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Developing Purchasing Process and Forecasting Practices in Retail Business

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Past year has been busy and rough, but in the end, also rewarding. Combining work and studies brought challenges in scheduling and everyday life, but the journey has been educational. But without the support from other people, this project would not have been possible. Therefore, I would like to take this opportunity to thank everyone who has supported me during this project, in any way.

First, I would like to thank my company for supporting my studies, especially my colleagues at the purchasing department, as well as the purchasing manager and the ERP project manager, who were willing to participate in this project and give their integral input during the data collection stages.

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This thesis focused on developing the purchasing process and forecasting practices of the case company. The purchasing process in the purchasing department of the case company has been working well overall in the past, but the constant growth of the company in the recent years has put pressure on the performance of the company and especially the purchasing. The case company is also implementing a new version of the ERP system during 2019 and this gave a good opportunity to improve the purchasing process and forecasting practices, while taking into account the characteristics of the new ERP.

The study was based on design research, which is not its own research methodology but a method of approach which uses both qualitative and quantitative research methods. The study was conducted in four parts, including three data collection rounds. Data was gathered mainly in three workshops with key stakeholders.

This study revealed some inconsistencies and deficiencies in the purchasing process of the case company. The current state analysis pointed the most significant problems being in product categorization, safety stocks and forecasting. With the help from conceptual framework constructed from the literature review, the improvement proposal was conducted. This study proposes several improvements to the three aforementioned steps of the purchasing process, as well as to some other issues encountered during the research.

By applying the improvements proposed in this study, the case company can increase efficiency, reliability and customer satisfaction, and reduce costs. The improvements proposed in this thesis will start taking place after this study is finished.

Keywords	Purchasing, forecasting, product categorization, safety stocks, process development

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1 Introduction

This thesis explores purchasing process and forecasting practices in the context of retail business. Customer orientation is becoming a more and more relevant aspect in retail and service business. This naturally includes customer satisfaction with service delivery, which again includes the service level, the availability of the products that customers need and the speed of the delivery to customers. From the customer perspective, the product availability could be resolved by just ordering enough products from the factories and other vendors. This, however, is viewed differently from the service provider perspective, as it would increase the value of the stock insanely and would hurt the economics of the company.

In certain retail business, customers can be cities, private customers and company chains. Many common products are sold in big quantities and often evenly throughout the year. It means that sales can be forecasted quite reliably. However, with more uncommon products, and especially with spare parts coming into the scene, the demand varies quite strongly, and this causes significant problems when making forecasts.

This thesis takes up this problem of making the forecasts more reliable in a challenging environment of less predictable orders and delivering spare parts. The thesis is carried out for a case company operating in the retail business.

1.1 Business Context

The case company is the leading supplier in its field in Finland. The case company provides the latest technology equipment and software, daily supplies and comprehensive support services for professionals. The case company is part of a company group, whose parent company, is one of the world's leading equipment manufacturers in its field. The parent company's product development is also closely linked to the case company's customers' needs and aspirations. Within the company group, the case company belongs to a business group, which operates in 12 countries across Europe. The business group is Europe's second largest supplier in its field, and many of the group's companies are leaders in their own market.

The case company in Finland also serves a sister company in Estonia as their warehouse for all products and all of their products are ordered and shipped first to the case

company and then sold and shipped to Estonia. The same process has also been implemented with most of the products for sister companies in Norway and Sweden. Spare parts were included in this process with Norway in 2016 and with Sweden in 2019, so practically all of their spare parts are now ordered, stored and handled in Finland. The collaboration in purchasing is also increasing with sister companies in Denmark, Latvia and Lithuania. This puts a great deal of pressure to the purchasing department regarding the purchasing process and forecasting.

1.2 Business Challenge, Objective and Outcome

The business challenge in the case company is that the increasing product range, sales volume and varying needs, especially for the spare parts, too often cause out-of-stock situations, but also overstocking. This increases pressure for the whole purchasing department, but especially regarding the spare part purchasing. The current ABC-classification, i.e. product classification by their movability, for the products is not working properly, especially for the spare parts. Often many spare parts are placed in category C because of their rare sales, which means that the ERP-system lets the stock balance go empty, and even stay empty for a long time, before the forecasting of the system suggests purchases to be made. Many of these spare parts are too critical for the customers and the maintenance of their equipment to wait for the purchasing and shipping from the factory.

The company is also in the process of upgrading the ERP system to a newer version in 2019. This brings the company more challenges as the ERP system changes might not go as smoothly as the company hopes. However, this also brings more possibilities as the new system allows the purchasing department to implement more and better features in the new system than what they have in the current system. The challenge in this lies in configuring what are the essential and desirable changes and upgrades which the purchasing department needs in the new system, and which upgrades and changes can be, and need to be, implemented immediately and which can be implemented later.

Key development areas are increasing the quality and accuracy of the purchasing forecasts and decrease out-of-stock situations and overstocking in order to reduce costs and increase customer satisfaction. This also includes changing the product classification system to allow more variation within the product range regarding their purchase forecasts.

The objective of this thesis is *to propose improvements to the purchasing process and forecasting practices* in order to increase their quality and accuracy.

The scope of this thesis is focused on the purchasing department of the case company, which also serves other sister companies in northern Europe. The outcome of this thesis is an improvement proposal for purchasing process and forecasting practices.

1.3 Thesis Outline

The study is conducted by organizing discussions and workshops with key stakeholders, analyzing these findings related with the KPI's and studying theoretical literature in order to find best practice. In the end the goal is to implement the improvement suggestions, analyze the results and make the final improvement suggestions.

This thesis contains 7 sections. Section 1 is the Introduction to the topic and Section 2 describes the materials and methods used to achieve the objective of the Thesis. Current State Analysis is described in Section 3 and Best practice and literature in Section 4. An initial proposal is given in Section 5 and validated in Section 6. Thesis ends with conclusions in Section 7.

2 Method and Material

This section describes the research method and material that were used in this study. This section starts by describing the research approach, then continues with research design and data collection and analysis methods used in this Thesis.

2.1 Research Approach

The reason for defining the research approach is to give some frame and clarification to the information and claims made in the study. (O'Gorman and MacIntosh 2015: 50)

Selecting a research approach depends on the project, experience of the researcher and the environment of the study. Creswell (2014) implies that it is not only about choosing between qualitative, quantitative and mixed methods studies, but deciding on a type of study within these three methods. Choosing the appropriate methods for the project gives the researcher direction for procedures in a research design.

Qualitative research approach is mostly used when there is not much, or any, information of the issue that is being studied, and it does not have guidance or methodological framework to help. It is also used to get more in-depth understanding of the phenomenon. Quantitative research needs models or theories and understanding the case. Different factors affecting the case also need to be known for the researcher to operate calculations for quantitative research. (Kananen 2013)

Case research studies cases. A case subject could be a company, a business unit, a group of people or an individual. Case research is not its own research methodology but a method of approach which uses both qualitative and quantitative research methods. The target for case research is to get understanding and make statements of the one case in hand. If the research ends up changing the current situation of the subject, the case research has changed to action research or design research. (Kananen 2013: 37-39)

Unlike action research, which would be ongoing and making cycles for a longer period of time, design research makes only one cycle and ends with the final results. Design research was chosen to give the guidelines for this project, because the purpose of this

thesis was to make improvement suggestions and, in the end, change the current situation in the case company, without repeating the research process cycles indefinitely.

2.2 Research Design

This section describes the research design of this thesis and the different parts that are included in it. The research design consists of four parts as shown in Figure 1, including three data collection rounds.

