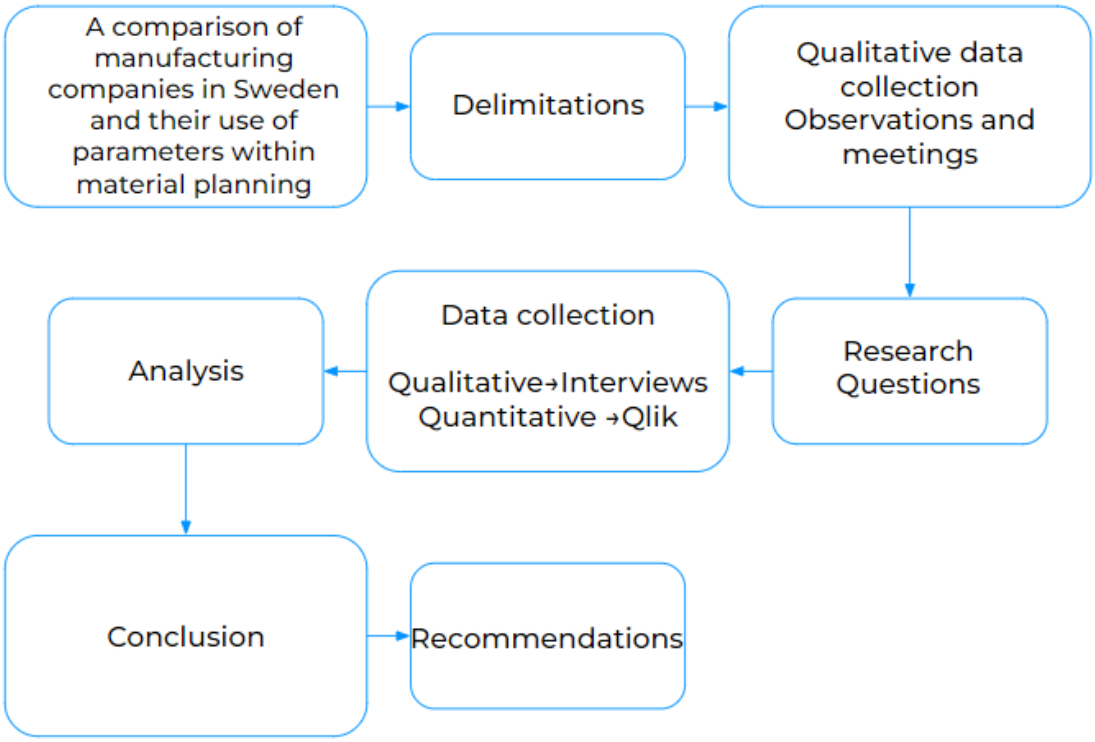

Figure 2.3, a summary of the research design.

2.3 Literature review

According to Bell et al. (2019), it is important to conduct a literature review within the selected research field in order to identify already existing researchers. Hence it could further be a guide of which area to not include in new research. Furthermore, reading existing literature in the selected field can further show what methods and concepts that have been used. Bell et al. (2019) stress that linking new research to current literature and concepts can increase credibility of the research. For this project, a literature review was conducted in the beginning of the project in order to identify and map out the selected area. By reading articles, it was further possible to define a problem description with the foundation of the gap in the literature. However, searching for literature was an iterative process throughout the whole project in order to complement, if necessary, based on the direction of the project.

It is important to be critical to the choice of sources and to selectively choose sources makes the content more reliable (Blomqvist & Hallin, 2015). Primary sources are close to the research objective and can for instance be interviews connected to the project, and secondary sources have a wider perspective of information and can for instance be paragraphs from academic articles (Blomqvist & Hallin, 2015; Säfsten & Gustavsson, 2020). As can be seen in table 2.1, the main used databases were Google Scholar, Scopus, and Chalmers library. Furthermore, the key words used in the literature review can also be seen in table 2.1.

Table 2.1, showing the key words used when conducting the literature review.

Data base	Key Words
Google Scholar, Scopus, and Chalmers library	Supply chain management
	Supply and demand
	Material planning
	Covid-19
	Data knowledge
	Business intelligence tool (BI)
	Parameters
	Safety stock
	Lead time
	Planning environment
	ABC-classifications

2.4 Data collection

Data collection within a research study can be conducted in several ways (Blomqvist & Hallin, 2015; Säfsten & Gustavsson, 2020). In order to answer the research questions for this project, the data collection consisted of observations, interviews, and Qlik. In the following subchapter, the data collection methods will be presented and described how it was applied in this project.

2.4.1 Observations

In this master thesis project, the observations were conducted at the case company KraftPowercon. The observations were classified as a qualitative research method in this master thesis since the collected data was words and images, which goes in line with Bell et al. (2022) definition of qualitative data collection. All observations for this project were carried out at the case company KraftPowercon and were made at an early stage of the project in order to give the researchers a background and understanding of the current state of their organization and processes. Hence, the observations in this thesis project did not have the purpose to identify practices and behaviors but rather to gain an insight and understanding of the company. In the following table 2.2, information regarding the observations is presented.

Table 2.2, the different sessions of observations.

Date	Activity	Duration
2023-01-17	First visit at the case company. Visiting the warehouse and production site	2 hours
2023-01-25	Meeting with the case company about the company and more in-dept information	3 hours
2023-01-26	Meeting with the case company about the company and more in dept information	2 hours
2023-01-31	Observation of incoming goods and warehouse management	1 hour
2023-02-06	Meeting with the case company about the product assortment	1 hour

The observations were designed as observations as participants, which means that the participants interacted by asking questions to the observed (Blomqvist & Hallin, 2015; Säfsten & Gustavsson, 2020). The observation sessions were both meetings and in-house observations, i.e., visiting the warehouse or production. During the observations, documentations were done with field notes to make the documentation precise. This is a common method used when performing observations according to Blomqvist and Hallin (2015). Furthermore, the documentation was summarized in a document to make it easier for the researchers to get an overview of what has been observed and founded. Considering this, reflections were made for interviews and further analysis.

2.4.2 Interviews

In this research project the interviews were conducted at the case company KraftPowercon. According to Denscombe (2018) interviews can be both quantitative and qualitative, however, the interviews can be classified as qualitative if the purpose is to get an in-depth knowledge within the field and it is by collecting words and not numbers. The interviews in this research project were defined as qualitative data collection since the purpose was to collect detailed data at the case company KraftPowercon. Including interviews in research projects is a common method (Blomqvist & Hallin, 2015; Bell et al., 2019; Säfsten & Gustavsson, 2020). However, there are several ways of applying and making use of it. One design is the semi-structured interview, which consists of both closed and opened questions (Blomqvist & Hallin, 2015; Säfsten & Gustavsson, 2020). The design is hence including both general questions where the respondent has a greater freedom when responding to the questions, but it also includes closed questions which can be more direct questions that the interviewers need a more specific answer to (Bell et al., 2019). In this study, the design of the interviews was semi-structured in order to give the respondents a freedom when answering the questions but also give the interviewers the possibility of asking direct and closed questions.

According to Blomqvist and Hallin (2015), and Säfsten and Gustavsson (2020), interviews can be structured by different guidelines. Furthermore, an interview guide is a helpful tool to get the structure of a semi-structured interview and stimulates good

interplay between the respondent and the interviewer. According to the research design of this project, the observations were the first performed data collection and the interviews as the second. This was done in order to understand the theme and scope of the project and KraftPowercon. Hence, the observations were partly the foundation of the interview questions. The focus of the interview questions was to get a better understanding of important parts defined from the project observations.

In total, eight interviews were performed for the data collection in this project, as can be seen in table 2.3. All interviews took place on site at KraftPowercon, hence, they were all face-to-face. The length of the interviews varied between 15 minutes and 40 minutes, however, all interviews followed the structure of the interview guides, as can be found in Appendix A, B and C. The interview guides were designed in order to cover important areas for the research, however, the interviewers were flexible regarding the order of the questions and listened to the respondent answer without disruptions. This way of conducting an interview goes in line with Denscombe's (2018) definition of a semi-structured interview. The decision was made to conduct interviews as personal interviews, i.e., only one respondent per interview. According to Denscombe (2018), some benefits of using this method is that it is easy to distinguish which respondent said what and this also facilitates later transcription and analysis of the interviews. However, during one interview there were two respondents included since two separate interviews was not possible. Since all respondents speak Swedish, it was decided to conduct the interviews in Swedish.

Table 2.3, an overview of the interviews.

Date	Number of respondents	Recording	Duration
2023-02-16	1	The respondent agreed to the recording the interview	29 min
2023-02-16	2	The respondent agreed to the recording the interview	35 min
2023-02-22	1	The respondent agreed to the recording the interview	33 min
2023-02-22	1	The respondent agreed to the recording the interview	38 min
2023-02-23	1	The respondent agreed to the recording the interview	39 min
2023-03-20	1	The respondent agreed to the recording the interview	22 min
2023-03-20	1	The respondent agreed to the recording the interview	16 min
2023-03-20	1	The respondent agreed to the recording the interview	28 min

Three different interview guides for the interviews at the case company were conducted where the questions were adapted based on the respondent's role, see appendix A, B and C. The interview guides consisted of a mix between open and closed questions depending on if the interviewer needed a more specific answer or open and describing

answers. Furthermore, two out of three interview guides were constructed with seven questions with each question having several sub-questions. The questions were further divided by different categories by topics that were relevant for this study. The different categories for the first interview guide were *procurement process*, *parameters* and *challenges and development.* The second interview guide was categorized as *production planning process*, *parameters* and *challenges and development*. The last interview guide was constructed with five questions with sub-questions. The different categories that were covered in the guide were *logistic process, warehouse management,* and *challenges and development*.

2.4.2.2 Selection method for respondents

There are several ways of making a selection by whom to include in the research and who to interview. One method is subjective selection which is, according to Denscombe (2018) a selection based on knowledge and relevance of the subject. The principle is that the selection will give the researchers a participant to include where relevant information can be shared (Denscombe, 2018). Snowball sampling is another method that can be used when selecting interview participants (Blomqvist & Hallin, 2015; Denscombe, 2018). This method is based on having a small number of participants at a first sample. These individuals are then further asked if they know other interviewees who might be relevant to the study. If they suggest additional participants, the sample will grow, and this is why the method is called snowballing.

In this project, eight interviews were conducted at KraftPowercon, and it could further be viewed as two rounds. For the first round of interviews, a subjective selection was made since the respondents were selected by their knowledge and experience within the field. However, for the second round of interviews, the selection was based on suggestions by the respondents from the first round of interviews, which goes in line with snowball sampling according to Denscombe (2018).

2.4.2.3 Recording of the interviews

According to Denscombe (2018), when conducting an interview face-to-face it is beneficial to record the interview to be able to gather all data and the details. Recording the interview allows the interviewer to have a full documentation of the interview and does not have to rely on notes or memory. According to Blomqvist and Hallin (2015) is it beneficial to combine recording and taking notes in parallel during interviews. Although, recording an interview does not include documentation of the non-verbal communication (Denscombe, 2018). The possibility of including this is then by video recording, however, Denscombe (2018) stresses that by video recording an interview can result in disruptions e.g., obtrusive and disturbing the respondent.

In this study, all respondents were asked for permission to record the interview. In total, eight numbers of interviews were recorded. During the interviews, there were always two interviewers, one asking the questions and one taking notes, this was done in order to follow the guidelines by Denscombe (2018) and Blomqvist and Hallin (2015) when performing interviews.

2.4.3 Data collection in Qlik

The data collection done by the BI tool Qlik is representing the quantitative data collection within this project. The method consisted of collecting a large amount of data in numbers, hence this goes in line with Denscombe's (2018) definition of quantitative method. The data in Qlik is connected to the 10 companies ERP systems M3. This gave the possibility of tracking data from different parameters and different years. The data in Qlik was collected from all 10 companies that were included in the study. According to Säfsten and Gustavsson (2020) quantitative data needs to be visualized and this can be done in different ways. In this study, the quantitative data collection was visualized in different pie charts. The settings that were used in Qlik were aligned with the delimitations of the scope of this master thesis project. In the following table 2.4, the different settings are presented.

Table 2.4, description of the different settings applied in Qlik

Settings in Qlik	Description	Selected companies
Number of suppliers	Identifying number of suppliers per company	All
Number of items	Identifying number or handled items per company	All
Status of items	Number of active and non-active items	All
Purchased material	Only investigating the purchased material	All
Parameters	Changes in the planning data	All
Lead time	Investigate the impact of the lead time	All
Material planning	Identifying the material planning method	All
Sourcing strategy	Identifying sourcing strategy of the items	All
Order quantity	Identifying the method used for determining the order quantity	All

2.5 Cross-case analysis

Collected data needs to be processed by critical and reflecting approaches connected to the purpose and research questions of the study (Blomqvist & Hallin, 2015; Säfsten & Gustavsson, 2020). According to Blomqvist and Hallin (2015), and Säfsten and Gustavsson (2020), quantitative data can be analyzed and visualized in different ways. Bell et al. (2019) and Säfsten and Gustavsson (2020) argue that thematic analysis is a method for analyzing qualitative data and that it is commonly used.

Denscombe (2018) argues that recorded interviews often need to be transcribed in order to analyze and compare the data collected. Transcribing an interview is time consuming, however, this method gives the researcher a connection to the collected data since they have to work with it in detail (Denscombe, 2018). Since all interviews were recorded in this project, transcribing was used as an analyzing method. Further on, the transcribed interviews were analyzed by the method *thematic analysis* (Bell et al., 2019). When analyzing the qualitative data, the researchers were searching for themes or codes in the data that was identified from the interviews. There are different ways of identifying data and to code them and recommended themes to search for are (1) *repetitions*, (2) *indigenous typologies and categories*, (3) *metaphors and analogies*, (4) *transitions*, (5) *similarities and differences*, (6) *linguistic concepts*, (7) *missing data* and finally (8) *theory related material* (Bell et al., 2019). Säfsten and Gustavsson (2020) mean that thematic analysis can be done in various ways, the importance is that the analysis can answer the research questions for the study. When all interviews in this project had been completed, they were transcribed and analyzed. The different themes that the research searched for were *forecast, parameters, tied-up capital in order flow and material flow, effects of Covid-19, inventory levels, challenges and development* and *classification*. The different themes were selected due to relevance for the research questions. The results from the interviews were applied to RQ2 when analyzing it. This is described more in depth in the following chapter.

2.5.1 Data analysis aligning to the research questions

When all data in this study were collected, different methods to analyze it were applied. Furthermore, the methods were selected upon what type of data that were collected and in what way. In the following paragraph, the analysis methods for the two research questions will be presented.

RQ1: How are material planning parameters applied within manufacturing companies in Sweden?

Comparative analysis was one method used for partly answering RQ1 and where the comparison was done with KraftPowercon and the other 9 companies. The comparative analysis was conducted in Qlik. The reason for why this comparative analysis was conducted was due to increasing the understanding of the parameter settings and use of them, i.e., frequency of updating them, but also in order to analyze if the result could be seen as generic.

RQ2: What are the effects of the use of parameters within material planning?

- *How does the planning environment affect the use of parameters?*
- *How should the work with parameters be conducted in order to be effective and efficient within material planning?*

For this research question the focus was on KraftPowercon, hence, the main data used was the interviews. As mentioned in chapter 2.5, all interviews were recorded, transcribed and further a thematic analysis were applied. Furthermore, the interviews gave the possibility to understand it from an organizational perspective more in-depth. In addition, result from the observations and data collection in Qlik was applied as well. This was done in order to understand the current state of KraftPowercon from different perspectives.

2.6 Research quality

In the following subchapter the research quality will be discussed. The different viewpoints will be ethics, validity, and reliability, and finally a more general discussion about the research and its quality.

2.6.1 Ethics

A research project needs to consider ethical parts of a study where the researchers need to reflect on the work (Blomqvist & Hallin, 2015; Säfsten & Gustavsson, 2020). Blomqvist and Hallin (2015) presents national codes to consider when conducting a study which are *the information requirement, consent requirement, confidentiality requirements* and *good use requirement.* All participants in this project knew about the research study and have agreed about being studied. This agreement was made for both observations and interviews. There were also agreements and approvals in advance of the interviews regarding permission to record it. All handled materials in the study were confidently used with respect to all included participants. Other ethical parts considered in this project connected to observations and interviews was that the participants were anonymous. In addition, the researchers of this project have signed a secrecy agreement with the included companies.

Ethics regarding the written text in the report is something that researchers need to take into consideration (Säfsten & Gustavsson, 2020). This includes plagiarism and the use of other methods and models. The researchers of this project were well known about this ethics and were using the reference model APA. Another aspect with ethics within this master thesis was that of all 10 companies included in this study, only KraftPowercon was referred to by its company name and the other companies were anonymous. This was done in order to minimize the risks with confidentiality, however, since KraftPowercon was acting as the case company in this study, an agreement was made so it was agreed to share their company name in the report.

2.6.2 Validity and reliability

Blomqvist and Hallin (2015) describes validity as studying relevant aspects for the project. Regarding the validity of this study, the parameters and collected data was done in line with the scope and delimitations of the project. The data and observations for

the project are collected from the original environment, which supports the validity of the study (Säfsten & Gustavsson, 2020). Furthermore, to strengthen the validity, the selection of respondents could be considered as important. The selection includes participants with knowledge about the studying theme. Regarding the data collection during this project, there were always two researchers that executed the work that supports the validity as well (Säfsten & Gustavsson, 2020). Furthermore, since the data collection was both quantitative and qualitative and collected from various sources, triangulation was used and hence, the validity was strengthened (Bell et al., 2022).

Blomqvist and Hallin (2015) describes reliability as conducting the research in the right way. All documentation from interviews, observations and Qlik was done in a systematic and specific way in order to increase the reliability. Furthermore, the reliability of a study can be strengthened by including participants with superior knowledge within the selected study field (Säfsten & Gustavsson, 2020). In this project, it was taken into consideration in the selection of participants for the observations and interviews. Furthermore, to strengthen the reliability of the data collection in Qlik, the data collection was conducted together with employees at Meridion. To strengthen the reliability of the study even more, the theoretical framework, chapter 3, is only described with peer reviewed articles (Säfsten & Gustavsson, 2020).

2.6.3 Research discussion

When designing a research project there are several options to design it and selecting different types of methods. The chosen method or methods can have an impact on the research quality. In this project, the chosen methods were data collection by observations, interviews and data collection in the BI tool Qlik. One aspect highlighted by Denscombe (2018) is the verifiability of the collected data, and one method to use is triangulation. This concept refers to the benefits of collecting data from different perspectives in order to investigate the research topic from different viewpoints (Denscombe, 2018). One way of applying the concept of triangulation is by combining different methods, since it could strengthen the accuracy of research, give the findings a more holistic view and finally the possibility to analyze the result in more depth since it is a different kind of data (Denscombe, 2018). In this study, a triangulation was compiled since observations, interviews, and data collection in Qlik were conducted. Hence, it was possible to view the data from different perspectives. However, triangulation of data collection was only fulfilled from KraftPowercon since the data collection from the other companies was only through Qlik. Furthermore, to confirm the data collection in Qlik, a verification meeting with KraftPowercon was conducted in order to secure quality of the data collection.

In this master thesis, both qualitative and quantitative data collection has been conducted. When using qualitative data collection, the generalizability of the results can be questioned (Denscombe, 2018). In this study, 10 manufacturing companies in Sweden were included, hence the findings could be considered as generalized to some

extent. However, to make the findings of this project applicable to a larger extent and classified as even more generalized, additional companies would have needed to be included in the study. Furthermore, all interviews were conducted at the case company KraftPowercon and to get even more generalized findings, the additional companies could have been included in the interview part of the study. However, given the time and resources allocated to this project, this was not practicable.

There were limitations regarding the number of interviews. The selection of the respondents was done in order to get a higher quality of the collected data by interviewing the employees with high competence within the field of parameter settings and ERP systems. During the data collection for this project, there were always two interviewees or two observers, no data collection was done individually. This was done in order to receive different perspectives but also to ensure that the correct data was collected. One aspect to consider regarding the collected data in Qlik is that the used data was not uploaded in Qlik at the same time. Hence, for some companies the result is more up to date and current which can have an impact on the result. Furthermore, it is notable that the data in Qlik are based on the companies' parameters settings and item information in M3, hence, the data collection in Qlik for this master thesis project is based on the companies' data in M3.