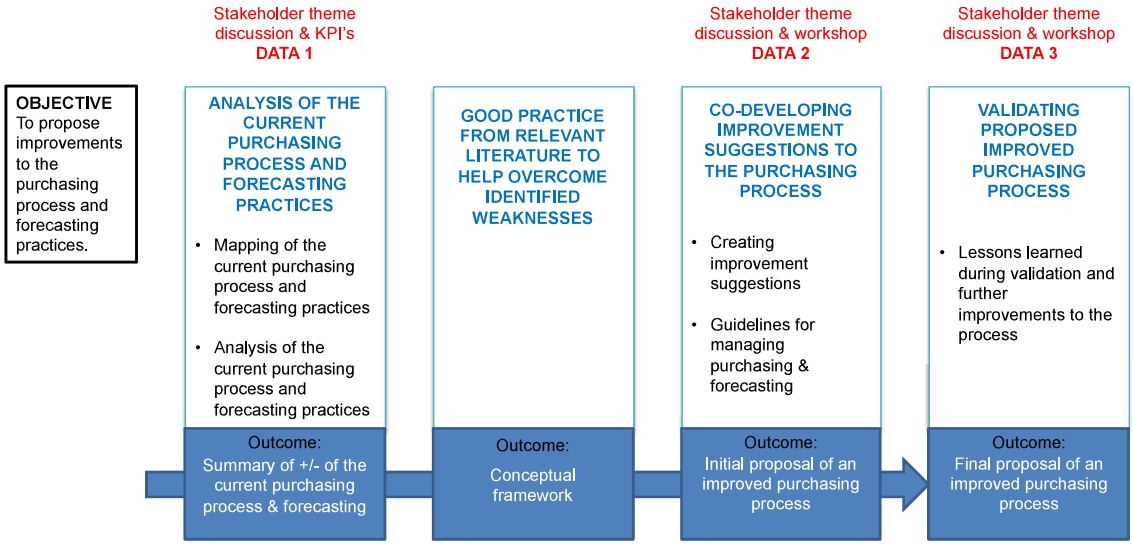

Figure 1. Research design of this Thesis.

As shown in Figure 1, the research design consists of four parts. The first part is the current state analysis. This was performed to get a better understanding and view about the current situation. The current state analysis included stakeholder theme discussion (DATA 1) and analyzing strengths and weaknesses of the current processes, in regards of the KPI's of the company.

Good practice from relevant literature was searched after the current state analysis as the significant issues and aspects of the current state of the purchasing process and forecasting practices were to be found during the current state analysis stage. The conceptual framework for the project was built regarding that relevant literature.

The next step was to co-develop improvement suggestions and ideas via discussions and workshops (DATA 2). Also, guidelines for managing processes was done with initial proposal of an improved purchasing process.

The research ended with validating the proposed improvements and analyzing them with the stakeholders during a workshop (DATA 3), after which the final proposal of the improved process was delivered.

2.3 Data Collection and Analysis

This study collected data from a variety of sources and from several data collection rounds. Figure 2 below gives an overview on Data 1-3 collection rounds.

	CONTENT	SOURCE	INFORMANT	TIMING	OUTCOME
DATA 1 CURRENT STATE ANALYSIS	- Description of current purchasing process and forecasting - +/- of current process	- Stakeholder theme discussion - KPI's	- Purchasing manager - ERP project manager	JANUARY-FEBRUARY	- Summary of process strengths & weaknesses
DATA 2 BUILDING PROPOSAL	- Creating improvement suggestions - Guidelines for managing purchasing & forecasting	- Stakeholder theme discussion & workshop	- Purchasing manager - ERP project manager	MARCH-APRIL	- **Initial** proposal of an improved process
DATA 3 VALIDATION /FEEDBACK	- Improvement ideas to initial proposal	- Stakeholder theme discussion & workshop	- Purchasing manager - ERP project manager	APRIL	- **Final** proposal of an improved process

Figure 2. Data plan for this Thesis.

As seen in Figure 2, data for this project was collected in three rounds. The first round, collecting Data 1, was conducted for the current state analysis and included themed key stakeholder discussion, own observations, analyzing KPI's and exploring system guidelines.

In the next round, Data 2 was collected to gather suggestions from the case company for developing the proposal based on the results of the CSA and the findings of best practice. This data included improvement suggestions. The final Data 3 round was collected when receiving feedback for the proposal from the case company. A more in-depth look into the data collection can be seen in Table 1 below.

Table 1. Data 1-3 collection rounds.

	Participants / role	Data type	Topic, description	Date, length	Documented as
	Data 1, for the Current State Analysis				
1	Purchasing Manager ERP Project Manager	Open Themed Discussion	The current state of the purchasing process, forecasting and the ERP system preferences	Jan 2019 1,5 h	Field notes and recording
	Data 2, for Proposal Building				
2	Purchasing Manager ERP Project Manager	Workshop / Discussion	Proposal building	Apr 2019 1,5 h	Field notes and recording
	Data 3, for Validation				
3	Purchasing Manager ERP Project Manager	Workshop / Validation	Validation, evaluation of the Proposal	Apr 2019 1,5 h	Field notes and recording

As seen in Table 1, the discussions and workshops with key stakeholders made the primary method of data collection, in this study. The discussions were conducted as semi-structured discussions, held on the company premises, using open questions. The discussions were recorded, and field notes were taken.

There were two key stakeholders chosen for the discussions for data gathering. The two stakeholders were the purchasing manager and the ERP project manager. These two stakeholders were chosen for their position in the case company and their significant knowledge of the issues in hand. The situation was organized as a group discussion and not a one-to-one interview because there was more information to gather with open discussion than with an interview with specific questions, as these stakeholders were known to openly discuss about different aspects of the themed matters. Also, most of the system documents and manuals were left out of the analysis as they were outdated or otherwise not suitable for this purpose.

The biggest part of data analysis took place in the current state analysis stage, in order to understand the current state of the purchasing process. The findings from the current state analysis are discussed next in Section 3. The analysis was carried out using thematic analysis.

3 Current State Analysis of the Purchasing Process and Forecasting Practices

This section discusses the current state of the purchasing process and forecasting practices within the Purchasing department in the case company. The first sub-section describes the current state analysis and how it was conducted. It is followed by the description of the current processes and practices and the analysis of strengths and weaknesses. This section ends with the key findings from the current state analysis.

3.1 Overview of the Current State Analysis Stage

The purpose of the current state analysis was to create a better view and understanding of the current situation in the case company and within the business issue.

This current state analysis was executed in four steps. Step 1 describes the current purchasing process and the current forecasting practices. For this end, the study used discussions with the colleagues in search for a more in-depth view and understanding of the current state of the purchasing process and the forecasting practices and to identify the problems in the current system.

Step 2 analyzed the current KPIs in the purchasing process and the current forecasting practices. This was done to increase understanding of the current situation and its metrics.

Step 3 mapped the current purchasing process and forecasting practices and related KPIs to most of the steps. The map gave an overview to point out the issues of the current process. A more detailed description of the map is given in the next sub-section.

Finally, in Step 4, the study identified and summarized the strengths and weaknesses of the current purchasing process and forecasting practices. The identified weaknesses helped to point to the direction for searching business and research literature in order to find best practice and to come up with a proposal for improvement.

3.2 Analysis of the Current Purchasing Process and Forecasting Practices

The case company is part of a 12-company business group operating in Europe. Within this business group, the Purchasing department, warehouse and product management

of the case company serve directly four companies in Finland, Sweden, Norway and Estonia. The Purchasing department and the warehouse also serve a few other sister companies, so far occasionally, but constantly increasing business and collaboration with them.

Currently, the Purchasing department consists of six people, including the purchasing manager. The responsibilities regarding vendors are divided equally between all purchasers, although with different emphasis on the selection of vendors. In most cases each purchaser handles each vendor and their business in its entirety, but with some bigger vendors, the responsibilities are divided between two or three purchasers regarding their emphasis on other vendors, e.g. spare parts, devices and materials could be purchased by a different purchaser.

Based on the results from the observations and discussions with the stakeholders of the case company, the process map of the current purchasing process and forecasting practices was created. The process map is shown in Figure 3 below.

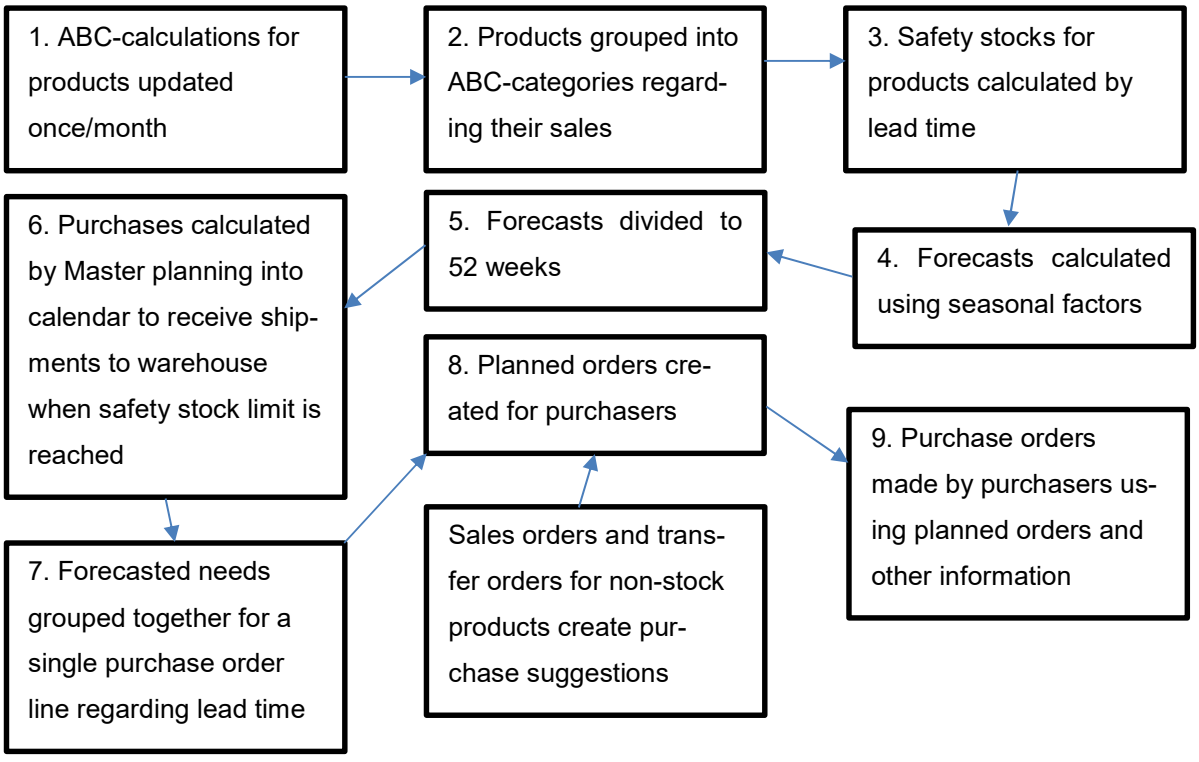

Figure 3. Process map of the current purchasing process and forecasting practices.

As seen in Figure 3, the current process starts from ABC-calculations and ABC-categorization, which is a traditional approach for inventory management and prioritizing products. Then the process continues with safety stock calculations and forecast calculations which are then divided to 12 months of the year, regarding the seasonal factors. After that, the purchases are calculated and grouped together for planned purchases, together with non-stock product orders. Purchase orders are then made accordingly by the purchasers. A more in-depth analysis of the current purchasing process and forecasting practices is detailed below.

As seen in Figure 3, in Step 1, ABC-calculations are updated. The update cycle for the ABC-calculations is one month, for both purchasing and forecasting. But there are also some exceptions for these ABC-calculations and categorizations, which are mostly in forecasting, and they will be discussed later in this section.

Currently, in Step 2, the products in the ERP system are grouped into ABC-categories regarding their sales. The products are analyzed by their movability, as in the number of picking lines in sales orders, not the sales quantities, in order to group them into categories A, B and C. The product categorization to groups of A, B and C, as described above, might make look like it is working well and that there would be hardly any products in group C. The reality, however, with tens of thousands of different products and huge volumes in sales, especially with the products in group A, means that there are still thousands of products in groups B and C. This excludes so called non-stock or service products, which are not stocked in the warehouse but only ordered from the manufacturer or vendor after the sales order has been made.

After that, in Step 3, the safety stocks for the products are calculated by their lead time. The A products get a safety stock that is the same quantity as their lead time consumption. B products get a safety stock that is 0,5 times their lead time consumption and C products get a safety stock that is 0,2 times their lead time consumption.

For some spare parts, the safety stock calculation is static and not calculated every month, while for some other category B and C products, which would not get a permanent safety stock regarding their actual sales quantities and forecasts, a minimum stock level of one or two is forced, if the products are seen crucial for the customers or the service department. These products are removed manually from the safety stock calculations every month.

As for the current forecasting practices, in Step 4, the forecasts are calculated utilizing seasonal factors, using the aforementioned categories A, B, C, quantities and transactions of the last six months together with seasonal factors, for the next year. The seasonal factors correct the straight forecasting regarding the last six months, e.g. the sales are not as high in July as in March.

After these calculations, in Step 5, the forecasts are divided to 52 weeks, according to their seasonal fluctuations. In the current forecasting practices, the seasonal factors are not calculated automatically, but they are maintained manually. The same seasonal factors cover all products and do not take into account product-based differences, special and regional sales spikes, or big project sales which might include several years of regular sales quantities of some products at once.

After the forecasts are calculated, in Step 6, purchases are calculated by Master planning into calendar to receive shipments to warehouse when the safety stock limit is reached. To be more specific, the master planning timing calculates the consumption into the calendar and creates planned purchase orders, which are also called purchase suggestions, in the way that the shipments would arrive to the warehouse at the presumptive date when the stock would reach the safety stock limit.

In Step 7, forecasted needs are grouped together for a single purchase order line regarding lead time. The system defines the length of the time period in which the needs are grouped together for a single purchase order. The grouping also calculates the throughput class of the products, e.g. if the throughput class is 0-14 days, the calculation groups 28 days of needs together for the products in group A, 56 days of needs for products in group B and 84 days of needs for products in group C.

In step 8, planned orders are created for purchasers, with the aforementioned parameters, including lead times and the ABC-classification. After all these steps comes the more visible step, Step 9, the actual purchase orders.

In Step 9, purchase orders are made by purchasers using planned orders and other information. This includes e.g. special offers, additional discounts and minimum order quantities, not to mention all the experience of the purchasers, which helps enormously in recognizing the exceptions and oddities in the planned orders, which need another look and clarification before making the purchase order.

There is also another step in the process map, where sales orders and transfer orders for non-stock products create purchase suggestions. Unlike regular products, which are stocked in the warehouse, non-stock products do not use these calculations, but the planned purchase orders are created one at a time for every need, even when there are several sales orders for the same non-stock product at the same day. This is partly because forecasts and safety stocks are not calculated for non-stock products.

Another reason is that the sales and purchase orders in these non-stock cases are linked together, and the ERP system cannot handle the sales orders if the purchases are grouped because it would lose these links. For the same reason, it would also complicate the work in the warehouse.

Summing up, presently, based on the results of mapping the current purchasing and forecasting practices, the purchasers at the Purchasing department, make purchases according to the planned purchase orders, which are calculated in the ERP system, validated and improved by the knowledge and experience of the purchasers. The forecasting practices include calculations to organize products into categories A, B and C, using the last six months of sales in creating the forecasting quantities for the next year, also adding seasonal factors to increase and decrease planned purchase orders accordingly.