Another aspect of the analysis made by the data in Qlik is that by collecting raw data from a company, it can be considered as correct and not affected by any bias (Denscombe, 2018). Even though raw data could be considered as good quality, it is important to consider that data and settings can differ, which further might have an impact on the result. Hence, it is important to identify that the data is collected on the same foundation. With this in mind, all data entry and data analysis were done together with Meridion experts in order to anchor the credibility and accuracy of the data and increase the research quality.

3. Theoretical framework

In the following chapter, the theoretical framework will be presented. This chapter begins with literature relating to supply chain management, material planning and data knowledge and information and in the end, a summary of how the literature will be used further in the report. The aim of this chapter is to be able to relate and support the analysis and findings of this project to literature. The literature in this chapter was selected in order to discuss findings from the research questions in this master thesis but also to put the subject into its context.

3.1 Supply Chain Management

Supply chain management is described as how an organization manages and coordinates the supply chain regarding the material processes (van Weele, 2014). These processes can be both internal and external, and as well as incoming and outgoing flows. Lummus, Krumwiede and Vokurka (2001) make a distinction between logistics and supply chain management. They conclude that supply chain management can be defined as including the logistic flow, the customers, and the production processes. Moreover, the supply chain management includes the information flow that is required through the whole chain, including all activities and nodes. Furthermore, Lummus et al. (2001) concludes that one of the characteristics of a supply chain is the awareness of the companies involved, that it is a holistic view and that they all strive to improve the supply chain.

3.1.1 Meridion's supply chain framework

Meridion has developed a generic framework for describing the different activities in the supply chain and which processes that are included (Meridion AB, n.d.). As seen in figure 3.1, it is divided into seven different processes, where process five is divided into six steps. These six steps are visualizing the concept of the 6-box model as Meridion defines it. Furthermore, the 6-box model shows the order handling process both relating to the order flow but also to the material flow (Meridion AB, n.d.). Order handling, production planning and procurement planning is the order flow where the information goes from the customers to the suppliers. Receipt handling, production control and delivery handling is the material flow and where actual material is handled. Then the flow goes from the suppliers to the customers.

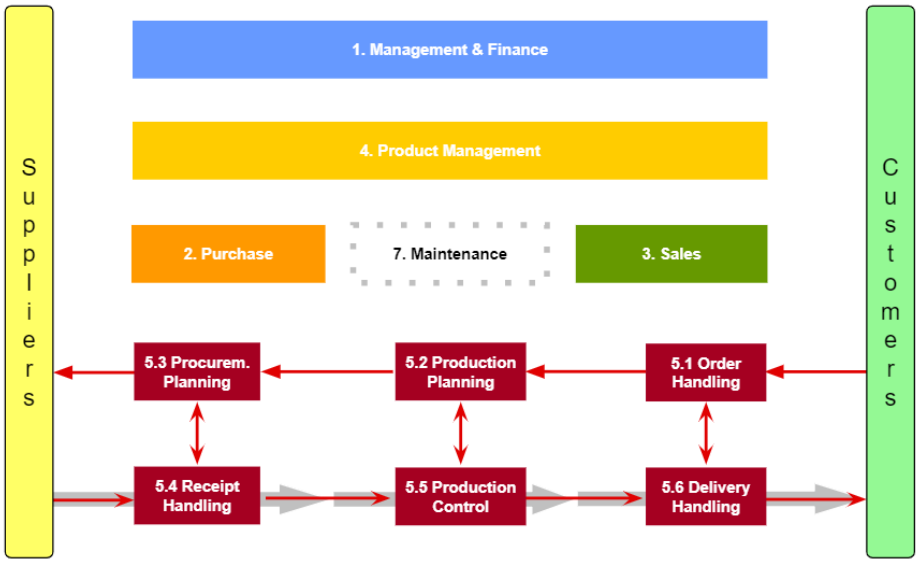

Figure 3.1, Meridions 6-box model describing the order delivery process of a company (Meridion AB, n, d.).

3.1.2 The supply chain triangle of service, cost, and cash

DeSmet (2017) argues that there are several ways of defining what supply chain management is, however, DeSmet (2017) further stresses that balancing the triangle of service, cost and cash is one way of defining it. The service dimension relates to the service to the customers. Within supply chain management, there are different kinds of service metric, however, DeSmet (2017) stresses that "service level" is usually used. However, there are many different ways of measuring service level and what to include or not. The cost dimension within this triangle is related to all the cost from purchasing raw material to deliver the product to the customer. Hence it includes sourcing costs, warehousing costs, shipping costs etc. The last dimension of the supply chain triangle is the cash dimension. DeSmet (2017) stresses that this is the most complex dimension to understand. Cash is defined as the working capital for an organization and the formula is the account receivable plus the inventory minus the accounts payable (DeSmet, 2017).

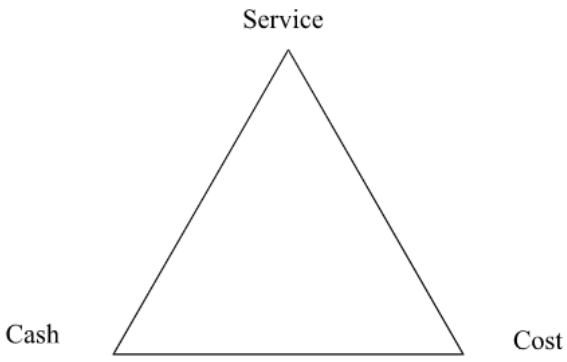

Figure 3.2, an illustration of the supply chain triangle of service, cost and cash adopted from Desmet (2017)

A definition of tied-up capital stated by Jonsson and Mattsson (2009, s. 456) is "the capital tied-up in the flow of materials, i.e., materials that are held in raw material and components stocks, in production, in finished stocks or distribution stocks and transports". Furthermore, the tied-up capital is a measurement of organizations assets in costs (Jonsson and Mattsson, 2009). Those assets can be divided into two categories, fixed and current. Fixed assets are the constant costs, e.g., factory and existing equipment. Current assets can vary and are focusing on, e.g., inventory and accounts receivable (Jonsson & Mattsson, 2009). According to Jonsson and Mattsson (2014), the organizational goal of material control is to have low delivery costs and a low tied-up capital.

Jonsson and Mattsson (2016) presents different efficiency variables within logistics and two of them are tied-up capital and service level. However, they stress that efficiency variables can cause conflicts. For instance, if the ambition is to have a high service level, one option is to increase the inventory levels. However, that further has a negative impact on the tied-up capital that will increase as well. Hence Jonsson and Mattsson (2016) stress that sometimes the ambition to achieve some efficiency variables can be a conflict.

3.1.3 Sourcing strategy

When purchasing materials from suppliers, different strategies can be applied (van Weele, 2018). It needs to be a strategy for how the company wants to source the materials from the suppliers. Different aspects to consider is from how many suppliers they can purchase the materials from, what type of relationship they want to have, contract duration, and source globally or locally for instance. Regarding the number of suppliers to use for supplying the material can be divided into single sourcing, dual sourcing, or multiple sourcing (van Weele, 2018). Single sourcing is when the company is only using one supplier for a certain item or material (Jonsson & Mattsson, 2016). Dual sourcing is when the company is sourcing the item or material from two suppliers (van Weele, 2018). Finally, the multiple sourcing strategy is to use several suppliers to supply the item or material from (Jonsson & Mattsson, 2016; van Weele, 2018). However, all three strategies enable both risks and benefits.

The purpose of using single sourcing could be for instance that there are low volumes purchased and the company needs to keep the administrative cost down, it can also be if there is a specific material or component that is difficult to replace (Jonsson & Mattsson, 2016). Another reason to use single sourcing is if the company want to build a partnership and work more closely together for future development. The main reason for using multiple sourcing as a strategy is the possibility to use several suppliers in parallel and it makes it possible to put the suppliers against each other in order to get a better negotiating position in terms of price and delivery conditions (van Weele, 2018). When using dual sourcing, the strategy could further be to have one supplier as a primary supplier and one as secondary supplier (Jonsson & Mattsson, 2016). This gives

the possibilities to have a close collaboration and communication with the primary supplier but secures the risks of having a secondary supplier that could deliver if there is a problem with the primary supplier.

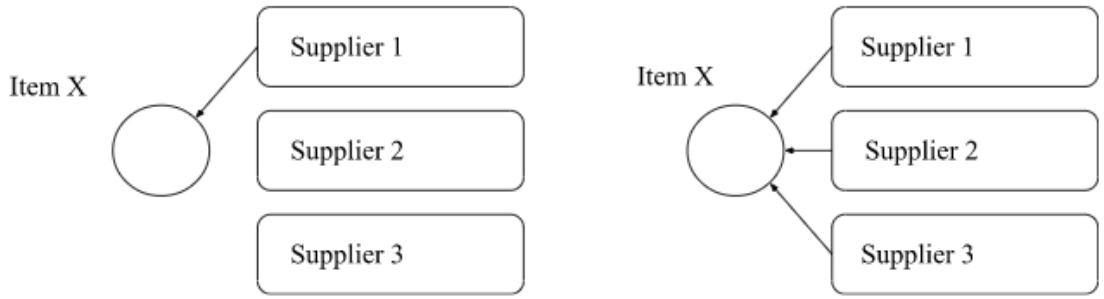

Figure 3.3, an illustration of single sourcing and multiple sourcing, the illustration is adopted from Jonsson and Mattson (2016, p.191).

3.1.4 Risk and disruptions in demand and supply

Uncertainties within a supply chain are always present (Rahdar, Wang & Hu, 2018). The disruptions can appear in the whole supply chain, for instance, the suppliers cannot deliver raw material, or the customer changes the demand. A purpose with a supply chain is the connection in the network with all parties (Rahdar et al., 2018). Its further results in that the inventory systems are also related, hence the supply chain becomes more complex and interconnects the variety and uncertainty in the supply chain as well. The uncertainty in the supply chain regarding supply and demand has an impact on the total cost (Rahdar et al., 2018). Uncertainty from a supplier can result in variability in the lead times and uncertainties from the customer side can impact the order quantity or requested delivery time.

Furthermore, Christopher and Holweg (2011) argue that there are many variables that have an impact in global supply chains, and that these are of a different nature and character, hence, strategies are needed to prevent and not react to turbulence. Cheng, Fredriksson and Fleury (2021) discusses global turbulence that affects manufacturing and how digitalization has an influence in supply chains and especially for manufacturing companies. They state that as a result of supply chains becoming more and more complex, there is more data to manage (Cheng et al., 2021). However, models of how to use it in an efficient way have not been developed and kept up with the increased compatibility and a result of that is that many companies are still relying on manual calculations and estimations.

Bag, Dhamija, Luthra and Huising (2021) makes a distinction between internal and external purchasing and supply risk management. From the internal perspective, it is important to mitigate the risks and volatility within the inventory levels, forecasting, sourcing of components etc. From the external perspective, the focus is on fluctuations of price, poor quality and communication from suppliers and also inaccuracies of

delivery (Bag et al., 2021). Both these internal and external purchasing and supply risks are important for companies to consider since these factors can have a negative impact on the supply chain management result. Bag et al. (2021) concludes that when there are uncertainties on the market, e.g., Covid-19, it is important for companies to continuously work towards minimizing these external and internal risks by strengthening the supply chain management processes to be able to keep up with their business.

3.1.4.1 Pandemic of Covid-19

The outbreak of Covid-19 impacted the whole world in many different perspectives, both social and economic (Free & Hecimovic, 2021). One characteristic of manufacturing companies is that their supply chains have since 1980 become more globally and sources raw materials from different parts of the world. Hence, the Covid-19 outbreak affected the global supply chains with different disruptions due to the global effect the virus had. Covid-19 impacted the supply chains during the outbreak but will also have an impact with new problems to address afterwards as well, according to Bag et al. (2021).

Free and Hecimovic (2021) presents three key drivers for the uncertainties in the global supply chain which were affected during Covid-19. These drivers are *consolidated centers of production*, *reduced inventory levels* and *lack of supply chain transparency* (Free & Hecimovic, 2021). The first driver, *consolidated centers of production,* implies that producers of critical components have come together for increased production which has increased the number of critical components in the supply chain. However, as a consequence of this, there has been a shortage of other components in the supply chain instead. For the second driver, *reduced inventory levels*, is a topic that has been in focus for a longer time to decrease the total cost (Free & Hecimovic, 2021). However, during Covid-19 this has led to materials shortage and minimized the supply chain resilience instead. The third driver, *lack of supply chain transparency,* implies that due to the increased complicity of the supply chains, the transparency in the supply chain has decreased. The visibility often extends only to the first-tier suppliers. The consequences of this are the difficulties in controlling and identifying capacity problems or material supply problems upstream the supply chain. This was the case for many supply chains during Covid-19 (Free & Hecimovic, 2021).

3.2 Material planning

Material planning are defined by Jacobs et al. (2018) as a system within the supply chain used to manage an efficient material flow by using internal and external resources to meet the customer demand. The internal resources could be defined as machines and humans and the external resources could be defined as suppliers. Having an effective and efficient material planning system is considered as important for manufacturing companies according to Jacobs et al. (2018). However, designing and setting up a framework for such a system is not a one-off exercise, it is an iterative process that

needs to be adapted to the development of the market and customers. In addition, Jacobs et al. (2018) stress that the fundamental issues addressed in the material planning process is to find a match between the supply and the demand.

Development of material planning has been done for several years (Wikner, Jonsson & Helgesson, 2021). Material planning aims to, in a cost-effective way, balance the demand and supply of the material (Jonsson & Mattsson, 2009). Jonsson and Mattsson (2009) makes a distinction between quantity dimension and time dimension within material planning where the time dimension is the most challenging once. If the delivery arrives prematurely, the materials or components will be stored for a longer time than planned which will increase the tied-up capital. However, if the materials arrive later than planned, it may cause consequences for production. For instance, production may stop, and the customer may not be delivered on time. Furthermore, Jonsson and Mattsson (2016) stressed the importance of not working with too many items and to phase out items that are not used. Phasing out items makes it easier for companies to control their material planning. Hence, it is easier to forecast a smaller number of items and the focus can be on items that have the largest impact for the companies, which further brings higher quality (Jonsson & Mattsson, 2016). In addition, effects of this are decreased tied-up capital, more efficient resource utilization and a higher service level.

When working with different kinds of material planning, there are different methods to apply. For instance, Material Requirement Planning (MRP) and Re-ordering point (ROP) among others (Thürer, Fernandes & Stevenson, 2020; Jonsson & Mattsson, 2016). According to Thürer et al. (2020) MRP is a method used for material planning to have material available when it is needed for production, MRP is a backward schedule planning. The material planning method MRP is most effectively used in a complex planning environment (Jonsson & Mattsson, 2003). Re-ordering point is a material planning method that is defined by Jonsson and Mattsson (2016) as a new order is initiated when the stock goes below a reference quantity. The reference quantity could be seen as the re-ordering point.

3.2.1 Planning environment

According to Jonsson and Mattsson (2009), manufacturing companies' planning environments can be designed in different ways. Jonsson and Mattsson (2003) stressed the importance of using a material planning method that suits the company’s planning environment. In a planning environment with long lead times, and capacity and resource variations the planning needs to be extensive (Jonsson & Mattsson, 2009). Furthermore, the planning environment can include variables such as the size of the order quantity, how long the lead times for the items are and also the uncertainties of the demand (Jonsson & Mattsson, 2014). The planning environment can affect, for instance, the tied-up capital and the delivery capacity (Jonsson & Mattsson, 2014). In

addition, Jonsson and Mattsson (2014), stress that the planning environment for companies has an impact on the ability to sustain competitive in the market.

Managing risks in the planning environment can be done proactively or reactively (Dittfeld, Scholten & Van Donk, 2020). Many organizations design their organizational work proactively with a main focus on the planning environment. According to Dittfeld et al. (2020) the main focus of proactively work is to reduce risks before they occur. Reactively work is made when a risk has occurred and is often a temporary solution to manage the risk (Dittfeld et al., 2020). According to Wikner et al. (2021) proactively planning and control emphasizes planning for the future and being able to handle unexpected occurrences, e.g., with safety stock and safety lead time. However, Dittfeld et al. (2020) stress that not all risks can be managed proactively, hence, they need to be handled reactively.

3.2.2 Parameters within material planning

Within material planning there are different parameters to consider, e.g., order quality, lead time, safety stock and forecast (Jonsson & Mattsson, 2009; Jonsson & Mattsson, 2014). According to Jonsson and Mattsson (2009), applying safety stocks and safety lead times can be useful in order to prevent uncertainties between the supply and demand. By including this in the material planning, it can prevent uncertainties in material supply. Jonsson and Mattsson (2014) describes that parameters connected to safety stock have an impact on organizations outcomes and can be a risk if the parameters are updated less frequently. A consequence of not maintaining their parameters can result in that the parameters are not aligned and updated with reality (Jonsson & Mattsson, 2016). This in turn can affect the organizational processes, for instance if the delivery of materials either arrives later than planned or earlier than planned. Where both entail a consequence of the material handling.

To find a balance in supply and demand is a challenge and since it depends on many different parameters, it is almost impossible to perfectly synchronize it (Jonsson & Mattsson, 2009). Changes in the planning environment require constant updated parameters to retain efficiency (Jonsson & Mattsson, 2014). Parameters have an impact on the planning process, both regarding information and decision making (Jonsson & Mattsson, 2009). Furthermore, parameter settings affect organizational efficiency. According to Jonsson and Mattsson's study from 2014, they concluded some differences between high and low performance companies regarding the use of parameters. The study showed that high performance companies updated their parameters more frequently and are using calculation methods for deciding the parameters to a larger extent than the low performance companies (Jonsson & Mattsson, 2014).

Parameter Safety stock

Using safety stock can decrease uncertainties within the material supply for an organization (Desmet, 2017). Safety stock is helpful to use if, for instance, the delivery is late or if the delivery contains a smaller quantity than ordered. Furthermore, safety stock has an impact on the inventory cost and on the component or material shortage cost (Jonsson & Mattsson, 2009). Best case scenario is to minimize both these costs while optimizing the use of safety stock. The size of safety stock depends on the demand and lead time and should further be updated when demand or lead time is changed (Jonsson & Mattsson, 2009).

According to Jonsson and Mattsson (2009), there are mainly two ways of determining safety stocks. Either by manual estimations or by calculations where more information is included regarding the situation for the item. Manually estimating safety stock requires registrations and changes in the ERP system (Jonsson & Mattsson, 2009). Furthermore, this is seen as resource and time consuming when individuals need to reflect on planning environments that have been changed. For using advanced methods, software support is necessary. Jonsson and Mattsson (2009) categorize it to five different methods, divided by two manual and three advanced as can be seen in table 3.1.

Table 3.1, the five methods of determining safety stock according to Josson and Mattsson (2009).

Method classification	Description
Manually	Manually estimated safety stock or safety lead time
Manually	Safety stock as percentage of lead time and demand
Advanced	Safety stock based on cycle service
Advanced	Safety stock based on demand fill rate
Advanced	Safety stock based on cost optimization

Parameter Lead time

Lead time is one parameter that has a significant effect on the methods used for material planning (Jonsson & Mattsson, 2014). Furthermore, constant changes in the lead time requires frequent documentation in the ERP system. Possible risks with less frequently updated lead time parameters are that material can be ordered too late or too early, which contributes to, for instance, high tied-up capital (Jonsson & Mattsson, 2014). In addition, Jacobs et al. (2018) stress that lead time is not a constant factor, hence, it is a parameter that needs to be managed.

Lead time can be divided into subcategories, for instance procurement lead time, delivery lead time and safety lead time (Jonsson & Mattsson, 2009; Masha, Ata Allah & Fariborz, 2019). Procurement lead time is focusing on the administrative work in an organization (Jonsson & Mattsson, 2009). This lead time occurs from when material is

needed to delivery of the material. Delivery lead time is also included in this time period, the time it takes to deliver between the placed order to the order is delivered (Jonsson & Mattsson, 2009; Masha et al., 2019). Furthermore, transportation lead time is also a part of this time period. Transportation lead time is the time it takes to transport the material (Jonsson & Mattsson, 2009). Safety lead time is determined to easier manage uncertainties and balance the supply and demand. Identified by many researchers is that delivery lead time is an important factor to consider in organizations supply chain management (Masha et al., 2019).

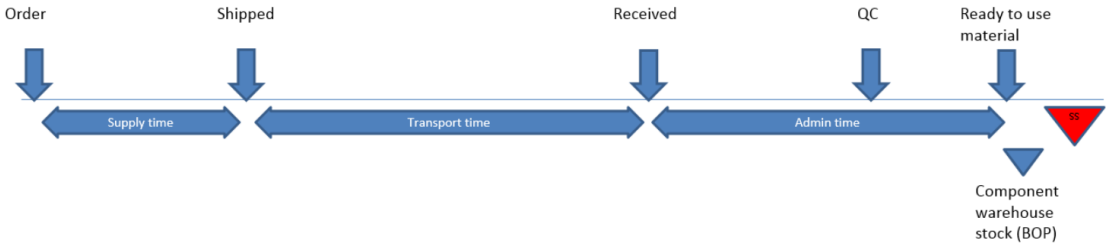

Figure 3.4 visualizes the different types of lead time that are included in the total lead time.

Parameter Forecast

Forecast is another parameter mentioned by Jonsson and Mattsson (2009). Planning for the future requires some sort of knowledge about upcoming activities, which can be forecasting. Forecasts are an estimation on the future demand and there are several forecast methods to use e.g., moving average and exponential smoothing (Matsumoto and Komatsu, 2015). Forecast is a supportive tool within material planning and decision making for the future in different levels of the organization, e.g., strategic, tactical, and operative levels (Jonsson & Mattsson, 2009). According to Matsumoto and Komatsu (2015) it is a challenge to develop reliable forecasting methods that bring efficiency to the planning and control process. More access and availability of forecasting methods makes it possible for organizations to choose a method that fits them the most (Hofmann and Rutchmann, 2018).

3.2.3 Classifications

Classifications of components are conducted in order to differentiate the items and the focus can be categorized and structured in different ways (Mattsson, 2008). The classification of components can for instance be divided into categorizations of e.g., frequency and volume. The main purpose of item classification is to delimitate the focus (Mattsson, 2008). Organizations deal with a wide variety of components that require knowledge on how to structure and prioritize in a beneficial way for the supply chain (Jonsson & Mattsson, 2014). The classification is often done in respect to the components that have a significant impact on the tied-up capital and delivery lead time, hence by prioritizing to monitor them could be time saving and not focusing on the components with lower impact on these parameters (Jonsson & Mattsson, 2014).

According to Khanorkar and Kane (2022), components used in the industry can be classified into categories where the focus is on the critical components. One classification to use is the ABC-classification. Items categorize into a classification of A, B and C depending on how important they are in the supply chain of an organization (Khanorkar & Kane, 2022; Prachuabsupakij, 2019; Mattsson, 2008). Furthermore, this classification is based on the thought "*80% of the overall consumption value is based on only 20% of the total items*" (Khanorkar & Kane, 2022; Prachuabsupakij, 2019; Mattsson, 2008). Classification A are components with high risk in the supply chain and need to be checked frequently with a revenue of around 70%. Classification B components are in the middle and reach a financial value of around 20%, while C components are around 10% (Khanorkar & Kane, 2022; Prachuabsupakij, 2019; Mattsson, 2008).

3.3 Data knowledge and information management

A trend in supply chain management today is the development of digitalization within the industry (Schniederjans, Cuardo, & Khalajhedayti, 2020). Digitalization for a company generates many opportunities, especially within the field of data and information sharing and could further be viewed as a key factor in order to achieve competitive advantage (Schniederjans et al., 2020; Chipriyanova & Chipriyanova, 2022). However, it also poses challenges, which for instance could be how to use the data and how to utilize it in order to make strategic decisions (Schniederjans et al., 2020). Furthermore, Schniederjans et al. (2020) argues that these developments should not be limited to larger companies and should be available to smaller enterprises within the supply chain as well.

Knowledge and information could be considered as a fundamental pillar within a company (Ghazanfari, Jafari & Rouhani, 2011). By managing information and being able to use it in decision-making processes, competitiveness can be achieved. Many companies are using different kinds of digital software and systems, hence this is where the information is stored and the ability to integrate them is a way for achieving the competitive advantage. According to Ghazanfari et al. (2011), implementing Business Intelligence (BI) in the systems, and making the systems integrate with each other could be useful in order to have a good basis for decision-making processes. In order for the companies using these kinds of systems to be effective and efficient, applying BI tools has increased among the companies (Sangari & Razmi, 2015).

Using computer technology in today's businesses evaluates changing levels of organizations (Grover & Davenport, 2001). A well working data system needs to consider information to make good outcomes. Information reduces problem uncertainty and is therefore seen as an important context. Transforming the company information into a data system could be complicated regarding how to do it and what should be included. Knowledge is even more value-adding than information (Grover &

Davenport, 2001; Enberg, 2012). It is needed to be able to consider what type of information that should be collected and included in the data. Other important considerations in an organization are how information and knowledge are spread through the organization (Grover & Davenport, 2001).

3.3.1 Business Intelligence

Business intelligence (BI) is a technical tool for cooperation of organizations' data that makes it possible for organizations to conduct data-based decisions (Chenhao, Aloisius, Xinhu & Wang, 2021; Sangair & Razmi, 2015). BI are data systems that combine internal and external organizational data to make it easier for organizations to make decisions that bring value (Chenhao et al., 2021; Richards Yeho, Yee Loong Chong & Popovic, 2019). The data in BI are aggregated and consider transformations of transactional information. In BI, technical components are used to view the data in a more understandable way with relevant information (Sangari & Razmi, 2015).

Sangari and Razmi (2015) mentioned that supply chain BI competence includes the possibilities to provide the information related to the supply chain in different levels. This could be strategic network planning, outsourcing, and purchasing. Furthermore, BI interacts with managerial, technical and the BI cultural competence in the organization (Sangari & Razmi, 2015). BI can further be used in different data tools and could be seen as a developed digitalization of the manual data work. This type of tool needs to consider a lot of data connected to the organization and the data could also be viewed as important in terms of cooperation between different levels in the organization (Sangair & Razmi, 2015).

Big data is related to BI by utilizing the processed big data in BI tools. Big data is defined as an essential element of collected data that affects the operations of organizations (Hofmann & Rutschmann, 2018). Instead of manually coordinated data, the time can be utilized by using BI tools for processed data. A highly competitive business environment brings new challenges for organizations that are needed to structure their work (Chipriyanova & Chipriyanov, 2022). Organizational decision making connected to activities and processes affects the further work and the goal is to achieve a more efficient work that meets organizational goals.

Qlik is a technical BI tool where data is summarized. According to Qlik (Qlik.com, n.d), the tool closes the gap between data, insights, and actions in one platform. It is stated as "*make your data and analytics real-time, AI-driven, collaborative and actionable*" (Qlik.com, n.d.). The goal of Qlik is to build data-driven organizations. Qlik makes it possible to combine several types of data into one summary with some aligned factors. Furthermore, these summaries can export the data into visualizations to make it easier for organizations to understand their data.

3.4 Literature in relation to the research questions

In figure 3.5, the relation between the literature and the research question is presented. The idea of this figure is to visualize how the different chapters in the literature chapter will be used later on in the report. Which literature that will support the findings and discussion in the following chapters divided upon the research questions.

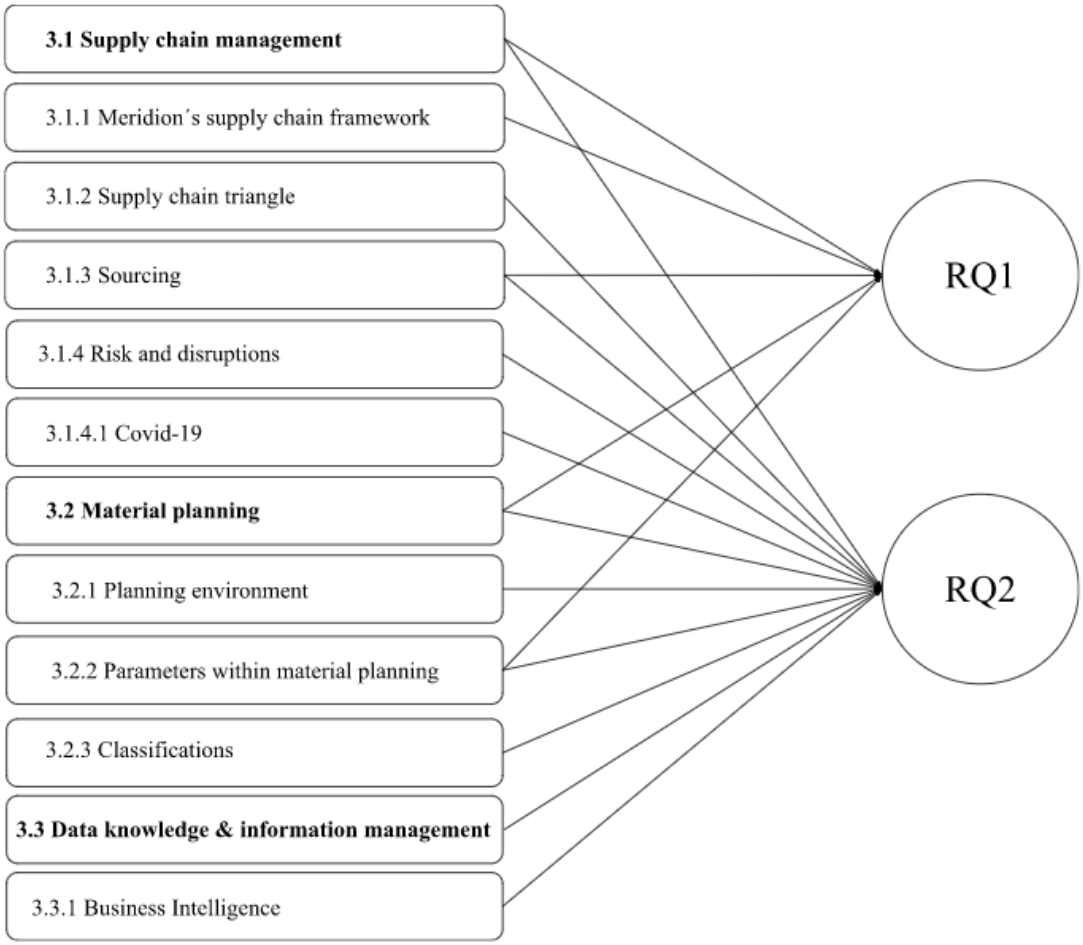

Figure 3.5, a summary of the literature presented in relation to the research questions.

The literature that will be used for RQ1 is mainly the material planning literature along with parameters, and sourcing. These chapters are used since it will support the findings from Qlik regarding RQ1. The literature will be used to find similarities and differences between the findings and literature. For RQ2, several parts from the literature chapter will be used since it is a broad research question. Hence literature regarding the supply chain triangle, material planning, parameters classification will be used. This will be used to be able to identify similarities and differences of how KraftPowercon is working compared with the literature. Furthermore, literature regarding uncertainties and disruptions will be used since the recent years have been characterized by uncertainties,

for instance by Covid-19. In addition, literature regarding BI and data knowledge will be used to support the findings regarding data driven work and how data tools can support organizational work.

4. Empirical findings

In the following chapter, the empirical findings of the study will be presented. This chapter is structured by the two research questions and the findings for RQ1 are based on data from Qlik and the findings for RQ2 are based on data from the observations, the interviews and Qlik. Furthermore, in each subchapter, the empirical finding is presented and then analyzed by the relevant literature.

4.1 Findings relating to RQ1

RQ1: How are material planning parameters applied within manufacturing companies in Sweden?

In order to answer RQ1 of this master thesis, a comparative analysis has been conducted in Qlik. The findings are visualized in this subchapter by pie charts with different settings and filtrations in Qlik. The basic selection of the items included is that they are purchased items and that they are registered as active within the company. The subchapter is structured by the different filtrations and are as following; Maintaining parameters, Lead time, Material planning method, Sourcing strategy and in addition, a final pie chart is visualizing Number of active and inactive items. The data in Qlik are based on the company's settings in M3, therefore the result reflects how they apply settings in M3. Hence, this means that the data can differ between the companies and the filtrations. Some items might not have the settings that were used in Qlik when the result was retrieved for this master thesis.

4.1.1 Maintaining parameters

The change of planning data is visualized in figure 4.1 and 4.2. The pie charts represent the amount of updated parameters over years. It shows when the planning data has changed i.e., when some parameter has been updated or changed for a certain item. The parameters that are taken into consideration is all settings relating to an item in M3. Moreover, the figures visualize the number of suppliers and items for each company included in this study. The data uploaded in Qlik was retrieved latest from 2022, hence, there is no data for 2023. The red color represents 2022, the light blue color represents 2021 and the beige color represents 2020. Other colors represent years before 2020.

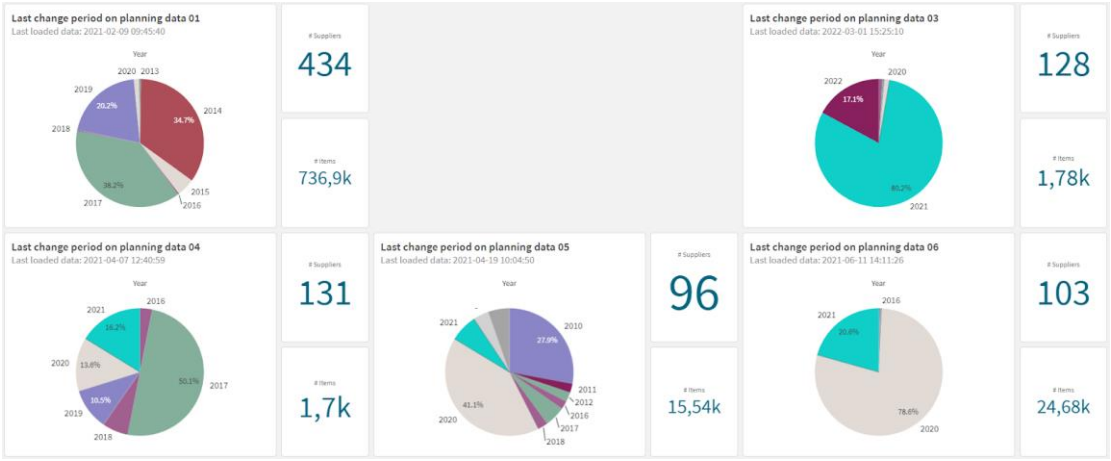

Figure 4.1, an overview of the frequency of change of planning data for company 01-06. The colours visualize different years when the parameters have been updated.

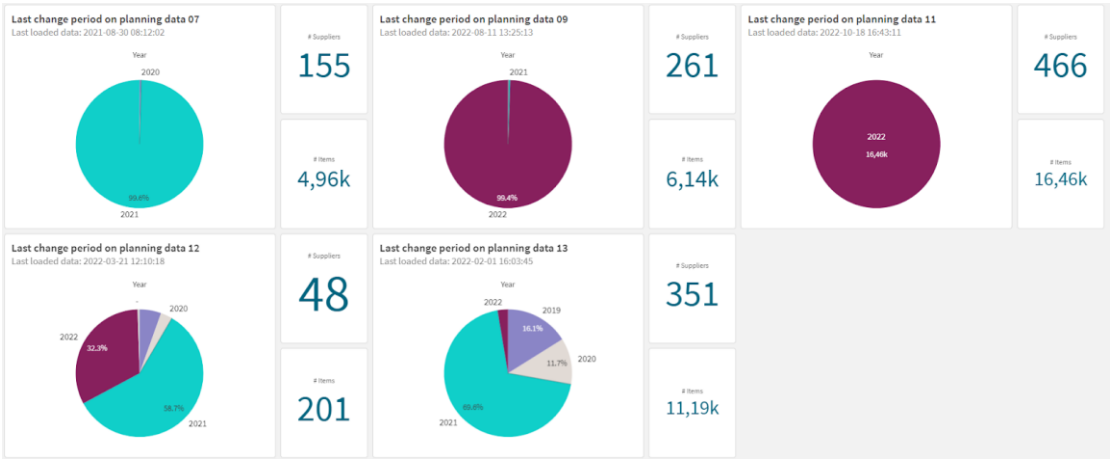

Figure 4.2, an overview of the frequency of changing of planning data for company 07-13. The colours visualize different years when the parameters have been updated.

Jonsson and Mattsson (2014) stress the importance of frequently updating parameters within material planning in order to sustain competitive. When analyzing the result from Qlik regarding the parameters and the frequency of updating them, it differs between the companies, as can be seen in figure 4.1 and figure 4.2. Some companies have parameters that have not been updated for a longer period, for instance company 05 that have some parameters that have not been changed in 13 years (around 27 % of their items). On the other hand, there are some companies that have updated the majority of their parameters since 2021 (company 07) respectively 2022 (company 09 and 11).

Furthermore, there is a difference between the number of suppliers and number of items listed for all companies. The items have a range of 201 (company 12) to 736 900 (company 01) and the suppliers have a range of 48 (company 12) and 466 (company 11). The companies 07, 09 and 11 can be seen as the ones with the highest frequency of changing the planning data, more than 99 % of their items planning data have been updated the same year as the data was retrieved in Qlik. It is notable that the data is

retrieved in August 2021 (Company 07) and August 2022 (Company 09) and October 2022 (Company 11), hence, the data does not show the work with parameters the months after. Company 07 and 09 are categorized as a large company and company 11 is categorized as a medium sized company. Company 07 has 155 suppliers and 4 960 items, and company 09 has 261 suppliers and 6 140 items, which could be seen as similarities. However, company 11 (KraftPowercon) differs with 466 suppliers and 16 460 items.

Since the companies 07, 09 and 11 are distinguished from the average and are updating their parameters with a higher frequency than the other companies, some deeper investigation in Qlik for these companies have been conducted. Since they have almost all the parameters updated from the year the data was last retrieved, it was of interest to investigate more deeply at which time and month the changes have been conducted. For company 07, around 70% of the parameters were updated in January and the data was retrieved the same year in August. This shows that over the year, the parameters are not being frequently updated, it is mainly during one specific time period. This could be shown for other companies as well. For company 09, around 70% of the parameters were updated in February. Company 11, KraftPowercon, has around 88% of their parameters updated in April. Hence, the companies have updated their parameters in the beginning of the year, and not update them frequently after that. This was further compared with the two companies that have a lower frequency of updating parameters, companies 01 and 05. The data showed that this structure and pattern could be found for these companies as well. Both companies had the structure of when parameters have been updated, it was mainly the same month.

When having parameters that are not updated means that there is a potential risk that they are not aligned with reality, hence this can affect the outcome of material planning (Jonsson & Mattsson, 2014). For instance, if the lead time is not updated to reality, then the material might be delivered ahead or behind schedule, which can lead to negative consequences for the company. This is something to consider for the companies, as can be seen from figure 4.1 and 4.2, several of the companies have parameters that have not been updated for years. However, in the figures, which type of parameter changed is not specified e.g., lead time or safety stock. Furthermore, the pie charts are also including other type of changes in planning data, i.e., changes in M3.

The aim of material planning is to find a way to balance the supply and the demand (Jacobs et al., 2018; Jonsson & Mattsson, 2009). However, it is further described in the literature that uncertainties within the material flow are always present and that these uncertainties can occur from both the demand and supply side (Rahdar et al., 2018). In order to handle these uncertainties, maintaining parameters and frequently updating them is a way to balance the supply and demand (Jonsson & Mattsson, 2009). As can be seen in figure 4.1 and figure 4.2, there are many parameters that have not been updated for a longer time. Hence, the current state of the studied companies shows that not all companies are in line with the recommendations from the literature of frequently

updating parameters. However, it is important to highlight that RQ1 is based on quantitative data and in this part of the study, an in-depth analysis of the underlying causes has not been conducted.