Min-max categorization for products is not in use at the moment. The min-max categorized products would always create planned purchase orders when the stock level goes under the minimum stock and order the exact amount to achieve the defined maximum stock. This would be possible to implement to the current system, but the levels would have to be managed and updated manually, which would increase the workload for several employees.

3.3 Analysis of the Weaknesses of the Current Purchasing Process and Forecasting Practices

In some in-depth analysis, the research concentrates more on spare parts, as they, as a product group, are mostly affected by the problems that are discussed in this thesis, and thus they are easier to work with as a product group. Nonetheless, the results of this research can easily be implemented to other products which means all of them are not needed in this text all the time.

3.3.1 ABC-Categorization of Products

As mentioned earlier, all the products are placed in ABC-categories based on their movability, as in order picking lines on sales orders. Below, in Figure 4, is a chart that depicts this categorization to show how the order picking lines affect the products in this categorization.

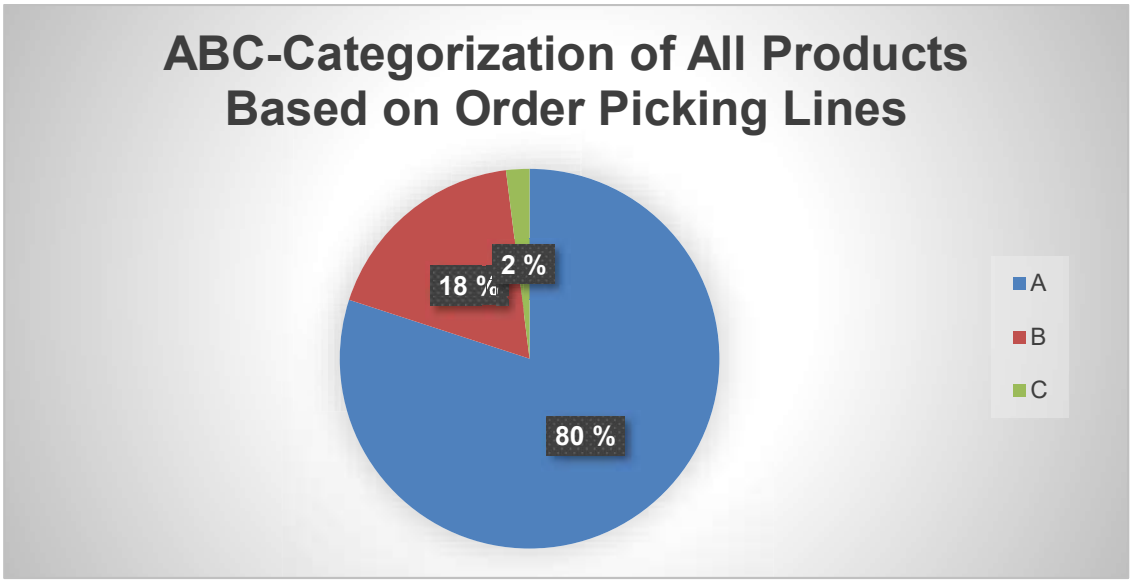

Figure 4. ABC-categorization based on order picking lines, in the case company (calculated monthly, 2018-2019).

As seen in Figure 4, 80% of these transactions cover category A, while category B gets 18% and category C 2%. The case company has a product range that includes tens of thousands of products and all these products are sold in different quantities. This means that as the products are divided between only these three categories, all these categories include a big variety of different products with very different sales quantities and e.g. two products in category A, of which one is sold in thousands per month while the other is sold by a hundred or less, are treated with the same characteristics in the ERP and all calculations while in reality they are in a very different position. Thus, it is clear that the ABC-categories are just too large and include too much variety within the products in those categories.

Figure 5, next, describes the relative and absolute quantities of products in ABC-categories within the spare part segment of the product catalogue.

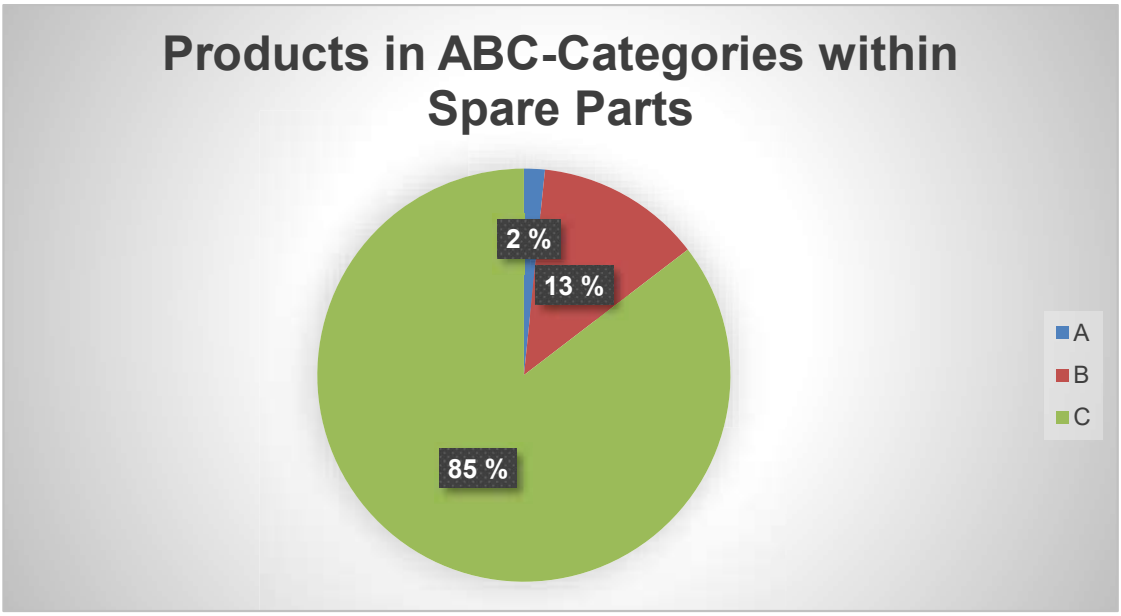

Figure 5. Products in ABC-categories within spare parts, in the case company, (on average, 2018-2019).

As seen in Figure 5, most of the products in the spare part product group fall in to category C and only 2% are in category A. This means that only 2% of all spare parts that are supposed to be stocked, are sold enough to be put in category A, and that they get calculated efficiently based on their sales.

In addition to this problem with variety amongst products in one category, there is also a lack of market-based categorizations. E.g. one product can be sold as a category A product in one market but overall average sales within the whole market drops it to category B and changes the product's other calculations also. This was very clearly expressed by one of the stakeholders in the discussions, as follows:

> *One downside with these calculations is that if we have a certain product assortment in certain market, e.g. some laboratory equipment that are sold only in Finland, they do not take into account that the ABC-classification for this product drops when we always calculate the whole sales, in four countries. (Interviewee 1)*

This leads to the conclusion that as the market specifics are not taken into consideration and products fall to the next categories, it would be reasonable to make the calculations according to the sales in only that country.

3.3.2 Safety Stocks

Presently, safety stocks in the case company are calculated by the lead time of the products. The A products get a safety stock that is the same quantity as their lead time consumption. B products get a safety stock that is 0,5 times their lead time consumption and C products get a safety stock that is 0,2 times their lead time consumption.

The biggest problems in safety stocks, and especially with spare parts, is that the safety stock calculations don't take into account the service orders, but only sales orders. As many spare parts are sold through service orders instead of sales orders, the calculations cannot calculate the whole consumption and hence give these products too small safety stock values. This leads to out-of-stock situations when the purchase orders are always late because the safety stock is too low, and the planned orders do not see the actual consumption and thus make the purchase suggestions too late.

Additionally, as the whole product range is tens of thousands, and spare parts only make about 10% to 15% of them, it is not a surprise that only few products in spare parts product category, about 2% of spare parts that are supposedly stocked products, as excluding the non-stock products from this sum, fall in to category A. All of these category A products get a safety stock value that is more than zero. Of the stocked products in category B, which includes hundreds of products, more than half, about 57%, get a safety stock value that is more than zero, but already hundreds of products are left without one. But, as can be seen in Figure 5, in category C, which includes most of the spare parts, only few products get a real safety stock value. That is less than 2% of all of the products in category C. And this brings the bigger problem as in many cases the planned purchase order is not launched until the sales order is already made and leads to back orders and unhappy customers or service representatives.

For the past three years, in the spare part category, the back orders have been steadily within the target values in categories A and B. In category A, the target value in the company is 1,5% and in category B it is 8%. With spare parts in 2018 the actual back orders have been 1,58% for category A and 8,16% for category B, on average. Figure 6 shows the back orders on average as calculated per month, in 2018, for the case company.

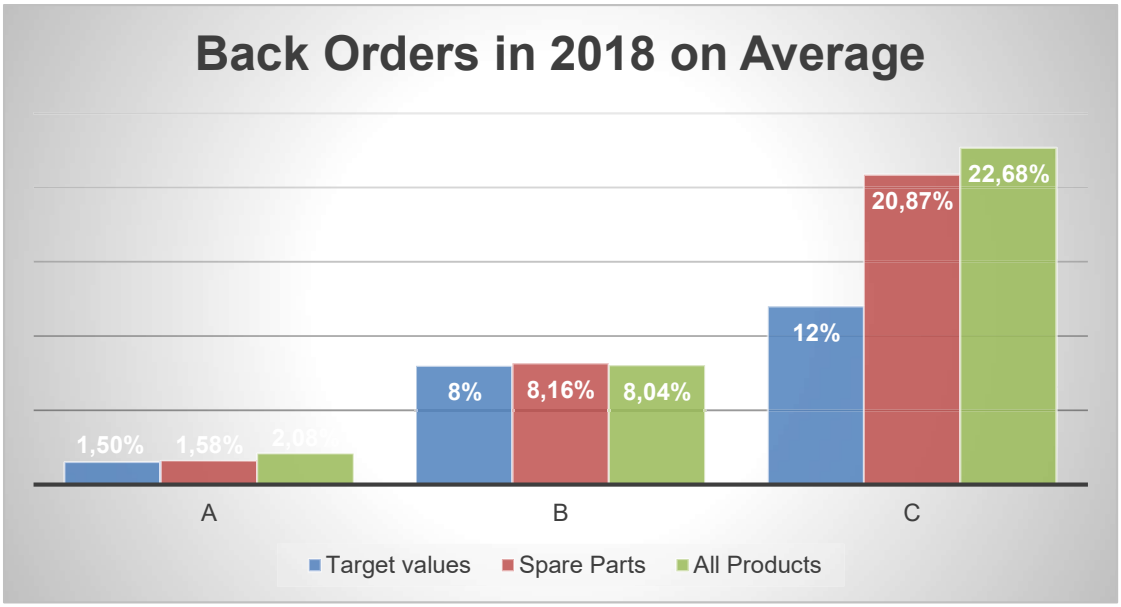

Figure 6. Back orders on average in the case company (in 2018).

As seen in Figure 6, on the other hand, the situation looks very different in category C. As the company target value for back orders in category C is 12%, the reality with spare parts is over 20%, on average. Comparing to the whole product range on company level, the actual back order levels are similar, which indicates that, even though back orders could be reduced in all product categories, most of the work should be focused on category C products.

For some category C products, a forced safety stock level of one has been implemented, but as they are updated manually, it cannot be the solution for every product as it would be overly costly and time consuming to manually go through the whole product catalogue and update the safety stocks regarding the product life cycle. Manually overriding the safety stock levels like this also means that if the product starts selling in a way that the system would calculate a bigger safety stock than one for it, it would not do this because of this forced minimum safety stock.

3.3.3 Forecasts and Seasonal Factors

Presently, in the Purchasing department of the case company, seasonal factors are calculated, or added to be more specific, to all products after ABC-categorization and safety stock calculations. They are the same for all products. At the moment, the seasonal factors are updated manually and there is only one set of factors that is used for all products.

Therefore, different factors, e.g. product group-based factors, market specific factors, or any other product specific factors are not taken into account in these calculations. Hence, they are rather more suggestive and limited to average seasonal sales through the year. As the seasonal factors are updated manually, they do not take into account big project sales or any other special cases. Additionally, one thing that is affected by both, i.e. the safety stock calculations and forecasts, is that spare parts are often needed quickly. Sometimes even the whole operation of a customer's practice can be interfered and stopped because of one broken part. In that case the product is needed and ordered as fast as possible even if it is a non-stock product. But when it is a product that should be stocked but is not in stock because of inefficient safety stock and forecast calculations, the problems start to escalate.

Another problem regarding the forecasts is that the ERP system cannot copy the forecast from a retiring and stopped product to the replacing product. When a product is stopped for purchasing in the system, it does not mean that the forecasting or planned orders would stop. It is only removed from the regular planned orders window view, and the forecasts will run for the next six months in the background, probably even longer if the product, at the time of stoppage, has large stock which takes time to sell out and keeps calculating forecasts accordingly.

Naturally, when the stopped product still has large stock, it is not as crucial to order the replacing product, but eventually it has to be ordered. However, since the system cannot copy the forecasts between products, and the only indication for the new product needs from the system comes from the sales order for the product that is not there yet, and needs to be ordered for the back order, the purchasers have to be awake and aware of these replacements and their possible future need and order them beforehand. In some cases, the product needs special attention several times before the purchaser can leave it and trust that the system will handle it properly going forward.

3.3.4 Retiring Products

In the Purchasing department of the case company, there is also another problem regarding the retiring products. When older products are in process of being retired in purchasing, it could happen for varied reasons, e.g. the factory has stopped producing it, replaced it with a newer model or the case company has stopped offering it or replaced it with another product. Usually then, when the stock of the old product is consumed, the

system will indicate the sales persons making the sales orders that the product is no longer available, and they should use the replacing product on the order instead. But the problem in this process is that the replacing product will not be offered to the sales orders, if the stopped product is already out of stock, but has any open incoming orders, as the system only sees that the old product has products coming to the warehouse. In the case company, retiring products are also referred to as stopped products, as blocking their purchasing and/or sales when they are being retired, is called stopping. An example of the problem regarding retiring products was given by one of the stakeholders in the discussions, as follows:

> *One example of this problem was a product which was sold in great quantities. The replacing product was already in the system and also in stock, ready for sales, so everything seemed to be ok. But there was a return order coming from Sweden and the system only saw that there is or will be stock to be sold. As normally the system indicates when the stopped product is out of stock and the replacing product should be used, but in this case, it didn't do it, and there were hundreds of back orders for this stopped product. (Interviewee 1)*

This includes small backorders from vendors and returning sales orders from customers or from other countries. So even when there is only one or a couple of products coming to the warehouse and there might be hundreds of open sales orders for the old product, the system does not alert people in sales or in purchasing.

Another problem regarding the products that are retiring and marked as stopped in purchasing is that as they are excluded from the regular view of the planned purchase orders for purchasers, they are not checked regularly. Nobody seems to be in charge of checking the stopped products and there might be open sales and transfer orders over six months old as they have not been checked and nobody is asking where they are, why they have not been delivered. In some cases, the customers have just made new orders.

These same problems are even worse with spare parts, as all the service representatives have their own warehouses, both physically and in the system. And if there are any products in any of the warehouses, the system sees them as available and does not indicate that the stock in the main warehouse is empty and the replacing product should be used. Also, with transfer orders, which are used to transfer products from the main warehouse to the service representatives' warehouses, the system does not indicate the out-of-stock situations or stopped and replaced product info at all.