Figure 4.3 illustrates the following analysis conducted in Qlik with the different settings and filtrations that were applied. The analysis was always based on the pie charts from *Maintaining parameters* (figure 4.1 and 4.2), however, different filtrations have been applied. Three additional categories were investigated and as can be seen in figure 4.3, it was lead time, material planning methods and the sourcing strategy. The selection was based on which aspects that were relevant to the research question and scope of the study.

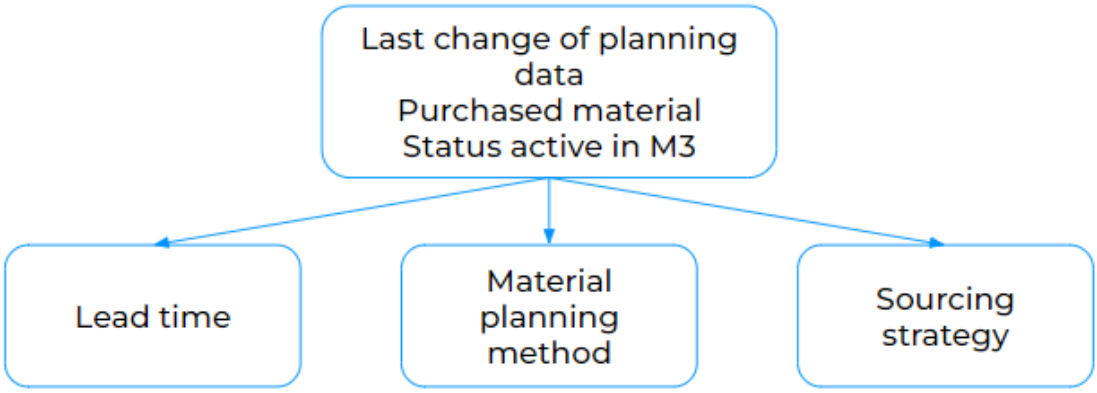

Figure 4.3, an illustration of how filters were applied in Qlik.

4.1.2 Changes depending on the items lead time

In the following figures, the change of planning data i.e., maintaining parameters, with focus on the items lead times is visualized. The different categories that were used were lead times 0-3 days (Sweden), 4-10 days (Europe), and more than 30 days (Long distance). The purpose of this filtration was to investigate whether the item's lead time could have an impact on how frequently the parameters have been updated. Hence, the data are visualizing all items and associated parameters, but classified depending on the items lead time.

Change of planning data applied with lead time between 0-3 days

The figures 4.4 and 4.5 visualize the items with a lead time of 0-3 days and the frequency of changed and updated parameters.

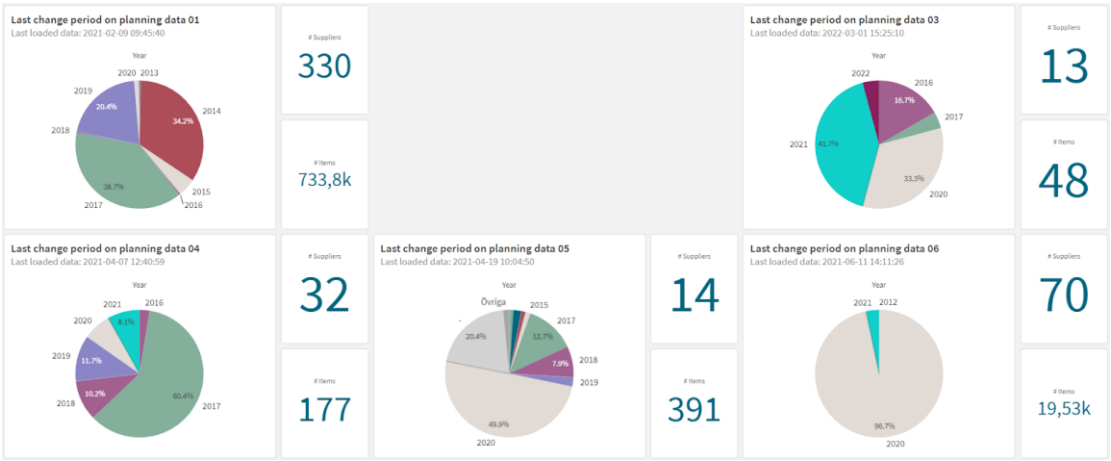

Figure 4.4, an overview of the frequency of changing of planning data for company 01-06 with the setting of lead time 0-3 days. The colours visualize different years when the parameters have been updated.

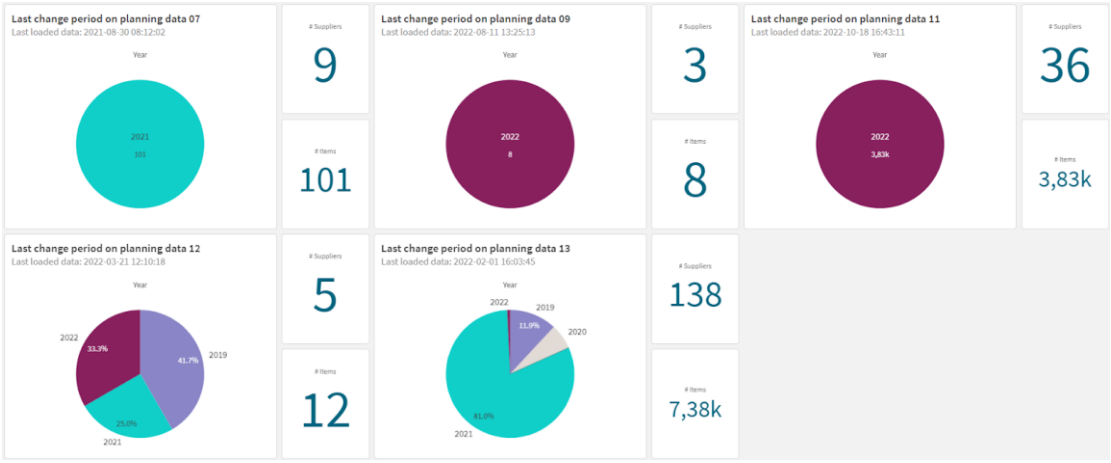

Figure 4.5, an overview of the frequency of changing of planning data for company 07-13 with the setting of lead time 0-3 days. The colours visualize different years when the parameters have been updated.

Change of planning data applied with lead time between 4-10 days

The figures 4.6 and 4.7 visualize the items with a lead time of 4-10 days and the frequency of changed and updated parameters.

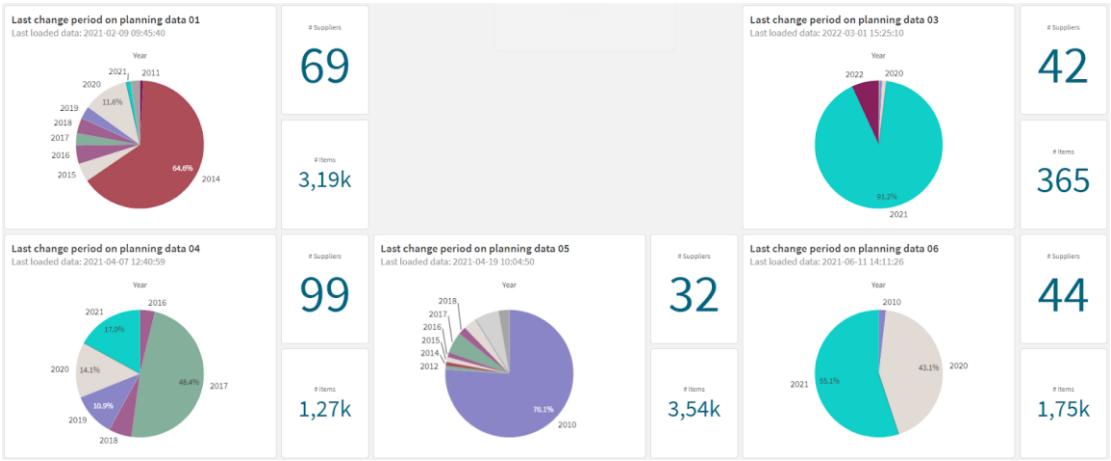

Figure 4.6, an overview of the frequency of changing of planning data for company 01-06 with the setting of lead time 4-10 days. The colours visualize different years when the parameters have been updated.

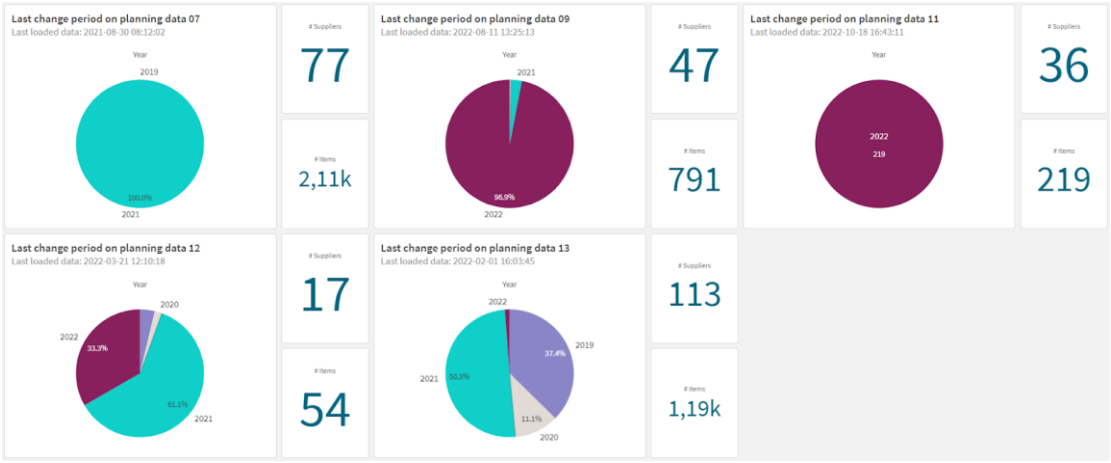

Figure 4.7, an overview of the frequency of changing of planning data for company 07-13 with the setting of lead time 4-10 days. The colours visualize different years when the parameters have been updated.

Change of planning data applied with lead time over 30 days

The figures 4.8 and 4.9 visualize the items with a lead time of over 30 days and the frequency of changed and updated parameters.

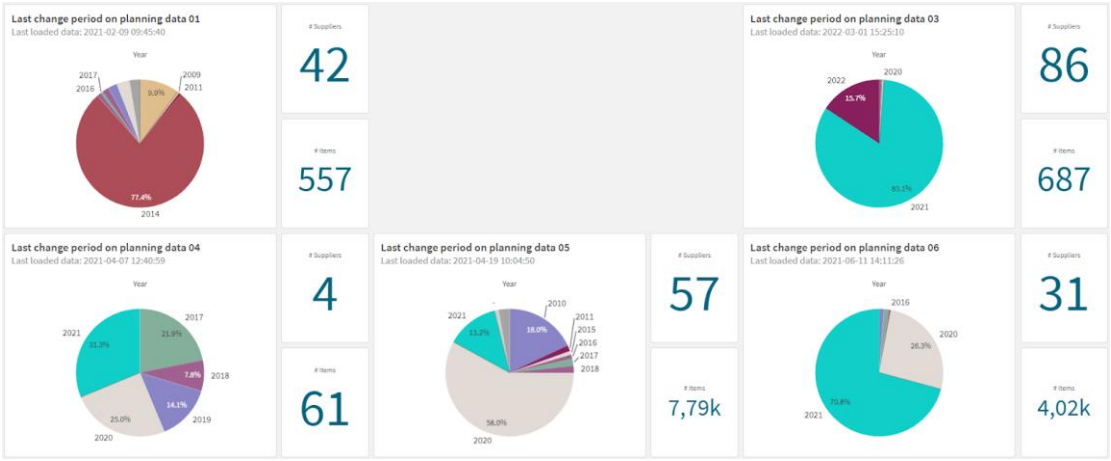

Figure 4.8, an overview of the frequency of changing of planning data for company 01-06 with the setting of lead time over 30 days. The colours visualize different years when the parameters have been updated.

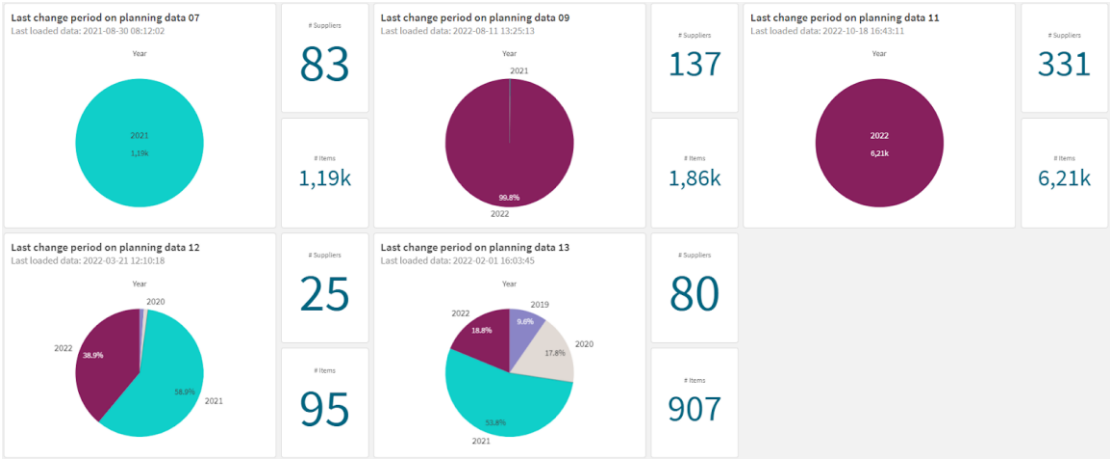

Figure 4.9, an overview of the frequency of changing of planning data for company 07-13 with the setting of lead time over 30 days. The colours visualize different years when the parameters have been updated.

When analyzing the change of planning data depending on the items lead time there are some patterns that stand out. Company 07, 09 and 11 have updated their parameters and change their planning data more frequently than the other companies. However, the data does not indicate that they are focusing on updating items depending on the lead time. However, for company 01 the situation is the opposite, they have updated their parameters more frequently for the items with a lead time between 0-3 days. The data in Qlik and the last change of planning data cannot distinguish which parameters have been updated or changed.

4.1.3 Material planning method

In the following figures, the filtration of material planning method for the companies is applied. The different methods investigated were Manual, MRP, ROP and Order driven material planning method. When analyzing the company's method, the two methods used most frequently were Manual and MRP, the other two were almost not used, hence, the pie charts for ROP and Order driven are not shown. Since this master thesis has a focus on parameters within material planning, the purpose of this filtration was to identify the material planning methods and to see if there are any links between the companies and the use of material planning methods.

Change of planning data applied with manual material planning method

The figures 4.10 and 4.11 visualize the items with a manual material planning method.

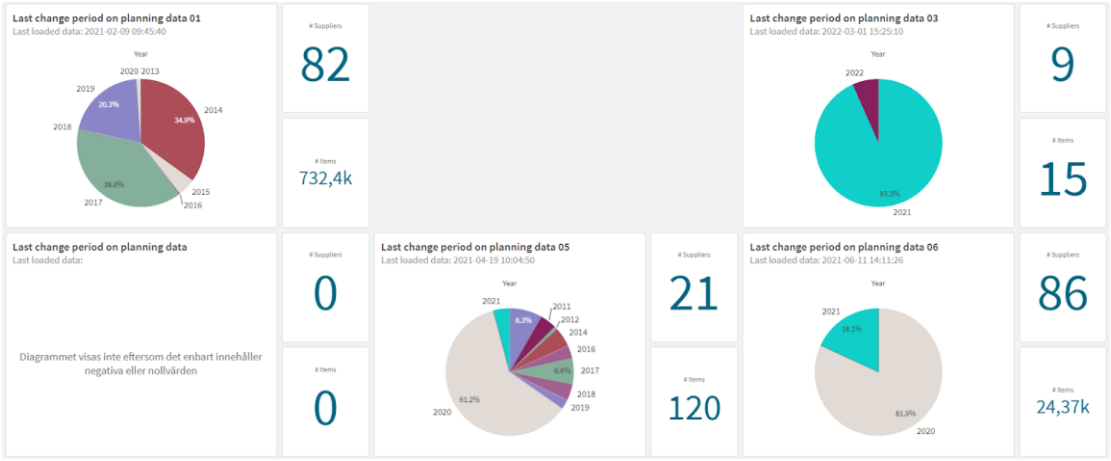

Figure 4.10, an overview of the frequency of changing of planning data for company 01-06 with the setting of material planning method as manually. The colours visualize different years when the parameters have been updated.

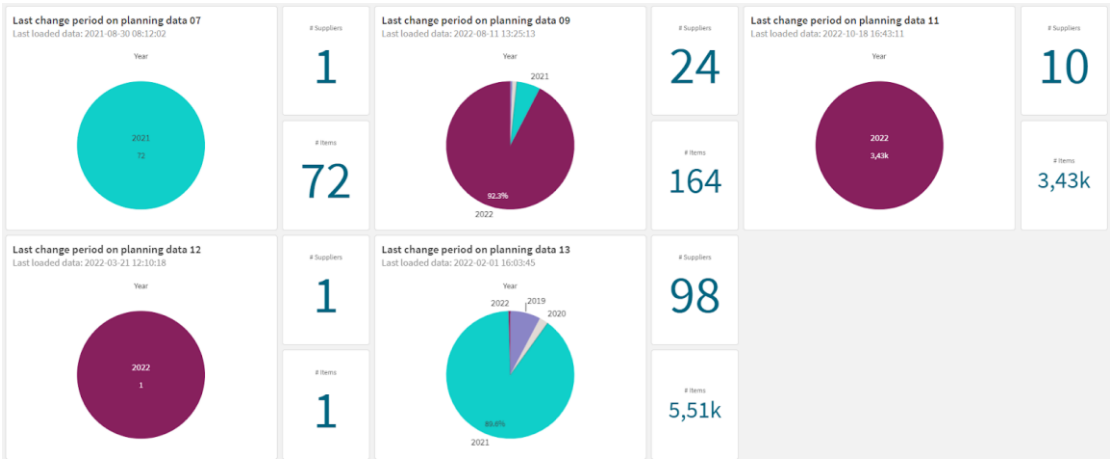

Figure 4.11, an overview of the frequency of changing of planning data for company 07-13 with the setting of material planning method as manually. The colours visualize different years when the parameters have been updated.

Change of planning data applied with the material planning method MRP
The figures 4.12 and 4.13 visualize the items with a MRP method.

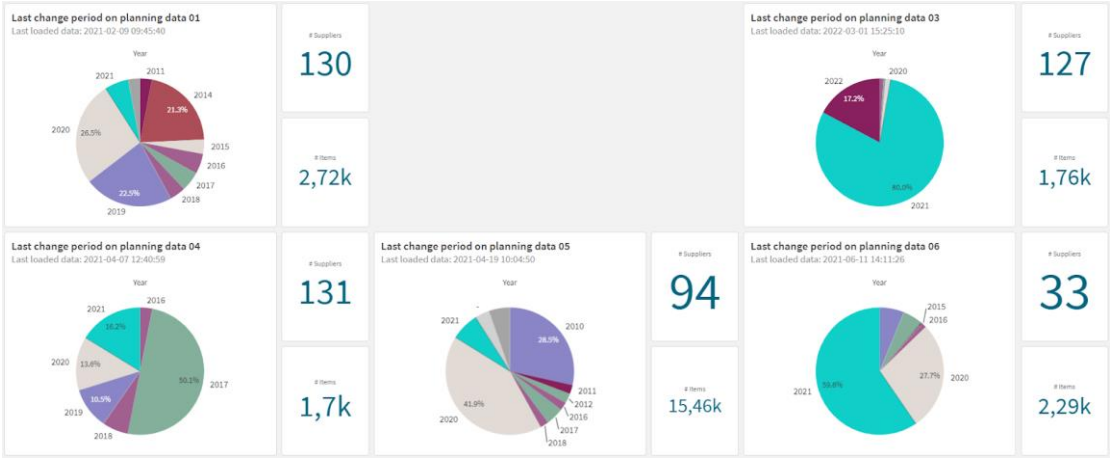

Figure 4.12, an overview of the frequency of changing of planning data for company 01-06 with the setting of material planning method as MRP. The colours visualize different years when the parameters have been updated.