3.3.5 Unreliability of Planned Orders with Less Common Products

There are also other more detailed issues with the current purchasing process and forecasting practices. One of these issues is that when a purchaser is checking the planned orders window for a certain vendor and as category A products can be ordered as they are planned and displayed, the category C products often have to be checked thoroughly because the planned orders suggestions cannot be trusted as they are. This includes going through the forecasts, stock levels, transactions and possibly the whole history of the product to get a better picture of why the system suggests the given quantities and if they are reliable or not.

Especially with spare parts the quantities that are suggested are often too low, as mentioned earlier. But there is also a good chance that the suggested quantities are too high. Reasons for these too high suggestions come from the forecasts that are calculated too high, and the source for the wrong calculations is most often either some big project sales or rare single sales orders that drain the whole stock at once.

3.4 Analysis of the Strengths of the Current Purchasing Process and Forecasting Practices

Even though several weaknesses have been found and analyzed in this research, there are also advantages and strengths in the current system. In the big picture the current system works reasonably well. It works relatively automatically and the whole product catalogue is controlled at least on some level. The planned orders tool is easy to work with and works well with the most common products. Also, the coverage groups for the products are updated automatically. If the product starts from category C but the sales increase enough, the system transfers the product automatically to categories B and A and vice versa. Additionally, if the lead time is changed, the system automatically transfers the product to the right coverage group with the right parameters.

The basis of the current system is that some priorities have been implemented. This has been necessary to handle the vast amounts of products. The big majority of products have been working well and the overall KPI's look decent, e.g. the stock turnover rates, which can be seen in Figure 7.

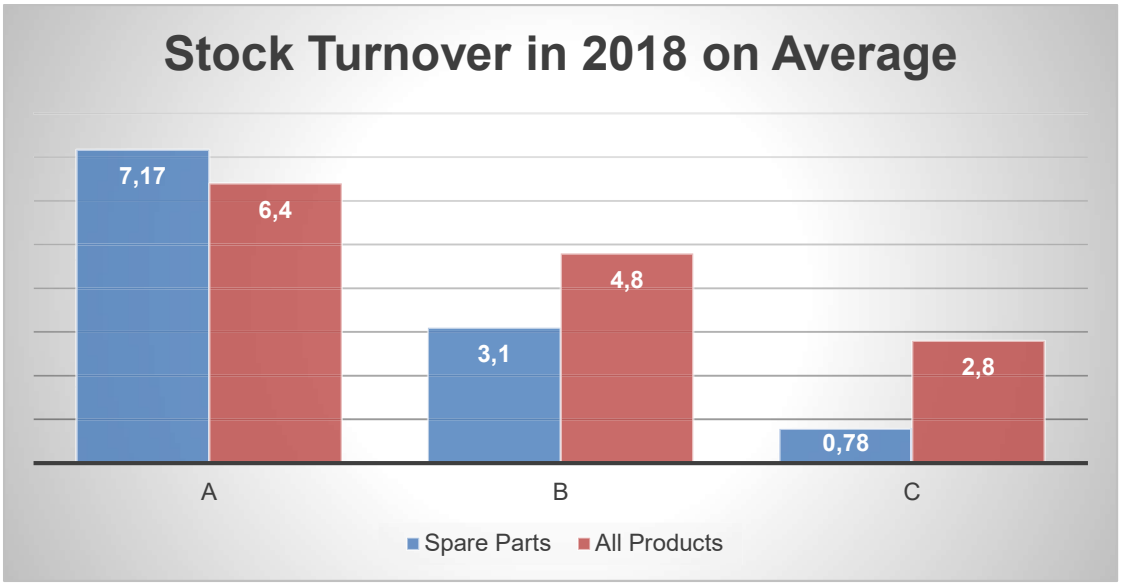

Figure 7. Stock turnover in the case company by product category (in 2018).

As seen in Figure 7, the stock turnover ratios in the case company are very good on category A and B products. And the low turnover ratio for spare parts in category C can be explained with the irregular nature of the more rarely needed spare parts, which need to be stored regarding their critical nature for the work of customers rather than great sales.

The current system keeps the overall service level good and, although there are several deficiencies, it would allow the case company to implement several diverse coverage calculations to the system. Unfortunately, this would require someone having time to implement them and be appointed to be responsible for processing and updating them, but the possibilities are there.

3.5 Key Findings from the Current State Analysis

This subsection provides an overview of the main strengths and weaknesses identified in the current state analysis in Section 3. The process map below in Figure 8, shows the identified weaknesses in the current purchasing process and forecasting practices.

After analyzing the issues that were found in the current state analysis stage, the key findings were categorized accordingly. The key findings can be found next in Figures 8, 9 and 10.

Summary of Strengths

Overall Works Well

- The whole product range is included at some level
- Coverage groups of the products are updated automatically based on the transactions
- Common products are easily ordered and handled with planned orders
- Overall KPI's look decent

Figure 8. Summary of strengths based on the key findings.

As shown in Figure 8, the current system works well in the big picture. All of the products are in the system and great amounts of more sold products can be handled easily. Coverage groups are updated automatically and overall KPI's are good. These strengths are good to keep in the future.

The weaknesses, on the other hand, need a closer look. The process map, with the identified steps suffering from the weaknesses discussed above, can be found below, in Figure 9.

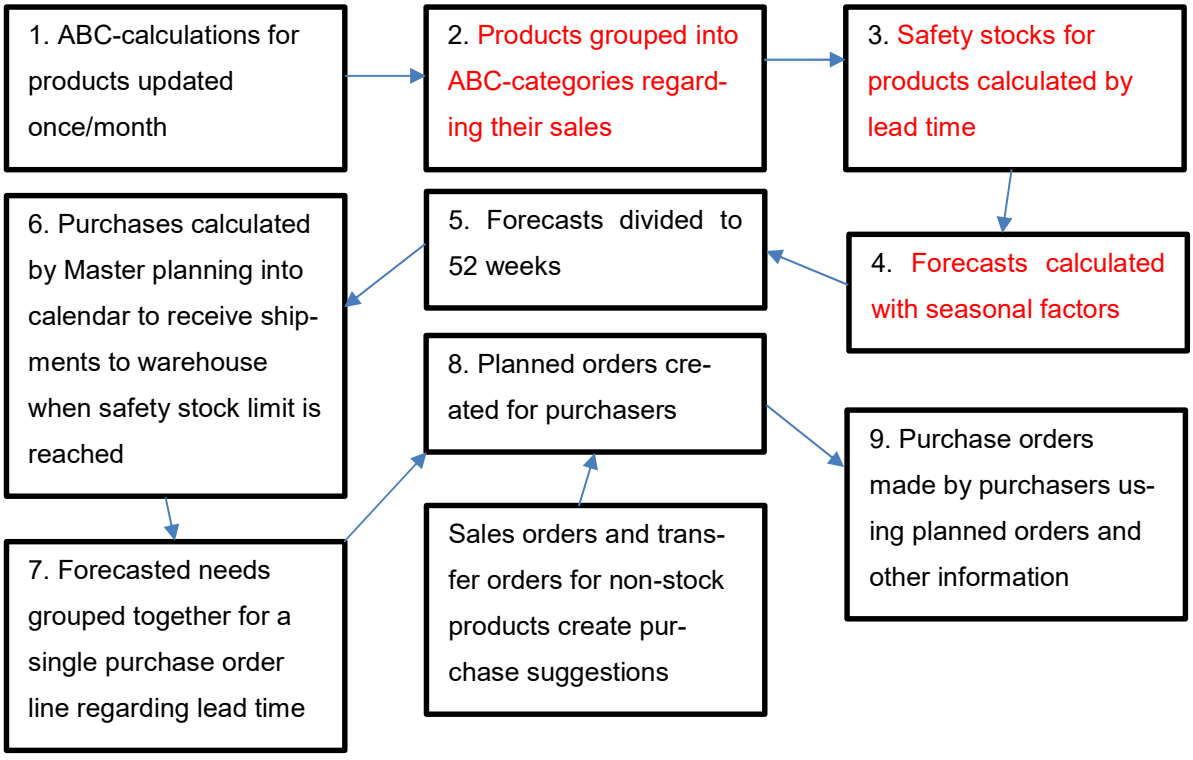

Figure 9. Process map of the current purchasing process and forecasting practices with the identified weaknesses highlighted.