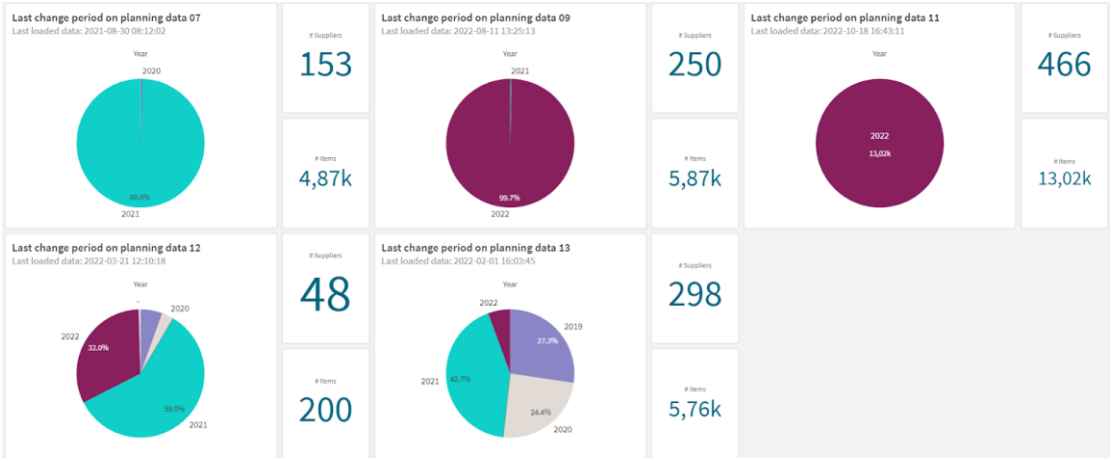

Figure 4.13, an overview of the frequency of changing of planning data for company 07-13 with the setting of material planning method as MRP. The colours visualize different years when the parameters have been updated.

By analyzing the manually material planning method in figure 4.10 and 4.11, there are some companies that are using this method more than others. Company 01, 06, and 13 are those with the highest number of items where a parameter has been changed with a manual material planning method. It is interesting to identify that it is common to use a manual method for material planning among the companies even though several of these companies have many items. When analyzing figure 4.12 and 4.13, it can be seen that all the companies included in this study are mainly using the material planning method MRP. However, the companies use of the ROP method and the Order driven method are not to the same extent as for MRP. In order to investigate more into the manual work and manually changed parameters, one parameter was chosen to analyze more in depth in Qlik. The parameter chosen was Order quantity. The findings showed

that company 07, 09 and 11 mainly used *manually entered quantity* or *manually entered run out time*. Hence, this indicates that for this specific parameter manually methods are dominant. In general, these were common methods used by the other companies as well.

4.1.4 Sourcing strategy

The sourcing strategy for the companies is visualized in figure 4.14 and figure 4.15. The definitions of the sourcing strategies are as follows, single sourcing is one supplier for one item, dual sourcing is two suppliers for one item and multiple sourcing is more than two suppliers for one item (van Weele, 2018). However, the pie charts will visualize the single sourcing and dual sourcing and not multiple sourcing since it was only two companies that used it as a method. The purpose of this filtration was to investigate the sourcing strategies among the companies and see if there are any similarities. Furthermore, the sourcing strategy has an impact on the purchased material, which is the focus of this master thesis, hence it is an important factor to consider for this master thesis.

Change of planning data applied with single sourcing

Figures 4.14 and 4.15 are visualizing the number of suppliers and items used for single sourcing. Furthermore, the pie charts show the frequency of updating parameters for the single sourced items. When no data is shown, single sourcing is not used by those companies.

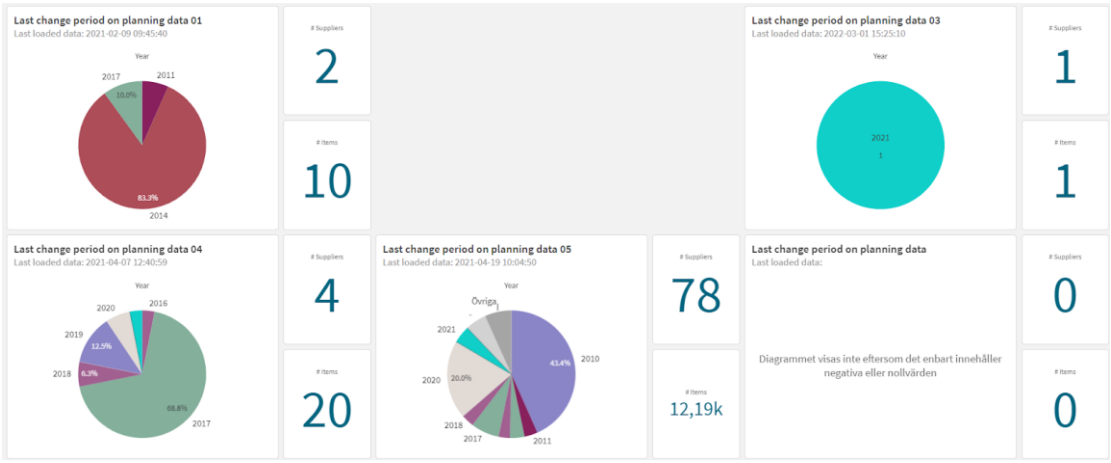

Figure 4.14, an overview of the single sourcing strategy for company 01-06. The colours visualize different years when the parameters have been updated.

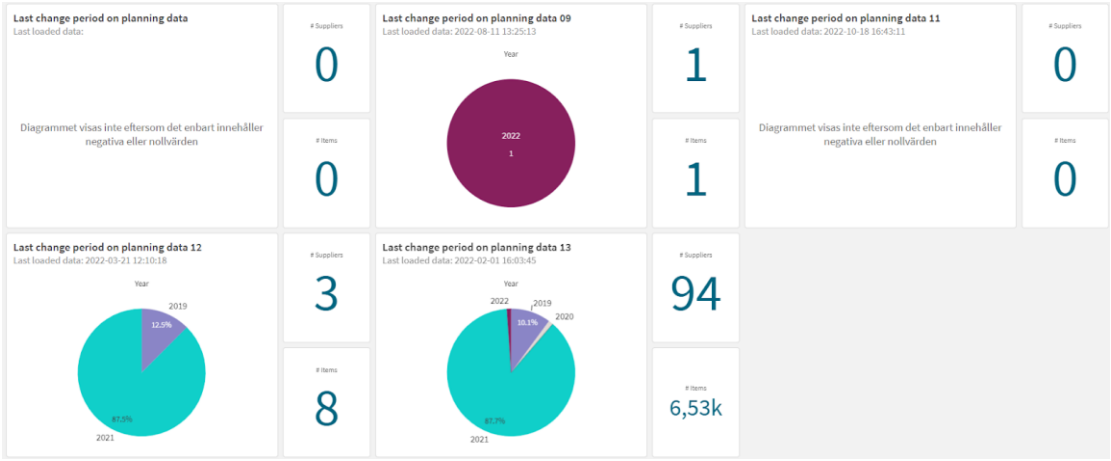

Figure 4.15, an overview of the single sourcing strategy for company 07-13. The colours visualize different years when the parameters have been updated.

Change of planning data applied with dual sourcing

Figures 4.16 and 4.17 are visualizing the number of suppliers and items used for dual sourcing. Furthermore, the pie charts show the frequency of updating parameters for the dual sourced items.

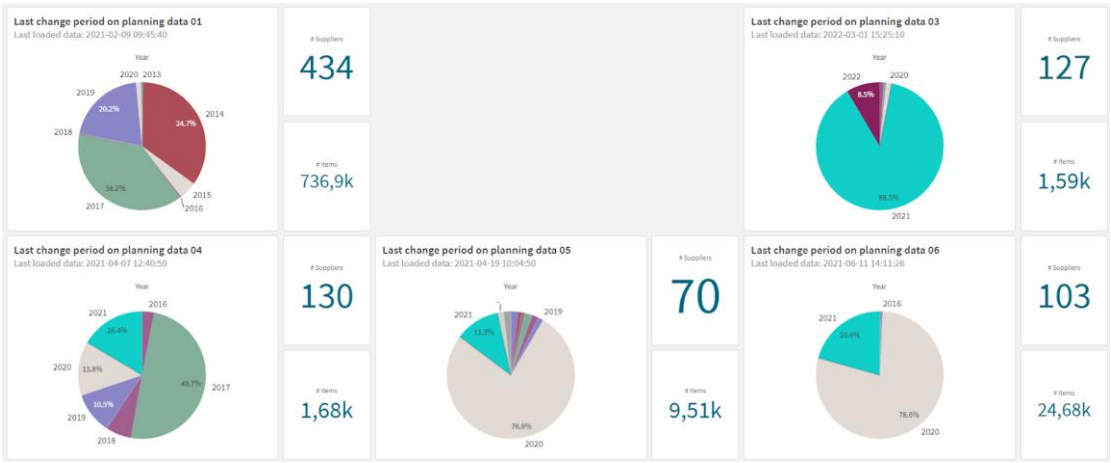

Figure 4.16, an overview of the dual sourcing strategy for company 01-06. The colours visualize different years when the parameters have been updated.

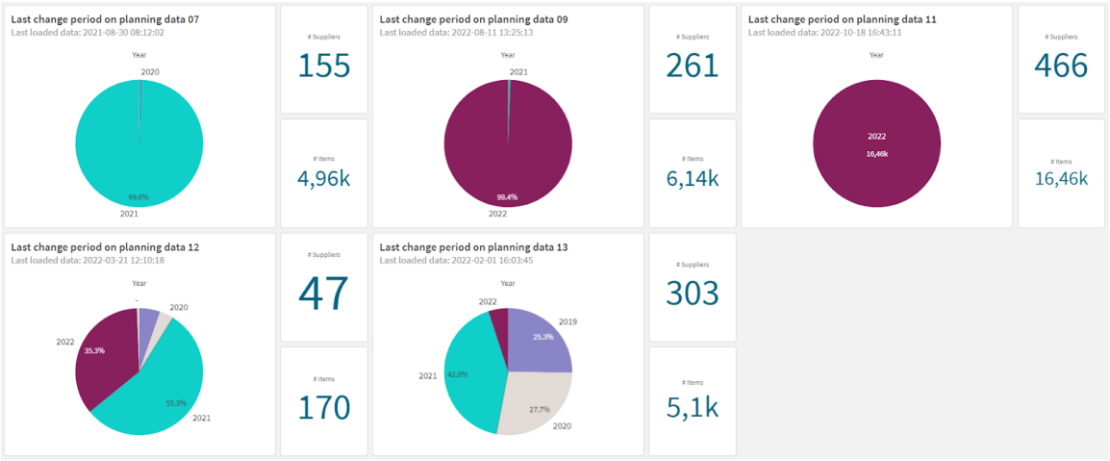

Figure 4.17, an overview of the dual sourcing strategy for company 07-13. The colors visualize different years when the parameters have been updated.

By analyzing the data, it can be found that the majority of the companies are using dual sourcing as their main strategy for supplying materials. The companies that deviate the most regarding sourcing strategy are company 03, 11 and 12, which are the ones using multi sourcing as a sourcing strategy, however, to a small extent. The other companies included in this study are not using multi sourcing at all as a strategy. According to van Weele (2018), multi sourcing brings a possibility for the company to get a better negotiating position in terms of price and delivery conditions when putting the suppliers against each other.

On the other hand, not all of the other companies are using single sourcing as their strategy as well, for instance, companies 06, 07 and 11 are not using single sourcing. The companies using it the most are companies 05 and 13. Single sourcing is used for unique material that is difficult to replace, if the administrative cost needs to be low or for a close partnership (Jonsson & Mattsson, 2016). In general, dual sourcing is the dominant strategy used in this study. To relate the sourcing strategy to updated parameters, there are some companies which are distinctive and where links can be found. For instance, companies 03, 09, 12 and 13 have the items supplied with single sourcing updated recently, majority 2021. However, company 13 is the company that deviated and have more items supplied with single sourcing than dual sourcing. Furthermore, there are some companies that have not updated their single sourcing items frequently, which is 01 and 05. Hence, their single sourcing items have not been updated with a high frequency. It is mostly interesting to highlight company 05 since they have a large amount of items supplied by single sourcing. Since single sourcing could be seen as a risk since the company can only receive the specific item by a specific supplier, it could be argued that it is important to maintain the associated parameters to items which are supplied by single sourcing.

4.1.5 Numbers of active and inactive items

Figure 4.18 and 4.19 visualizes the number of active items, inactive items and phasing out items for each company. The dark blue color visualizes the active items, the beige is inactive items, the red is phasing out items and the light blue is other types of categorizations of the items. The purpose with these pie charts is to identify the amount of items with different status for the companies. The active items are defined as if their status in M3 is active. The purpose of including this aspect to the study was to investigate the items status and settings in M3.

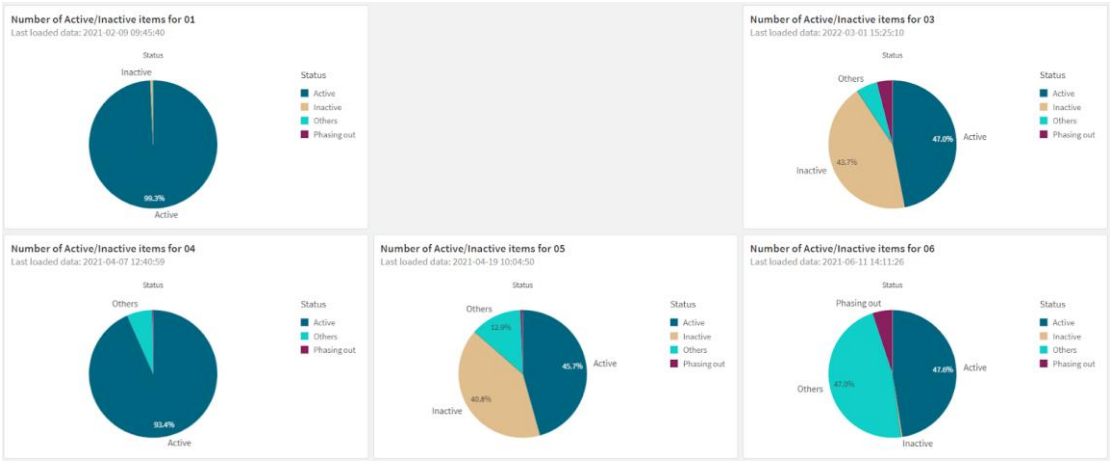

Figure 4.18, an overview of active and inactive items for company 01-06.

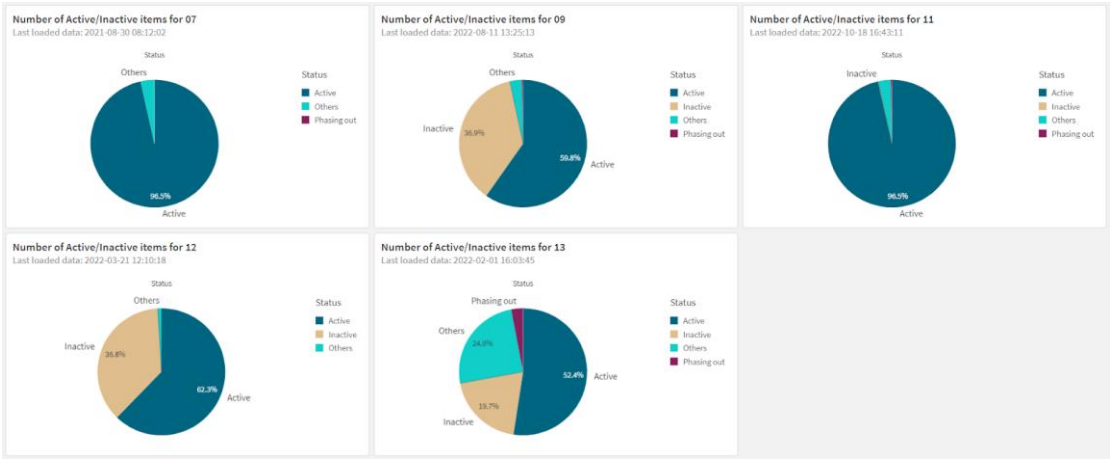

Figure 4.19, an overview of active and inactive items for company 07-13.

Companies 01, 04, 07 and 11 have the largest number of active items (dark blue), which is above 90 % of the total amount of items. However, companies 03, 05, 09 and 12 have around 40 % of their total amount of items as inactive items (beige). As can be seen in figure 4.18 and 4.19, companies 03, 06 and 13 are those who are working with phasing out items (red), and it is a small amount of their total items, 3 % to 5 %. Hence, those three companies are phasing out items that are not used anymore. According to Jonsson and Mattsson (2016), it is important to maintain items and to phase out items that are not used. Having the correct status of the items makes it easier for the companies to sustain control over the items and material planning. Furthermore, Jonsson and

Mattsson (2016) stress that by phasing out old items it is easier to perform a higher quality of forecast, the tied-up capital can decrease, and a higher service level can be achieved.

4.1.6 Summary findings RQ1

In the following subchapter, the most interesting findings from the data relating to RQ1 is highlighted within a table.

RQ1: How are material planning parameters applied within manufacturing companies in Sweden?

Table 4.1 is a summary of the highlighted finding relating to data collected for RQ1

Filtrations in Qlik	Highlighted findings
Last change of planning data	High variation of how frequently the companies have change their planning data and updated their parameters. When investigating company 07, 09 and 11 divided into month, it was mainly during one specific time period the changes had been conducted. Hence, the changes was not preformed continuously over the year.
Lead time	Some companies have changed parameters in relation to the lead time. For instance, company 01 had a higher frequency of change in the planning data for items with a lower lead time. However, for some companies, the items lead time did not impact the result of frequency of changing the planning data.
Material planning method	For all companies, the most common material planning method used was MRP followed by manually planned.
Sourcing strategy	Main scouring strategy for the companies was register as dual souring. Some companies' hade single souring as well. Using single sourcing could be seen as more critical, however, the frequency of updating the planning data was not higher.
Active and inactive items	There is a high variation of how the companies are using the different status of their items in M3. Some of the companies have almost all their items classified as active, and some companies are using different status to a higher degree.

4.2 Findings relating to RQ2

RQ2: What are the effects of the use of parameters within material planning?

- *How does the planning environment affect the use of parameters?*
- *How should the work with parameters be conducted in order to be effective and efficient within material planning?*

The findings relating to RQ2 are based on the case company KraftPowercon. Furthermore, these findings are based on interviews, observations and Qlik. The focus was to get a deeper understanding of how parameters are affecting the material planning process within an organization. The focus was moreover on KraftPowercon and their organizational perspective and to understand how they are using parameters and maintaining them. This subchapter is structured as starting with a case company description followed by the findings from Qlik, the observations and then the findings from the interviews. In each subchapter, the empirical finding is presented and then analyzed by the relevant literature.

4.2.1 Case company description

KraftPowercon Sweden AB, further referred as KraftPowercon, was founded in 1935 in Sweden (kraftpowercon.com, n.d). Today they have five production sites in Sweden, China, and India. The facilities in Sweden are located in Surte, where the headquarter is located, and in Växjö. There are 180 employed in the site at Surte inducing both production and office. This study is conducted at KraftPowercon in Surte. The company has four different business areas which are High Voltage Solutions, High Current Products, Uninterruptible Power Systems and Marine Rectifiers (kraftpowercon.com, n.d). KraftPowercon produces power conversion solutions, and their products are based on circuit boards. They act on a global market regarding both suppliers and customers and the majority of the products are exported (KraftPowercon Sweden AB, 2022). In this study, the focus was on the business area High Current Products. Within all four business areas there is a varied product range.

4.2.1.1 Current state at KraftPowercon AB Surte

In the beginning of this study, observations were conducted in order to identify and receive information of the current state of KraftPowercon in Surte regarding their work with material planning. KraftPowercon produces according to customer orders, however, they work with forecasts to be able to predict the outcome but do not produce anything until the customer has placed an actual order. Furthermore, since they are produced by customer order, their products are customized, and the customer can order their products based on their specific needs in terms of function and design. The observations regarding products and product range showed that the component shortage is something that has affected KraftPowercon. Before Covid-19 they had a delivery time of 4 weeks to their customers but today it is up to 16 weeks. Furthermore, during the observations, it was shown that they have an increased customer order stock which

further impacts the delivery lead times to the customers. Observations in the receipt handling and inventory showed that the material handling and how they are using M3 to keep track of the products. The situation today for KraftPowercon is that they have a high quantity of material in stock, which results in the warehouse becoming overcrowded and the material being stored elsewhere. This in turn has an impact on the first-in-first-out (FIFO) principle and tracking of the material. Furthermore, KraftPowercon stores spare parts for old products that they are not producing anymore in their inventory.