As can be seen in Figure 9, there are three steps in the current purchasing process, which have been identified as the main weaknesses. These weaknesses include the ABC-categorization of the products, safety stock calculations and forecasting. These steps are described in more detail in Figure 10 below.

Summary of Weaknesses

ABC-categorization

- ABC-categories are too large
- The calculations do not take into account the differences between markets

Safety stocks

- ERP does not count service orders, part of consumption excluded from calculations
- Too many back orders, especially in product category C

Forecasting and dealing with "retiring" products

- Seasonal factors are same for all products and updated manually
- ERP cannot copy the forecast from retiring and stopped product to replacing product, causing out-of-stock, late orders and backorders
- The replacing product will not be offered to the sales orders, if the stopped product is already out of stock, but has any open incoming orders, as the system only sees that the old product has products coming to the warehouse
    - The problem increases with spare parts, if there are any products in any warehouse, the replacing product will not be offered by the system
    - On transfer orders the retiring products can be ordered without the system indicating it at all
- Retiring products on planned orders are not checked regularly

Less common products need a lot of manual work

- Unreliability of planned orders for less common products
- Checking forecasts, stock levels, overall history and transactions before ordering

Figure 10. Summary of weaknesses based on the key findings.

As seen in Figure 10, there are four key findings in the weaknesses, of which three have been chosen for more in-depth study. The first of these findings is the ABC-classification. The size of the ABC-categories makes them less flexible and accurate as the products within these groups vary significantly and the same calculations should not be used for so many different products. A similar problem arises in the incapability to make market-based or other special ABC-calculations for products that are sold in different quantities in different markets, or other special reasons.

The second weakness relates to safety stocks. The current ERP system does not count service orders in the calculations, thus leaving a huge amount of data and transactions out of the calculations, especially within spare parts. This leads to wrong calculations and safety stock levels that are too low. Moreover, these issues accumulate back orders as the purchase orders are made too late and the shipments from vendors will not get to the warehouse in time. And not only do the back orders decrease customer satisfaction, but they also increase shipping costs.

The third big finding includes forecasting and retiring products. One of the issues in this segment is that the seasonal factors are same for all products, so it does not allow any specific factors to be implemented on some products that might be known to behave differently. They are also updated manually so real changes in sales do not affect these factors and they are often outdated.

As the products get replaced with other products, the new products do not have any forecasts, but they start from a clean plate. The forecasts from the replaced products cannot be copied to the replacing products, which often leads to out-of-stock situations and back orders with the new product. Another problem with replacing products is that the system does not offer them to the sales orders until the stock is completely empty for the old product. As this often works, too often there are situations where the old product is waiting for a return order to come to the warehouse and the system only sees that the old product still has inventory to be sold and does not indicate the product change to people making sales orders. As the system is not made for spare parts, but they were included in to it later, the problems with retiring and replacing products are even greater within spare parts. Transfer orders are the most common way for service representatives to receive spare parts from the main warehouse to their own. But with transfer orders the system does not indicate the product change at all. It does not stop the order transaction if the product is out of stock and stopped in purchasing, and hence it also does not give the replacing item to send to the service representative. This problem, together with the fact that stopped products are not checked regularly, sometimes lead to very long waiting period for the actual transactions to happen.

The fourth finding in the weaknesses list is about the workload that the less common products and many spare parts causes for the purchasers. But as all four findings above overlap each other, this issue receives less attention during this research, as improving

the other findings will help to improve this issue also. The selection of these three findings will guide the choice of literature in Section 4.

4 Existing Knowledge and Best Practice on Purchasing and Forecasting

This section discusses the theoretical background related to purchasing processes and forecasting practices. The section concentrates on existing knowledge, best practice and concepts which relate to the findings of the current state analysis, discussed in Section 3, namely, the concepts related to product ABC-categorization, safety stocks, forecasting and purchasing processes. Section 4 ends with the conceptual framework.

4.1 ABC-Categorization

ABC-categorization is a traditional approach for inventory management and prioritizing products. In this system, products are categorized into three categories called A, B and C. Traditionally, products in category A get the most attention and products in category C get the least amount of attention. Products in category B are in the middle. Many companies have a wide range of products, sometimes thousands, or even tens of thousands. As managing these products manually one by one would be impossible, ABC-categorization is a useful tool helping to solve when to make orders and for what quantities. According to Ravinder and Misra (2014), it has been a common practice to categorize products by their turnover. The number of products in category A would be small but they would account for most of the turnover. Accordingly, based on the Pareto Principle, the number of products in category C would be huge, but their turnover would be small. Although categorizing products by their turnover has been a helpful tool, it has been based only on one criterion. Other criteria can be taken into account in order to establish multi-criteria ABC-categorization. (Ravinder and Misra 2014)

Douissa and Jabeur (2016) agree with the increasing importance of other criteria in ABC-categorization in addition to traditional turnover. They also add that in the literature of this topic, there are two primary methods of doing the ABC-categorization, ranking and classification. In the ranking method, products are categorized based on their ranking, which could be performed using different calculation systems. Classification method, on the other hand, utilizes Artificial Intelligence (AI) systems in order to categorize products. Using AI system in ABC-categorizing would need implementing training sets for the system to learn with and deep knowledge of AI systems, which could be difficult for many companies to achieve. (Douissa and Jabeur (2016)

4.2 Safety Stocks

Sales and supply of products can be unpredictable and unreliable. Safety stocks are a typical and smart part of inventory management to deal with this challenge and they are calculated by evaluating risks and applying the safety stock value for the forthcoming time periods. Kanet et al. (2010) suggest that the easiest way of doing this is to define one simple safety stock value in a bigger scope, although more progressive approaches support progressive checkups and revision of the safety stock values. According to Kanet et al. (2010), safety stocks could be changed with time, in order to decrease their value when supply and sales are foreseen and increase the quantities when supply and sales are more unpredictable. Informing other members in the supply chain in advance about the changes in demand is crucial for the changing safety stocks to work properly and producing a trajectory to predict these changes is a helpful tool in keeping safety stocks on a reasonable and effective level. Decreasing stock levels and safety stocks and increasing service level is a desired result for companies, so planning for situations when sales and lead times are not stagnant is important. (Kanet et al. 2010: 6859-6860)

Inventory management gets challenging when demand and supply are random and vague. According to Inderfurth and Vogelgesang (2013) profit losses are not easy to forecast in these situations and introducing safety stocks is a good way to regulate them. It is safe to say that even in static environment the level of safety stocks fluctuates, one of the causes being inconsistent lead times. In the end, it is in the hands of the managers to decide, whether a fixed safety stock would be better for the company due to simpler and cheaper construction and maintenance, comparing to progressive and changing safety stock, which would need more work to build and update. (Inderfurth and Vogelgesang 2013: 293-294, 300)

According to Osman and Demirli (2012), the service level of the end customer is the determining factor regarding the safety stocks. Companies should find the optimal safety stock levels and fill rates to satisfy the customer service level, while keeping the inventory costs as low as possible. The main cause for failing to deliver products to customers in time is the unreliability of suppliers and their shipments coming in late. Another cause correlates with inventory systems with arbitrary order decisions and out-of-stock situations. (Osman and Demirli 2012: 299) As it has become clear, many aspects of safety stocks are heavily related to forecasting, which is discussed in the next sub-section.