4.2.2 Data collection in Qlik for KraftPowercon AB Surte

In the following subchapter a deeper investigation of KraftPowercon's material planning methods is presented. Furthermore, an investigation in how order quantity is managed at the company will be presented.

A deeper investigation in the material planning methods at KraftPowercon was conducted and the findings showed that the main method used for material planning was MRP and for some items the material planning was managed manually. Of KraftPowercon's 16 460 active and purchased items, 3 430 are handled manually and the rest are planned by MRP. This investigation was conducted at the other companies included in this study as well, which shows that the majority of the companies mainly use MRP as a material planning method. Furthermore, the manually material planning method was commonly used by the companies as well.

A deeper investigation regarding the parameter *order quantity* at KraftPowercon was conducted. The item analyzed was purchased items and the method used to determine the order quantity. As can be seen in table 4.2, the majority of the item's order quantity was determined by manually methods, i.e., manually entered quantity and manually entered run out of time. Hence, this shows that working manually with deciding this parameter is commonly used at KraftPowercon. The finding of how KraftPowercon are determining the order quantity, goes in line with the average of the other companies in this study, that manually entered quantity and manually entered run out time was the ones most used. However, it is notable that out of all items KraftPowercon has, only 35 of them have Economic order quantity as a method and 20 of the items have Discrete order quantity as a method. When these items were investigated and discussed with KraftPowercon, it was shown that these are old items that are no longer used at KraftPowercon in Surte. Hence it is notable since the settings in Qlik and M3 refer to these items as active and used at the production site in Surte today.

Table 4.2, an overview of the used order quantity methods used at KraftPowercon.

The methods used	Number of items
Manually entered quantity	4 520
Economic order quantity	35
Discrete order quantity (lot for lot)	20
Manually entered run out time	11 880

4.2.3 Interviews at KraftPowercon AB Surte

In the following subchapter, the result from the interviews will be presented, see appendix A, B and C for the interview guides used. This section is structured by the different categories used within the thematic analysis, hence the structure is as follows; *Parameters and parameter settings*, *Tied-up capital and inventory levels*, *Disruptions and uncertainties*, *Classifications* and finally *Challenges and development.*

Parameters and parameter settings

Findings from the interviews regarding parameters and parameter settings at KraftPowercon was that different parameters had different impacts on their material planning. However, different variables affect the parameter setting, for instance it emerged from the interviews that the market had an impact as well. Events on the market affect the access of material and components which further affects the purchasing process, i.e., the purchasers need to constantly be updated. During the interviews it emerged that if there is material shortage or if they cannot receive material from suppliers, they have the possibility to buy their basic items on the spot market. The majority of the respondents mentioned that the most common parameters maintained in their work are lead time, safety stock and forecast. They include and consider those parameters in different ways depending on what type of components and market they purchase from. The nominated parameters, lead time and safety stock, are commonly stressed within related literature, for instance by Jacobs et al. (2018) and also by Jonsson and Mattsson (2009).

The lead times of their items can vary between constant deliveries each week, for instance screws and nuts, and with items with a lead time over one year, for instance the circuit boards. Regarding global suppliers, with longer lead times, some respondents thought that a higher safety stock is important to secure material to be able to keep on producing. KraftPowercon has a constant delivery of items from suppliers in Sweden, this because of shorter lead times. Furthermore, respondents mentioned that it is easier to communicate with some suppliers than others. They mean that it is easier to update parameters for items that are delivered from suppliers where they have better communication, i.e., the suppliers are updating information regarding the deliveries. The high variation in lead times for KraftPowercon´s items and that some of their items have lead times over one year indicates a more difficult planning environment when comparing their situation with the literature. According to Jonsson and Mattsson

(2009), when having a complex planning environment, with for instance long lead times, it is even more important to conduct replanning. Hence, it could be argued that it is important for KraftPowercon with their complex planning environment to update their parameters more frequently. Furthermore, Jonsson and Mattsson (2003) stressed that the material planning method needs to match the planning environment and that MRP is the most suitable method in a complex planning environment. The data in Qlik shows that KraftPowercon are mainly using MRP as a material planning method.

Regarding the structure of how the work with parameters and parameter settings is applied different between the respondents. All participants in the interviews mentioned that each purchaser updates parameters connected to their items and suppliers in M3. One respondent stressed that they had tried to use calculation methods in the system, but the outcomes were not good enough to rely on. Hence, the parameters and parameter settings are done manually when an event occurs i.e., reactively, and in some cases might miss out an important parameter.

"E.g., if one item always is in shortage, you might feel that the safety stock needs to be higher because it's too low."

When analyzing the result from the interviews, KraftPowercon´s approach could hence be classified as reactive when working with parameters update. However, Dittfeld et al. (2020) and Wikner et al. (2021) present that working reactivity with risks is often only a temporary solution to the problem. Furthermore, Dittfeld et al. (2020) stress that if organizations have a more provocative approach, the risks could be reduced. One of the effects of working reactively with parameter updates and maintenance is that the changes could be done too late, and which can lead to negative effects on other functions in the company. One example brought up during the interviews was when they did not have the correct information as parameters for an item. They did not receive any new delivery in time and the consequences of the backlog for this item was production stoppage. This further shows the effects of not maintaining parameters and changing it to updated information.

From the interviews, some of the respondents wish for a process and structure regarding the work with parameters and parameter settings, e.g., which parameters are important and how frequently should they be updated. One of the respondents means that it is important to include the work with parameters in their daily work because today it is hard to manage. Hence, they mean that a structure is needed, maybe a standard, regarding parameters and parameter settings.

Furthermore, an example presented from one interview was that KraftPowercon got shipping problems from one day to another. The shipping time went from 6 weeks to 12 weeks and further it became even longer, in some cases they did not know if the material should be delivered. Furthermore, these delayed deliveries affected KraftPowercon´s material and production planning and forced them to take new

reactive decisions. This example strengthens the argument that KraftPowercon has an uncertain planning environment, where changes occur. To compare this with the literature, Jonsson and Mattsson (2014) stress that when a company has changes in the planning environment, it is important to constantly update their parameters in order to retain efficiency.

From the interviews it emerged that the existing forecasting at KraftPowercon is described as based on the last 12 months' sales and it becomes the basis for an estimate of how the next 12 months will turn out. However, it is updated each month. It also emerged that they work with both calculated and manual forecasts. From the majority of the respondents, it is stressed that the work with forecasting is considered as very important, however, there are shortcomings in how well it works today. Furthermore, it is described that for the last year the forecast has been very fluctuational and not always accurate. Furthermore, one of the respondents stressed that forecasting needs to be worked with more actively and also to cope with the changes of the demand and supply.

"Our challenges are to have more stable forecasts, more concrete, I can see that right away."

An analysis out of forecasting is that KraftPowercon are using it as a supporting tool for speculation in the future demand but that it is hard to rely on. Hence, this is commonly related to forecasts stressed by both Matsumoto and Komatsu (2015) and Jonsson and Mattsson (2009). Matsumoto and Komatsu (2015) mean that a reason for this is that forecasting methods are mostly focused on long term demand and not shorter seasons, which might affect the reliability.

Tied-up capital and inventory levels

Some of the respondents stressed that the tied-up capital in the material flow, more specifically in the inventory, have increased a lot lately. One reason for this is the effects of Covid-19 and the raw material shortage in the world and the difficulties within supply of material. Some respondents described that the approach has hence changed to continue to purchase as much material as possible so that there are no shortages and no production stoppages. However, they are aware that there will be more material in-house and an increased tied-up capital, but the respondents explained that they do not dare go into shortage.

"You'd rather take home a little more than lose a customer"

"But then it has been quite expensive"

Some of the respondents mentioned that before the Covid-19, they worked with decreasing the tied-up capital. However, since Covid-19 occurred, they had to change the approach and the goal was to have as few production stoppages as possible due to

material shortage. However, some respondents stress the importance of not having too high inventory due to the increased tied-up capital. Some respondents further stress that having high volumes of goods in the warehouse also affects the logistics and warehouse operations. The consequences of a higher amount of incoming goods and high safety stock is that the structure in the inventory is harder to manage. Furthermore, some of the respondent's stress that when there is a lot of incoming material, the consequences are also that the warehouse becomes crowded, and the work there becomes inefficient and principles such as FIFO become difficult to manage. This, in combination with the fact that they are growing as an organization with new articles and new suppliers increases the inventory levels even more, according to some respondents.

"…and when a lot of material comes in, it becomes difficult to find, it gets lost, and uh, so it's been very messy here during the last time…"

It is further clear from the interviews that KraftPowercon has many stocked items that are old and not used in the production today. Hence, some respondents stress that these items are scrap that allocates space, in particular in the external warehouse. However, it is also mentioned that phasing out these items is a major process that requires both time and money. Furthermore, Free and Hecimovic (2021) argues that reduced inventory levels are a topic that has been in focus for companies for years where the purpose is to decrease the total cost. Although, due to Covid-19, this approach has been harder to keep up with and have in some cases resulted in material shortages for companies. When comparing the findings from the interviews with the literature, it could be argued that Covid-19 had effects on the inventory levels and the concerns of running out of material has been more prioritized than keeping the inventory levels low.

Disruptions and uncertainties

During the interviews, all respondents mentioned some effect of Covid-19 and it mainly regards the difficulties of supplying material and also the large stock built up due to difficulties in obtaining components. This is something that is affecting their organization according to the respondents. Other effects by the difficulties of obtaining material was that they could purchase material on the spot market. Hence, those components and articles are more expensive to supply than from their regular suppliers. According to Bag et al. (2021) when risks occur, the internal aspects to focus on are the inventory levels, the forecasting and also the sourcing of components. Furthermore, Bag et al. (2021) argues that it is important for companies to minimize the internal risks by continuously working to strengthen their supply chain management. In literature regarding supply chain management and uncertainties on the market relating to recent years, it is mainly described as uncertainties and fluctuations within demand and supply (Christopher & Holweg, 2011; Cheng et al., 2021).

Some respondents further stress that the whole situation with procurement, supply and demand have changed a lot and it could be seen as a time before and after Covid-19.

Furthermore, it is not only Covid-19 that has left its mark, but there have also been many factors globally in recent years that have disrupted the global supply chain. The uncertainties that are explained, can further be related to the arguments by Jonsson and Mattsson (2014) of the importance of frequently updating parameters within material planning in order to manage uncertainties within supply and demand.

Classifications

From the interviews, it is clear that the focus is on classification regarding the suppliers, where an ABC-analysis is performed. However, the respondents point out that they have classified critical components, mainly the circuit board due to its complexity. Hence, the respondents explained it as one aspect of the ABC-classification of the suppliers if they are supplying KraftPowercon with critical components. However, if a supplier supplies KraftPowercon with items of classification C but also supplies them with one A or critical component, then this supplier will be classified as an A supplier.

"We focus on the suppliers. Actually, we don't really do that on the items, maybe we should really do that, but ..., that would be a suggestion for improvement".

Some respondents stress that there is a lot of focus on the critical components, hence, situations can occur where the other items are forgotten a bit. From the interviews it is clear that KraftPowercon are evaluating their suppliers once a year. When evaluating their suppliers and classifying them, some of the criteria are spend and single sourcing, critical components, or unique items. Furthermore, the classification for A suppliers is those that account for 80% of the value, this is checked by a list in M3, when changing suppliers and new suppliers, different audits are done according to requirements to categorize the suppliers. KraftPowercon's way of ABC-classification goes in line with Khanorkar and Kane (2022), Prachuabsupakij (2019) and Mattsson (2008) description, that classification A is 80 % of the value. However, KraftPowercon are using the ABC-classification on their items once to classify their suppliers into A, B and C. Suppliers classified by A are frequently checked, which also is stated by Khanorkar and Kane (2022), Prachuabsupakij (2019) and Mattsson (2008).

Challenges and development

The respondents in the interviews brought up different challenges and development possibilities. A challenge that was stressed by many of the respondents was that KraftPowercon is growing as a company which means that they are purchasing more items from several suppliers. Hence, there is a challenge to manage a higher volume of material, e.g., with space in the warehouse. Furthermore, it is a challenge to get all components in-house at the right time because of long lead times. Some of the respondents believe that it is better to have a higher number of items in-house to secure the production, while others think it is important to find a balance in supply and demand. Another challenge mentioned by some of the respondents was forecasting. They want more stable forecasts as a tool to rely on in their purchasing processes. Furthermore, some respondents stressed that it is important that all in the organization

have knowledge about the importance of forecasting. On the asked question if they need to focus more with parameters and parameter settings at the company, all respondents answered yes. One respondent mentioned that the work with parameters and parameter settings might be helpful for the tied-up capital, but that the biggest challenge and resistance is the access of components and material.

"The big impact that the lead times have might be a reason to focus more on parameters"

It is expressed from the interviews that the organization is using an old business system that is still working but it is hard to manage with today's new technology. The business system contains old suppliers and components that are not used anymore and furthermore there are a lot of old components in the warehouse. One respondent stressed that those components can be 30 - 40 years old. Regarding the amount of suppliers that KraftPowercon are using, some respondents stressed that it is too many suppliers. This is a consequence of using a lot of suppliers and the respondents means that it is possible to consolidate and reduce the amount of suppliers, i.e., buy several items from the same supplier. According to Jacobs et al. (2018) it is important to have efficient material planning to be able to handle material in an effective way. In addition, some of the respondents express that they think KraftPowercon has too many suppliers and many suppliers where consolidation could be an option. However, for the critical components, dual sourcing is applied.

4.2.4 Summary findings RQ2

In the following subchapter, the most interesting findings from the data relating to RQ2 will be highlighted.

RQ2: What are the effects of the use of parameters within material planning?

- *How does the planning environment affect the use of parameters?*
- *How should the work with parameters be conducted in order to be effective and efficient within material planning?*

Table 4.3 is a summary of the highlighted finding relating to data collected for RQ2

Highlighted findings	Explanation of the findings
No structured way of working with parameters	There is currently no structured way of working with parameters and updates in M3 at KraftPowercon. The purchasers are working in different ways and have different level of knowledge.
Reactive approach	Today they are changing or updating parameters when something has changed, hence they are taking an action and are reacting.
Classifications	They are working with ABC-classification on their suppliers. Some items are labelled as critical components, however, for their whole assortment, there is no classification of the items.
Planning environment	KraftPowercon has a complex planning environment with several aspects that are challenging to handle within their material planning process. Where both internal and external factors have an impact.
Cross functional communication	When changing and updating parameters that are deviating from the normal state, it can affect other functions at the company.
Visualization and accessibility	The importance of having supporting tools in order to visualize data and to understand it. Furthermore, this requires accessibility of the data and information.

5. Discussion of the findings

In the following chapter, the discussion of the findings from this study is presented. The purpose with this chapter is to discuss the findings from the study from different perspectives and to explain and add aspects to the findings in a nuanced way. The discussion is partly related to previous research and other relevant literature represented in the literature chapter in this report. The chapter is divided by starting with a general discussion for both research questions and to find links between them. In the second subchapter, the more practical suggestions will be discussed.

5.1 General discussion of the findings

From the literature regarding material planning and parameter settings, it is stated that maintaining and updating the parameters are important in order to sustain competitive and to be updated about the current state (Jacobs et al., 2018; Jonsson & Mattsson, 2014). However, when analyzing the findings in Qlik, it is shown that the majority of the companies have not frequently worked with their parameters since there are several companies that have parameters that have not been updated for years. The findings showed that companies 07, 09 and 11 are the ones with most updated parameters. However, it could be questioned about how frequently the work with updating parameters really is since the data further showed that all these three companies have updated the majority of the parameters at a specific month. However, it was not during the same month for the companies. This could depend on specific things at each company and a general conclusion of why is difficult to conclude more than the updates are mostly done during a certain time period. It could be argued that it is not continuously worked with during the whole year, according to the data in Qlik. Hence, to investigate deeper into this more qualitative data is needed.

From the literature, it is stressed, mainly from Jonsson and Mattsson (2014) that it is important to update parameters within material planning. This especially within uncertain times in order to be updated about the current state and when there are changes. However, in this study there are many companies that are not updating all their parameters with a high frequency even though the recent years have been characterized by uncertainties. For instance, Rahdar et al. (2018) defines a disruption as when a supplier cannot deliver raw material, hence, it could be seen as a change within the planning environment and a need of updating parameters. Covid-19 affected many supply chains and within the manufacturing industry, the shortage of material was a consequence, hence there were changes within the planning environment. Although, it could be argued that if the companies did not work frequently with updating their parameters before Covid-19 and the shortages of material, it might not be something they prioritized to start with. Since many of the companies have parameters that have not been updated since years before Covid-19, this could support this argument.

Regarding similarities and differences between the companies presented in chapter 4.1 it is challenging to point out a general conclusion of how the companies are working with maintaining parameters. Depending on what filtration that was added, different companies had similarities with each other. However, regarding sourcing strategy and material planning method for the companies, all of them used mainly dual sourcing and the material planning method MRP. Although, it is further interesting to identify that the second most used material planning method was to work manually. Working manually in general with parameters and material planning was also addressed during the interviews with KraftPowercon as a common method to use since they thought that manual work was more reliable. In addition to this, when investigating the method for determining the parameter order quantity in Qlik for KraftPowercon, the majority was done manually as well. This addressed questions of why and whether it is a lack of knowledge or inaccessibility of data tools for instance. However, it could also be argued that using manually updates for some parameters is beneficial if there is a special item, for instance critical, and then the expertise of the purchaser at KraftPowercon is useful. However, this brings up the aspect of efficiency, and how many parameters that are possible to be maintained manually to retain efficiency in their work. Furthermore, all companies included in the study have a large number of items, then it is a high workload to calculate and decide each parameter manually. For instance, due to time and resources. Moreover, if the parameter updates should be more continuously performed at the companies, change all of them manually is not efficient. Hence, some items and their associated parameters should be updated automatically, or data driven in order to work continuous with it. As can be seen from the companies included in this study, it is a high number of items and to work efficiently with maintaining their parameters, it is not sustainable to do it manually for all items.

However, one filter that showed interesting differences between the companies was lead time. The results showed that the majority of companies updated parameters differently depending on the lead time of the items. However, it was difficult to find a direct link since some of the companies updated parameters on items with a long lead time and some companies updated parameters on items with short lead times. In addition, there were some companies where there was no difference in how parameters were maintained in relation to the lead time of the items. Worth adding is that no underlying explanation has been identified and it is not possible to conclude with certainty that the lead time has a direct impact on the parameter's maintenance, hence it could be a coincidence. One company where the filter lead time did not impact the result in frequency of updating parameter was KraftPowercon (company 11). However, this addresses the questions of if it is suitable or not. Maybe the item's lead time should impact how often the parameters should be changed. If the lead time could be used as a classification or differentiation of which items that should be prioritized.

One part of RQ1 was to investigate how the work with parameters is applied and how it should be worked with in order to be effective and efficient. Something interesting that emerged from the interviews with KraftPowercon was that there is currently no

structured way of working with parameters and parameter updates. The effects of not having a structured way of working with parameters could be that they are focusing on some items which might result in missing other items. Furthermore, since there is no structure, the effect is that the parameter updates and maintenance is done reactively. The purchasers are changing the planning data when things do not go according to plan. However, the negative effects of that are that the action taken might be too late and the changes do not have an impact. Hence, it could be argued that their way of working could be influenced by also working proactively. According to Dittfeld et al. (2020) and Wikner et al. (2021), working more proactively also minimizes the risks. However, it might be necessary to set up a structured process regarding the work with parameters to be able to work more proactive with them. In addition to this, a proactive structure might result in them not missing out important parameters to update a monitor. However, Dittfeld et al. (2020) argues that not all risks can possibly be handled proactive, some risks need to be handled reactively. In the case of KraftPowercon, if the approach is more proactive and they have a more structured way of working and maintaining parameters, then it could be easier for them to respond to the changes that occur, which are to react and be reactive. Hence, it is possible to argue that they should work proactive but also react to the changes which are reactive.

By implementing a structured way of working with parameter settings, it could be a way of working more efficiently with parameters. From an organizational perspective on parameters, it emerged from the interviews that there are various levels on how integrated it is in their daily work. Furthermore, there was a difference between the respondents' thoughts whether the work with parameters is something to develop or not. One reason for that could be the different level of knowledge regarding the use of parameters and the effect maintaining it. When analyzing the findings, it is clear that the knowledge of parameters and the effect of them differs between the respondents as well. Hence, this suggests that it is vital to spread the knowledge about parameters and why it is important. Both Ghazanfari et al. (2011), Grover and Davenport (2001) and Enberg (2012) stressed the importance of knowledge and information within an organization. Furthermore, Grover and Davenport (2001), and Enberg (2012) argues that knowledge is value-adding.

By studying figures 4.1 and 4.2, it can be identified that many of the companies included in this study generally have many items in their warehouses. This could be a reason for the low frequency of updated parameters. For instance, company 01 with 736 900 items has a high workload if they should update all their items and their associating parameters. Hence, it could be argued that there is a need for some type of differentiation and selection in order to become more efficient within the work with maintaining parameters. This differentiation could be considered by an ABC-classification, where the classification is based on how important the items are for the company (Khanorkar & Kane, 2022; Prachuabsupakij, 2019; Mattsson, 2008). Items in category A should be those with highest risks and require the most focus of maintaining parameters. Another perspective of classification and differentiation is if there could be

any other dimensions to add. For instance, if the sourcing strategy could have an impact, e.g., single sourcing, dual sourcing, or multiple sourcing. If single sourcing could be seen as a risk and should be classified as an A item for instance. As can be seen in figure 4.14 and 4.15, some of the companies using single sourcing have not maintained or changed the parameters for the items with single sourcing. It is an interesting result, especially for company 05 which has 12 190 items with single sourcing. Furthermore, single sourcing has benefits but also drawbacks and since it can be a risk with only using one supplier for a specific item, it could be argued that these items parameters should be even more frequently monitored and updated. By taking the item classification into consideration, it is possible that it could facilitate the work with parameter updating for the employees and as a part of creating a structured way of working with it. By having a clear structure over the items and being aware of which item and parameter to prioritize, it might be easier to create a structured way of working.

Findings from this study showed the percentage of active and inactive items for each company. From the interviews with KraftPowercon, it emerged that there are many items in their system, including old items that are no longer used. Hence, the respondents stressed that these items take up space in the warehouse and furthermore results in higher tied-up capital. However, when analyzing their items in Qlik, it was shown that 96% of their items are classified as active items. This is interesting since it does not match the findings from the interviews. One reason could be that KraftPowercon's items do not have the correct status in M3. Since Qlik reflects the data in M3, there is a possibility that all the old items have status *active* in M3 but should have *inactive* or *phase out* status. Furthermore, after a deeper investigation of the data in Qlik for KraftPowercon, it was shown that some items that had active status in M3, were items that were no longer used and did not exist at the production site in Surte although the items had status active. Hence, this confirms that all their items do not have the correct status in M3. To discuss the consequences of this could for instance be that the companies think that they have more items to maintain than they have. If, for instance, KraftPowercon should implement a more structured way of working with parameter updates and to classify the items, it is beneficial if the items have the correct status in M3 in order to have better control over the current situation. Furthermore, some supporting arguments of phasing out old items is that it saves warehouse space, and it could decrease the tied-up capital (Jonsson & Mattsson, 2016). In addition, by only having the current items in the system might result in an easier work to maintain and update their parameters due to the decreased number of items in their systems. This further goes in line with literature from Jonsson and Mattsson (2016). In addition, some of the respondents stressed that the forecast needs to be improved. By developing the items maintenance work and phasing out old items can make it easier to create more accurate forecasts (Jonsson & Mattsson, 2016).

It is furthermore interesting for RQ2 to discuss how the effects of the use of parameters could be affected by the number of suppliers and KraftPowercon has a large number of suppliers. From the interviews, it emerged from several respondents that they have too

many suppliers. It would be interesting to understand if the high number of suppliers could have an impact on the work with parameters within the organization. It also emerged from the interviews that it is easier to update parameters for suppliers where they have better communication. Hence, a lower number of suppliers might result in higher possibility of increasing the communication with the suppliers. Which furthermore could have a positive effect on maintaining parameters.

Sangari and Razmi (2015) stressed the importance of transforming data into a BI tool with right information to get a value-adding outcome. During this study, it has been possible to identify multiple benefits of BI tools, and in this project, it was Qlik. During the interviews at KraftPowercon it emerged that some respondents wished for better visualization programmes in order to get a better view of the current situation on the parameters. It would be interesting to investigate if the use of some kind of BI tool could be helpful in order to work more with parameters within an organization. Sangari and Razmi (2015) argue that BI tools can be used for developing digitalization of manual data work. Since the quantitative and qualitative data from KraftPowercon showed that a relatively large part of their work with parameters is performed manually, a BI tool might be helpful. Furthermore, other possible benefits of implementing a BI tool could be the increased visualization that can provide a better overview of the current situation. This could further be helpful to set up a structured way of working with maintaining parameters. In addition, it is stated in the literature by Cheng et al. (2021) that since many supply chains, especially within manufacturing, are becoming more complex, there is even more data for the companies to manage. Hence the authors stress the importance of having some type of BI tools. This also goes in line with Schniederjans et al. (2020) statement of the challenges the data entails and how to utilize the data in order to make strategic decisions. In the case of KraftPowercon, they have a high amount of items and therefore many parameters to update. Then a BI tool might be helpful as well when working with parameters and updating them.

In the case of KraftPowercon, one of their most important items is the circuit boards which have a lead time between 30 days and one year. Hence, this indicates that they have a more complex planning environment due to the fact that their critical items have a long lead time which is more complex to handle and predict. This goes in line with Jonsson and Mattsson's (2009) states that variations in the planning environment, e.g., long lead times, need extensive planning. Except for the long lead times for some of the items, there are other aspects that affect the complex planning environment for KraftPowercon as well. For instance, they are only manufacturing products by customer orders, they have a high variation of product offers since they are customized, and they have a variation in the order horizon. These factors can have an impact on the work with parameters due to the high variation and can make continuous work more challenging. However, there are other aspects in the planning environment that give KraftPowercon advantages. For instance, their flexibility of purchasing items on the spot market if there is a shortage of material, and the possibility of being flexible and buying items for other suppliers if needed. It could be argued that if some parameters

for some items are missed to be updated, and if they are available in other shops or spot market, the negative consequence for the production and the company could be reduced. In figure 5.1, the planning environment with advantages and challenges are visualized. The aspects are further classified as internal or external factors, which are inspired by Bag et al. (2021) where they are considering supply risk management with both internal and external factors.

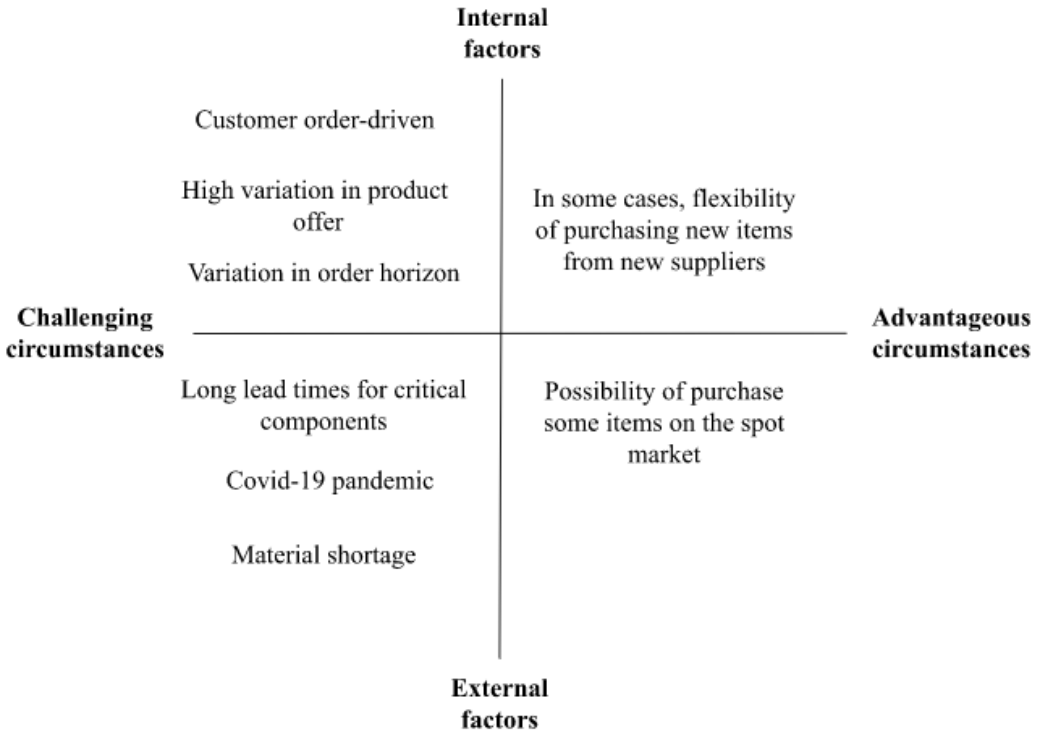

Figure 5.1, an overview of planning environmental factors that affect KraftPowercon's way of working with parameters.

Furthermore, it is interesting to discuss the result from this study in relation to the supply chain triangle presented by DeSmet (2017). From the interviews with KraftPowercon, it emerged that the view of purchased materials and inhouse logistics could differ between purchasers and warehouse workers. For instance, the purchasers stressed the importance of having materials at home in order to fulfill deliveries to their customers, hence they purchased more materials than the demand. This was something that increased during Covid-19. From the perspective of the supply chain triangle, KraftPowercon is prioritizing the service level aspect. However, when discussing this situation with the workers from the warehouse, they stressed that the high inventory levels had partly hampered their efforts to be structured and efficient and to use FIFO as a method. Furthermore, they stressed that the high volume of material further increases the tied-up capital. Hence, their focus is more on the warehouse approach of the supply chain triangle i.e., the cost dimension (DeSmet, 2017). This further shows the importance of communicating internally at the company when changing parameters, especially if the parameter updates deviate distinctive. For instance, if the purchasers are increasing the parameter safety stock on some items, then it is important that they

are aware of the consequences it emerges to other functions of the company. In the following figure 5.2, the situation of KraftPowercon and their focus in the supply chain triangle is illustrated by the blue circle.

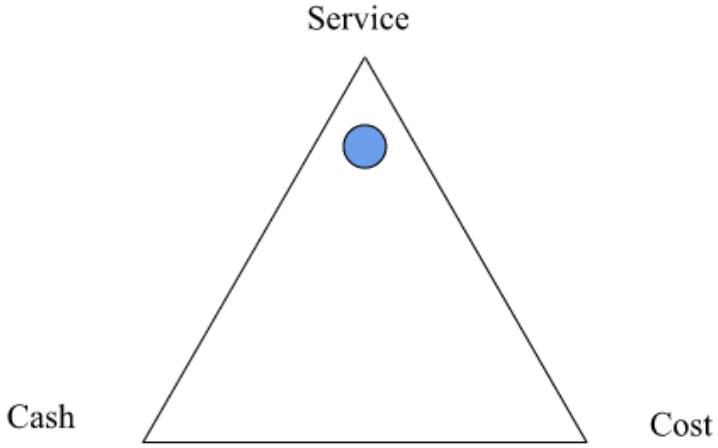

Figure 5.2, an adopted illustration of the supply chain triangle by DeSmet (2017) applied to KraftPowercon current situation.

Jonsson and Mattsson (2009) stress that changes in one parameter can have an impact on other parameters, which is something to consider. For instance, the size of safety stock depends on the demand and the lead time (Jonsson & Mattsson, 2009). This stresses the importance of having knowledge about how the parameters are interlinked and also the importance of maintaining communication between functions when changing the planning data i.e., updating the parameters. This communication could be adapted to already existing meetings at the companies, for instance operational meetings during the week between the purchasers and the warehouse.

To relate the tied-up capital to Meridions 6-box model, as can be seen in figure 5.3, these six boxes visualize different processes within a company that can have an impact on the tied-up capital (Meridion, n.d.). Since Jonsson and Mattsson (2014) stress the importance of having low tied-up capital, this strengthens the arguments for companies to have control over their material planning and how these six boxes and processes have an impact on the tied-up capital. Relating this to KraftPowercon, effects of increasing parameters, for instance safety stock, the inventory level will increase and increase tied-up capital. Another example from the observations at KraftPowercon is that they today have a long customer order stock, hence it can be related to box 5.1 *order handling.* Which increases the total tied-up capital for KraftPowercon. However, it is notable that this tied-up capital is related to promised orders, and not to physical material at the inventory. This shows the impact of the different boxes relating to the tied-up capital.

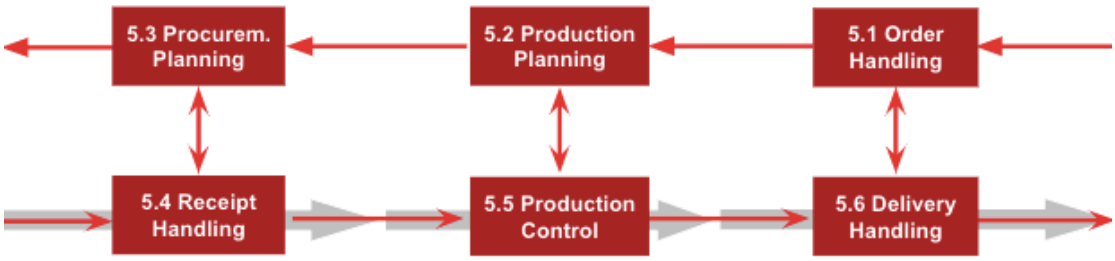

Figure 5.3, a visualization of the 6-box model by Meridion (n.d.)

Furthermore, to relate the frequency of updating parameters to the tied-up capital, there is a link as well. According to Jonsson and Mattsson (2014), if the parameter lead time is updated with a low frequency, then there is a risk that the material delivery is taking place too early or too late than planned since the parameter is not up to date. Hence, the frequency of updating parameters can have an impact on the tied-up capital in the inventory. Furthermore, by having knowledge about the effect of maintaining parameters and how it will affect the company and the different functions might result in a more efficient way of working with it. These further stresses the importance of having cross functional communication within the company.

5.2 Discussion of practical suggestions

In this subchapter, a more practical approach to the findings will be discussed. When analyzing the findings, there are some aspects that could be considered for companies that are working with parameters within material planning. Hence, this subchapter aims to discuss these findings as suggestions for companies to consider developing their work with parameters.

To implement a structured working process could be beneficial for companies that aim to develop their work with parameters and parameter settings. The recommendation is furthermore to start from how the work is performed today but to set up clearer guidelines and responsibilities in order to achieve more structure. It becomes clearer for the employees what to do, how to do it and how often it should be done. Furthermore, it could be helpful to use a supporting data tool to update the parameters and not work manually with all of them. To implement a more structured way of working with parameters and to do it more continuously is also a recommendation for the companies that have updated their parameters more frequently as well. This since the data showed that the companies 07, 09 and 11 conducted their updates during a specific month and not to a large extent continuously over the year. In addition to this, if the work with parameters is continuous, then it might create a more proactive approach to it rather than a reactive approach. According to Dittfeld et al. (2020), working more proactively can result in a reduction of risks. If the approach is proactive, then it is possible to react to changes and events that occurs. Hence, a combination of proactive and reactive is beneficial.

Another aspect to consider is that the parameter update is related to the company's items, hence it is beneficial if the status of the items is correct in the ERP system. The findings of this study showed that there is a difference between the companies and the proportion of classified active and inactive items. Furthermore, having inactive items stored in warehouses might result in a higher tied-up capital than necessary. Regarding the items, it is further a suggestion that the companies are using some kind of classification, for instance ABC-classification. Since the parameter update is related to the items, it is beneficial to classify them and be aware of a differentiation where some items need more focus than others regarding parameter updates for instance, classification considering critical components and single sourcing might need a higher monitoring and updating. The differentiation goes in line with Jonsson and Mattsson (2014) and that the items with a lower impact on the company do not have the same degree of maintenance of parameters.

The final practical suggestion regards knowledge and awareness of the impact of the parameters. If the employees have more knowledge regarding parameters, and also have a more structured way of working it might result in a more efficient work. Moreover, communication internally at the companies is important. Updating some parameters in one function might affect another function and their work, hence, cross-functional communication is important to consider. This communication could for instance be a part of operational daily meetings at the companies. As an aid to this, it is important to review how easily accessible the data is to employees and how easily it is visualized. The findings showed that there is a need of data driven work in this area and furthermore that it might be easier to work with parameters and maintain them if a BI tool is accessible for the employees. Then it is easier to visualizes the items and get a better view of the current state of the companies.

6. Conclusion and recommendations

In the following chapter, the conclusions and recommendations from this study will be presented and also suggestions of further studies. The first subchapter is divided by the two research questions where the conclusions will be presented. In the second subchapter the recommendations are presented. In addition, in the end a discussion of limitations and further research within this theme is presented.

6.1 Conclusion

The presented conclusions aim to answer the two research questions within this master thesis.

RQ1: How are material planning parameters applied within manufacturing companies in Sweden?

To answer the question of how material planning parameters are applied in manufacturing companies in Sweden, the answer is that it is applied with a variety based on the findings from this study. Hence, the first conclusion is that there are companies that are not updating and maintaining the parameters with a high frequency. When a deeper investigation in the quantitative data was conducted, no significant relations could be identified between the companies. However, the three companies that distinguished the most from the average were 07, 09 and 11 which updated their parameters with a higher frequency. Although, the data showed that they are mainly updating their parameters during one specific month and not continuously during the year. These three companies had several similarities when the filtrations in the data collection were applied except for the size of the companies. Company 07 and 09 are categorized as large companies and company 11 is categorized as a medium sized company.

In general, there were two main similarities between all the companies, which was the material planning method MRP and the sourcing strategy dual sourcing. Regarding the other filtrations used in the study, links could be found when investigate them individually. Hence the conclusion is that for some companies, the item's lead time had an impact on the frequency of updating data. Furthermore, the conclusion is that there is no relationship between low number of suppliers and low number of items and the frequency of updating parameters. Since the companies with low number of supplier and items was not the once that had updated their parameters the most frequently. In addition to that, it was not possible to draw any conclusion regarding if the size of the company impacted the result of the updated parameters as well since company 07 and 09 are large companies and company 11 is a medium size company.

RQ2: What are the effects of the use of parameters within material planning?

- *How does the planning environment affect the use of parameters?*
- *How should the work with parameters be conducted in order to be effective and efficient within material planning?*

A general conclusion regarding the effect of the use of parameters, is that it depends on the company's way of working with it. At KraftPowercon there is currently no structured way of working with maintaining parameters, hence one effect is a reactive approach to it. Other identified effects of using and updating parameters is that when changing or updating parameters it could affect other functions at the company, for instance the warehouse. Hence, it is possible to conclude from the findings that it is important to have a good communication cross functional within the company regarding changes in important parameters. Regarding the planning environment, it is possible to conclude that it is important to be aware of the impact the planning environment has on the company and the conditions it brings. Hence, it is difficult to copy other companies processes or compare with others since the planning environment can have an impact on parameters settings and how frequently they are used.

To answer the part of how companies should work with parameters within material planning is to have a structured way of working and to have better control over the items and conduct relevant classifications. By implementing a more structured way of working with parameters, it could be changed to a more proactive approach where the aim is to have better control and to only act reactively to the risks and changes that could not be worked with proactively. Dittfeld et al. (2020) stressed that it is beneficial to work proactively but some risks or events that occur needs to be managed reactively. Hence, it is important to have a proactively approach to be able to manage risk reactively. Then the positive effect of updating and monitoring the parameters could be applied more widely. Another conclusion is that in order to work more effectively and efficiently with updating parameters is to implement more ways of classifying KraftPowercon’s items.

The findings further showed the importance of maintaining the data settings in M3. The effect of parameters and parameter settings is relying on the data in M3, hence, it is important that the data is correct. Moreover, it is possible to conclude that the availability of data and how easy it is to visualize the situation also has an impact within this context. With the large amount of data, it is important that it is easily accessible for the employees. As a final conclusion, to relate the findings to the study conducted by Jonsson and Mattsson (2014), there are several similarities. However, the main similarity from the 2014 study and the findings in this master thesis is that there is still potential for improvements among the companies to update and maintain their parameters.

6.2 Recommendations

As can be seen in the result regarding the use of parameters and the frequency of updating them, there are potential for developments for companies included in this study. The aim of the recommendations is to give companies that want to improve the work with parameters some aspects to consider based on the findings from this study. The recommendations from this study is mainly based on the case of KraftPowercon, however, the ambition is that it is applicable for other manufacturing companies as well. Furthermore, as this study is conducted at a consulting firm, it will also be recommendations for consultants.

6.2.1 Recommendations to manufacturing companies

Implement a structured way of working

One recommendation for improving the work and the effects of parameters is to implement a more structured way of working with it. The structure could include areas of responsibility and how often to update for instance. Working in a more structured way could increase knowledge, awareness, and communication within the company about parameters and their effects. In addition, by implementing this, it might further have an impact on the approach to it, from mainly reactive to a combination of proactive and reactive. A proactively approach makes it easier to manage risks reactively.

Furthermore, it is a recommendation to review the manually work with parameters due to time and resource, hence a data driven tool is recommended. It is also a recommendation to identify which parameters that could be continuously updated by a data driven tool and which parameters that might need manually changes due to some circumstances, for instance a critical item.

Item and supplier maintenance

Furthermore, a recommendation is to review the status in M3, both for items and suppliers. Check that the basic data and the settings is correct and that it provides the right conditions for making decisions. For instance, the settings of items and suppliers. It is also a recommendation to phase out old items that are not used anymore and to set these items with status inactive. For the system M3 this is important in order to have the correct and updated information about the items and for the physically in the inventory in order to create more space and reduce unnecessary tied-up capital. By doing this, it is easier to maintain the items and their associated parameters.

Implement classification

The majority of the companies included in this study have a large amount of items registered in M3. Hence, to maintain them and the associated parameters requires time and resources. Therefore, it is a recommendation to use some type of classification on the items, for instance ABC-classification. Then the employees know which items that are most important and need the most maintenance, e.g., updating the parameters more

frequently. Other factors that could be used when classifying the items are if the items are considered as critical or due to the sourcing strategy where single sourcing could be seen as a higher risk than for instance dual sourcing.

Accessibility and visualizability

There are also recommendations regarding the accessibility and visualizability of the data within the companies. In order to work more with parameters, a recommendation is to have the data needed easily accessible for the employees, which could be achieved through a BI tool. Since there is a large amount of data to handle when working with many items and their associated parameters, the recommendation is to have some kind of supportive tool, for instance Qlik. Furthermore, a recommendation is that the data is transparent and easy to visualize in order to increase the understanding of the current situation at the company.

6.2.2 Recommendations to consultants

Since this thesis project was conducted at the consultant company Meridion, this study also aimed to view the outcome of the study to consultants working within this area as well. Hence, some general recommendations dedicated to consultant is presented below.

The general recommendations from the consultant perspective are that there is potential for development of how manufacturing companies are using parameters within material planning. The findings from the study showed that all companies are not frequently updating their parameters, and this is not in line with previous literature within this area of research. Furthermore, Qlik has been a strength in this project in terms of mapping the situation and being able to quickly detect items that stands out or changes that have occurred. Hence, in order to effectively work with these kinds of projects, a BI tool is helpful. However, during this project it has been discovered that registrations in M3 that is shown in Qlik are not always aligned with reality. Therefore, it is important to consider that the settings in M3 are correct and that the companies are utilizing the resources and settings that are available in M3.

In addition, a recommendation to consultants that aims to work on a full scale with these kinds of projects with parameters updates, it is important to take the company's planning environment into consideration. This study showed that the planning environment affects the use of parameters and therefore it is unique for each company.

6.3 Limitations of the study

There have been some limitations in this study. One factor that limited this study was the time allocated to this project, this limited the possibility to study the companies more in-depth. Therefore, KraftPowercon was used as a case company to get a deeper knowledge. Including more companies in the study could have contributed to more data and strengthened the outcome. Furthermore, to get a broader perspective of how

manufacturing companies in Sweden works with parameters within their material planning, more companies need to be included, then the generalizability of this study would increase. The decision of including 10 companies in this master thesis project was since Meridion had already existing data for these companies in their *"supply chain for real"* project.

Another aspect to consider as a limitation for this study could be the previous knowledge about Qlik. If the researchers had more knowledge about how to manage the BI tool Qlik then the data collection might have been more independent. This could be seen as a limitation of time and therefore was not the researcher's focus to understand and manage Qlik all by themselves. Hence, a consequence of this was that the researchers needed to rely on employees at Meridion with knowledge in Qlik. However, to rely on employees could be seen positively for the study to strengthen and ensure that the data found in Qlik was collected in a correct way. Regarding when the data were uploaded in Qlik differs between the companies, hence, the data findings in this study have different dates. Therefore, some companies might work differently after this data was collected. In order to get a more accurate result it would be beneficial to have all data collected at the same date.

Furthermore, a limitation is that the collected data and findings in Qlik for the companies was only verified at the case company KraftPowercon due to time and resources allocated to this project. However, to strengthen the findings could a verification of the data be conducted at each included company in the study. Furthermore, this could reduce eventual data errors. To identify when a qualitative data collection at all included companies in this study was needed was when a deeper investigation was made to identify if the parameter updates are done manually, or data driven. However, the data in Qlik and the settings were coded and set in different ways for the different companies. Hence, in order to make any conclusions regarding this data, a qualitative data collection would have been needed in order to confirm the settings.

6.4 Further studies

This master thesis was a comparative study, however, the data collection was mainly quantitative. It was only from KraftPowercon where the data was verified and discussed about causes and underlying factors to the result. Hence, for further studies within this scope and theme it would be interesting to conduct a more qualitative study and to understand in more depth each company's approach to the work with parameters. In addition, investigate what type of methods and tools each company is using when they work with parameters, e.g., method for safety stock calculation. Furthermore, in this study, some settings and filtrations were included, however, to find more links and conclusions, more filtrations need to be added.

In order to make the findings even more generic, more companies would need to be included. Hence, for future work it would have been interesting to investigate even more companies, both with quantitative and qualitative data collection to get a both wider and deeper result. Another interesting perspective is that Jonsson and Mattsson (2014) concluded that high performance companies tend to update their parameters more frequently than low performance companies. It is not within this study's scope to investigate if the companies are high performance or low performance companies, however, it could be interesting to compare the frequency of updating parameters and that the result in this study shows a low frequency of the updating parameters. This is further a suggestion for further studies to take into consideration.

References

Bag, S., Dhamija, P., Luthra, S. and Huisingh, D. (2021). How big data analytics can help manufacturing companies strengthen supply chain resilience in the context of the COVID-19 pandemic, *The International Journal of Logistics Management*, https://doi.org/10.1108/IJLM-02-2021-0095

Bell, E., Bryman, A., and Harley, B. (2019). *Business research methods.* Fifth edition. Oxford university press.

Bell, E., Bryman, A., and Harley, B. (2022). *Business research methods*. Sixth edition. Oxford university press.

Blomqvist, P. and Hallin, A. (2015). *Method for engineering students - Degree projects using the 4-phases Model*. First edition. Studentlitteratur AB, Lund.

Cheng, Y., Fredriksson, A. and Fleury, A. (2021). Guest editorial rethinking international manufacturing in times of global turbulence, *Journal of Manufacturing Technology Management*, Vol. 32 (6), pp. 1113-1120. https://doi.org/10.1108/JMTM-10-2021-501

Chenhao, Z., Aloisius, S., Xinhu, C. and Shuhong, W. (2021) A data-driven business intelligence system for large-scale semi-automated logistics facilities. *International Journal of Production Research*., Vol. 59 (8), pp. 2250-2268. https://doi.org/10.1080/00207543.2020.1727048

Christopher, M. and Holweg, M. (2011), Supply Chain 2.0: managing supply chains in the era of turbulence, *International Journal of Physical Distribution & Logistics Management*, Vol. 41(1), pp. 63-82. https://doi.org/10.1108/09600031111101439

Chipriyanova, G. and Chipriyanov, M. (2022). Business intelligence competence and enterprise resource planning (ERP) system tools. *Business Management / Biznes Upravlenie.* Issue 2, pp. 5-20. 16p., Database: Business Source Ultimate

Denscombe, M. (2018). *Forskningshandbok för småskaliga forskningsprojekt inom samhällsvetenskaperna*. Studentlitteratur AB.

DeSmet, B. (2017). *Supply chain strategy and financial metrics*. Kogan Page.

Dittfeld, H., Scholten, K. & Van Donk, D.P. (2020) Proactively and reactively managing risks through sales and operations planning. *International Journal of Physical Distribution and Logistics Management*. Department of operations, University of Groningen, Netherlands. Vol. 51(6), pp. 566-584. DOI: 10.1108/IJPDLM-07-2019-0215

Enberg, C. (2012). Enabling knowledge integration in coopetitive R&D projects—The management of conflicting logics. *International Journal of Project Management*, Vol. 30(7), pp. 771-780. DOI: 10.1016/j.ijproman.2012.01.003

Free, C. and Hecimovic, A. (2021), Global supply chains after COVID-19: the end of the road for neoliberal globalization, *Accounting, Auditing & Accountability Journal*, Vol. 34 (1), pp. 58-84. https://doi.org/10.1108/AAAJ-06-2020-4634

Ghazanfari, M., Jafari, M., and Rouhani, S. (2011). A tool to evaluate the business intelligence of enterprise systems. *Scientia Iranica.* Vol. 18 (6) pp 1579-1590. https://doi.org/10.1016/j.scient.2011.11.011

Grover, V., and Davenport, T.H. (2001) General perspectives on knowledge management: Fostering a research agenda. *Journal of Management Information Systems*, Vol. 18 (1), pp. 5-21,
DOI: 10.1080/07421222.2001.11045672

Hofmann, E. and Rutschmann, E. (2018). Big data analytics and demand forecasting in supply chains: A conceptual analysis. *The International Journal of Logistics Management*. Vol. 29 (2). pp. 739-766.
DOI 10.1108/IJLM-04-2017-0088

Jacobs, R.F., Berry, W.L., Whybark, C. and Vollmann, T.E. (2018). *Manufacturing Planning and Control for Supply Chain Management: The CPIM Reference*. 2nd ed. New York: McGraw-Hill Education
Jonsson, P., & Mattsson, S-A. (2016). *Logistik- läran om effektiva flöden*. 3rd edition, Studentlitteratur AB

Jonsson, P., & Mattsson, S-A. (2014). Best practice vid lagerstyrning i svensk industri. Logistikföreningen Plan och Chalmers tekniska högskola.

Jonsson, P. & Mattsson, S-A. (2009) *Manufacturing, Planning & Control*. McGraw-Hill Higher Education.

Jonsson, P. and Mattsson, S-A. (2003). The implications of fit between planning environments and manufacturing planning and control methods, *International Journal of Operations & Production Management*, Vol. 23(8), pp. 872-900. https://doi.org/10.1108/01443570310486338

Jonsson, P. & Mattsson, S-A. (2002). The selection and application of material planning methods. *Production Planning & Control*. Vol. 13(5), pp. 438-450. DOI: 10.1080/09537280210142763

Khanorkar, Y & Kane, P.V. (2022). Selective inventory classification using ABC classification, multi-criteria decision making techniques, and machine learning techniques. In *Materials Today: Proceedings*. Vol. 72, Part 3: pp. 1270-1274. DOI: 10.1016/j.matpr.2022.09.298

KraftPowercon Sweden AB (2022) Årsredovisning/ Annual report

KraftPowercon (n.d) https://kraftpowercon.com/ *Om KraftPowercon* (retrieved 2023-01-26)
Lummus, R.R, Krumwiede, D.W. and Vokurka, R.J. (2001). The relationship of logistics to supply chain management: developing a common industry definition.

Industrial Management & Data Systems, Vol. 101(8), pp. 426-432. https://doi.org/10.1108/02635570110406730

Mattsson, S-A. (2008) ABC-klassificering för effektivare materialstyrning. *Permatron AB.*

Matsumoto, M. and Komatsu, S. (2015). Demand forecasting for production planning in remanufacturing. *International Journal of Advanced Manufacturing Technology* .Vol.79(1-4). pp.161-175. DOI 10.1007/s00170-015-6787-x

Meridion AB. (n.d.). 6 box - Modellen [PowerPoint]

Meridion.se. (n.d.) https://meridion.se

Prachuabsupakij, W. (2019). ABC classification in spare parts for inventory management using ensemble techniques. I*EEE Asia Pacific Conference on Circuits and Systems (APCCAS) Circuits and Systems (APCCAS)*, pp. 333-336; DOI 10.1109/APCCAS47518.2019.8953154

Qlik.com (n.d.) https://www.qlik.com/us/

Rahdar, M., Wang L,. & Hu, G. (2018). A tri-level optimization model for inventory control with uncertain demand and lead time, *International Journal of Production Economics.* Vol (195), pp. 96-105 *https://doi.org/10.1016/j.ijpe.2017.10.011*

Richards G., Yeho, W., Yee Loong Chong, A., and Popovic, A. (2019). Business Intelligence effectiveness and corporate performance management: An empirical analysis. *Journal of computer information systems*, Vol. 59 (2), pp. 188-196. DOI 10.1080/08874417.2017.1334244

Sangari, M.S. and Razmi, J. (2015), Business intelligence competence, agile capabilities, and agile performance in supply chain: An empirical study, T*he International Journal of Logistics Management*, Vol. 26 (2), pp. 356-380. https://doi.org/10.1108/IJLM-01-2013-0012

Schniederjans, D.G., Cuadro, C., and Khalajhedayti, M. (2020). Supply chain digitisation trends: An integration of knowledge management, Inte*rnational Journal of Production Economics*. Vol. 220, https://doi.org/10.1016/j.ijpe.2019.07.012

Säfsten, K. & Gustavsson, M. (2020) *Research methodology: For engineers and other problem-solvers*. Lund. Studentlitteratur.

Thürer, M., Fernandes, N., & Stevenson., M. (2020). Production planning and control in multi-stage assembly systems: an assessment of Kanban, MRP, OPT (DBR) and DDMRP by simulation, *International Journal of Production Research.* Vol. 60(3). pp.1036-1050 DOI: 10.1080/00207543.2020.1849847

Van Weele, A.J. (2014). Inköp och supply chain management. 1:3 edition. Studentlitteratur.

Van Weele, A.J. (2018). Purchasing and supply chain management. 7th edition,

Wikner, J., Jonsson, P., & Helgesson, F. (2021) *DDMRP in relation to OP, MRP, DBR and RBS.*

Appendix A- Interview guide production planners

Information to the respondent regarding the interview

- Introduction of the interviews and the master thesis project. The aim of the thesis and why this interview is included in the project.
- As a respondent, you answer the questions that you feel comfortable with and ask if there is anything that feels unclear.
- The information will be confidentially handled and as a respondent, you will be anonymous within the report.
- Do we get permission to record the interview in order to analyse and include details? When the master thesis is completed, these will be deleted.
- Our focus is material planning and parameters within the field.

Presentation of the respondent

Do you want to start with a presentation of yourself and your area of responsibility at the company?

a. For how long have you been at the company?
b. Work tasks?

The production planning process

Do you want to describe the production planning process with focus on material planning?

a. What aspects do you consider?
b. Do you integrate with other parts of the company?

What type of challenges do you have in today's production planning with focus on material planning?

a. What does the planning environment look like today?
    i. How is the access of components?
    ii. For how long is a planning horizon?

Can you describe the work with forecasting and the access of material?

a. Who is responsible?
    i. Can you rely on the forecasts?
    ii. What are the effects?
    iii. Can you give any examples?

Parameters

Would you like to tell us about how you work with parameters within material planning? Are there any specific parameters that you work more or less with and how integrated is it in your work?

a. What does the work with parameters look like internally in the company?

b. Who is responsible?
c. How often are they reviewed and updated?
d. Do you make any manual changes?
e. Which parameters do you consider having the biggest impact on your business?
f. Do you have any specific parameters to follow that are classified as material control parameters for your business?

How does the work with lead time and safety stock look like for you as a production planner in terms of material and material management?

a. Classification and critical products?
b. What method do you use to determine safety stocks?

Challenges and developments

What challenges do you see in today's work regarding supply and demand?

a. Any specific influencing factors?
b. What does it look like with component shortages, etc.?
c. How would you like to work with parameters?
d. What strengths and weaknesses do you see in it?

Appendix B- Interview guide purchasers

Information to the respondent regarding the interview

- Introduction of the interviews and the master thesis project. The aim of the thesis and why this interview is included in the project.
- As a respondent, you answer the questions that you feel comfortable with and ask if there is anything that feels unclear.
- The information will be confidentially handled and as a respondent, you will be anonymous within the report.
- Do we get permission to record the interview in order to analyse and include details? When the master thesis is completed, these will be deleted.
- Our focus is material planning and parameters within the field.

Presentation of the respondent

Do you want to start with a presentation of yourself and your area of responsibility at the company?

a. For how long have you been at the company?
b. Work tasks?

The purchasing process

Do you want to describe a purchasing process? What ordering method do you use?

a. Special strategies including production against customer orders?
b. Do you interact with other parts of the company before orders are placed? Ex goods reception with warehouse
c. Different requirements from different suppliers? Geographical position?

What does your supply chain look like? What challenges do you see?

a. What does the distribution look like between local and global suppliers?
    i. How does it affect, for example, the outcome with a calculated date, etc. (Lead time)
    ii. Flexibility? For example, suppliers far away → fill an entire container.
    iii. How many suppliers do you use for the same product?

Parameters

Would you like to tell us about how you work with parameters within material planning? Are there any specific parameters that you work more or less with and how integrated is it in your work?

a. What does the work with parameters look like internally in the company?
b. Who is responsible?
c. How often are they reviewed and updated?

d. Do you make any manual changes?
e. Which parameters do you consider having the biggest impact on your business?
f. Do you have any specific parameters to follow that are classified as material control parameters for your business?
g. Is it easier to update parameters towards certain suppliers (close relationship or close geographically?).

How does the work with lead time and safety stock look like for you as a production planner in terms of material and material management?

a. Classification and critical products?
b. What method do you use to determine safety stocks?

Challenges and developments

What challenges do you see in today's work within procurement?

a. Any specific factors that affect?
b. The situation with component shortages etc? Does it still affect the company?
c. How would you like to work with parameters in material management (material planning)?
d. What strengths and weaknesses do you see in it?

Appendix C- Interview guide logistics

Information to the respondent regarding the interview

- Introduction of the interviews and the master thesis project. The aim of the thesis and why this interview is included in the project.
- As a respondent, you answer the questions that you feel comfortable with and ask if there is anything that feels unclear.
- The information will be confidentially handled and as a respondent, you will be anonymous within the report.
- Do we get permission to record the interview in order to analyse and include details? When the master thesis is completed, these will be deleted.
- Our focus is material planning and parameters within the field.

Presentation of the respondent

Do you want to start with a presentation of yourself and your area of responsibility at the company?

a. For how long have you been at the company?
b. Work tasks?

The logistics process

Can you describe the logistics process, with focus on material handling from your perspective?

a. What aspects do you consider when planning?
b. Do you interact with other parts of the company before a plan is set?

Material handling

Do you want to tell us about the stock situation and stock management?

a. How often do materials arrive on time?
b. How are you affected when the buyer's increase the purchase materials?

In this study we are focusing on lead time and safety stock. Can you describe how these two parameters affect your work in the warehouse?

a. What are the effects? Both positive and negative?
b. Do you see any effect of these parameters in other processes within the company?

Challenges and developments

What challenges do you see on the logistics side today?

a. What does the availability of the components look like today?

What challenges do you see in your work today?

a. Any specific influencing factors?

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