4.3 Forecasting

Prak et al. (2017) suggest that in the related literature it is usually presumed that all specifications of supply and demand are known. In reality, however, this is not the case, but the forecasts regarding to the future demand are based on past experiences and old information. Variation on the estimation of the demand could cause safety stocks being considerably smaller than needed and service level worse than intended. (Prak et al. 2017: 454)

When dealing with products that have varied and inconsistent demand, many sources concentrate mostly in spare parts, as their nature is often inconsistent, but often the same methods can be utilized with other products, with similar traits, as well. Pennings et al. (2017) depict spare part business and management and their influence on the success of companies significant, especially for companies that have broad selection of spare parts, perhaps thousands of them. Forecasting for spare parts and other products that are sold irregularly is difficult as the clear and consistent signals, comparing to more common products, are missing. At the same time, service level targets are set high, while trying to keep inventory costs low. The accuracy of forecasting becomes even more challenging when customers order large quantities at a time, draining the inventory for some products, which increases out-of-stock situations and back orders, especially if the lead time for these products from factories is long. With external customers, companies often have to rely solely on historical data from previous transactions, as the exact information about the customer and the order that is specific to the context, is rarely accessible. (Pennings et al. 2017: 958-959)

According to Dombi et al. (2018), managing spare parts systematically and efficiently can increase loyalty within customers significantly. Then again, as mentioned earlier, there are many challenges in forecasting their demand. These challenges include the range of spare parts, which can be immense, and their demand, which fluctuates vastly. Spare parts are also often needed urgently, which puts pressure to increase inventory. The risk of ending up with huge amounts of obsolete products, on the other hand, puts pressure to decrease the inventory. Understanding and identifying product life cycle, for the spare parts, and the end products, for which they are used, supports finding the right balance in forecasting. (Dombi et al. 2018)

4.4 Improving the Purchasing and Forecasting Process in Other Areas

For improving business processes, defining a business process is needed first, which can be challenging. According to Sharp and McDermott (2009), a business process is "a collection of interrelated activities, initiated in response to a triggering event, which achieves a specific, discrete result for the customer and other stakeholders of the process" (Sharp and McDermott 2009: 56). When looking more closely into this definition, the customer can be a person or an organization, and it can be internal or external. Next, the triggering event that starts the whole process needs to be identifiable, and the activities within the process interrelated. Alternatively, according to Sharp and McDermott (2009: 57-58), a business process can be defined, especially when the process includes repetitive and clearly described tasks. Then, the process is also reasonable to be modeled. Creative, strategic and executive processes, on the other hand, are much more difficult to model, as they usually cannot be defined as easily. Considering these arguments (Sharp and McDermott 2009), it could be said that a purchase process is a business process and, in many aspects, could be modeled.

According to Martinsuo and Blomqvist (2010), process management can be implemented almost anywhere in companies and organizations in order to enhance their work. Enhancing work requires specifying targets and improving their processes. Frequently, process improvement involves information systems and it is typically based on using documentation and tools from process management. In order to achieve this, tracking performance and getting suitable information is essential for process improvements. Before starting the process improvement, the process or the part of the process needs to be defined, for which the improvement is going to be made for. This defining work also includes the information on the amount of unpredictability and the level of detail in the process. (Martinsuo and Blomqvist 2010: 4-5)

Business Process Reengineering (BPR) is one way of decision making when processes are analyzed and designed. O'neill and Sohal (1999) describe BPR as not being a constant process or organization, but as an instrument created for reengineering one process and to be dismantled after it is done. After that, the employees return to their normal work and organization, which might have changed during the reengineering process. Usually, companies should not do more than one process reengineering at a time, as this interrupts normal work and causes stress. They can, however, create another BPR team right after the previous team has finished their work and has been dismantled. Still,

the process itself is not forgotten after the reengineering is finished, but constant development is needed from the people who work in the process. BPR also has the interest set on the results more than activities. Keeping the results in mind provides guidance and measurability. Nevertheless, BPR includes risks. The changes might not be suitable after all, or the reaction within the organization might be negative and oppose the changes. However, communicating in simple terms and early on to the organization could help overcoming these issues. (O'neill and Sohal 1999: 578-579)

Also, decision making is a crucial part of improving processes. Everything that companies do, whether it is an opportunity or success or misfortune, is a result of decision making. According to Rogers and Blenko (2006), decisions often get stuck inside the organization and the effects can be huge for the processes. (Rogers and Blenko 2006) The benefits of decision making could still be lost even in companies with good reputation on decision making, if the accountability of who is making the decisions disappears, and the whole process could be stopped. Thus, defining and designating the roles and responsibilities is the first procedure in tackling the obstacles of decision making. People who are good at making decisions identify the decisions that are most critical for the work of the company. They also discover the right people to have the right role in the decision-making process. One approach to this is called RAPID. This abbreviation comes from the roles of recommend, agree, input, perform and decide. (Rogers and Blenko 2006)

In RAPID, in the recommending role, the person gives a recommendation of the activity that should be done but needs analysis and data from persons who are giving the input for the decision making. Persons who give input into the decision-making process work like consultants. They provide facts, statistics and other useful information for the recommending persons, who, on the other hand, are not constrained by this input, but have to take it into consideration, nonetheless. In the agreeing role, the person either agrees with the original recommendation, or permits it to go forward, or works with the person recommending in order to improve the recommendation so that the action can be performed. The next step in this approach is deciding. There should not be too many persons in the role of decision making in order to keep the decision-making processes operating fluently. Finally, the person with the last but not the least role is the performer. Performers execute the decision and make sure it is done efficiently and fast. The importance of this role comes from the idea that a good decision executed fast is better for the organizations than trying to make the perfect decision and execute it poorly or slowly. (Rogers and Blenko 2006)

RACI is a similar approach to decision making process as RAPID. RACi is an abbreviation from words responsible, accountable, consulted and informed. According to Costello (2012), in RACI, accountable employee is in charge of the realization and the outcome of the process. Responsible employees are responsible in executing the work. In small organizations, one employee could be both, the responsible and the accountable person. Consulted employees give their expertise on the issue in hand. Informed employees are usually managers and other affiliates who need to know about the issue and results. (Costello 2012)

RACI is not meant only as a planning tool or a remark in documentation, but a mentality throughout the company to work effectively. Assigning the roles clearly is essential for RACI-model to work. The accountable employees are the most important to be assigned as they are responsible for the whole process to work. The same could be said about the responsible employee who is responsible in the execution. The employees assigned to these two positions should also be active on the process and always present in all meetings as without their input and perspective the meetings could end up being discussing about hearsay and the process itself will be stalled. (Costello 2012)

Rogers and Blenko (2006) also argue that cross-functional cooperation is becoming more and more important for companies in order to gain the most excellent results for the company itself and for the customers. Unfortunately, it seems that the cooperation in decision making between functional units is not as common and easy as it should be. Sometimes this leads to worse and more inefficient decisions when all the available information is not used. Many decisions regarding more than one functional unit are critical and challenging, so it is important to still make the decision, as not making any decision could end up being expensive for the company. Different organizations and functions have different objectives, which makes the role of the decision maker even more important and these decision makers should be appointed early on, in every team affected by the decisions. But even though appointing the decision maker is important, in cross-functional decisions, it is even more important to make sure that the right persons can contribute to the decision-making process with their knowledge. When the roles in decision making process are clear, it reduces the time used in the process and decreases uncertainty and frustration within the organization and in meetings. Although all of these aforementioned points are not miracle makers and might not be easy to implement at once, all the steps a company makes towards a more structured decision making, help the company overcome the issues it encounters. (Rogers and Blenko 2006)

Although RAPID and RACI can give good guidelines to decision making processes, Kesler et al. (2016) argue that they cannot be used blindly in every situation and for every possible issue, as some companies do. For complicated decisions, these tools might be too simplistic when managers are struggling in differentiating between responsibility, authority and accountability. On the other hand, some companies do not try to improve their decision-making processes at all and only wish that the unfavorable issues disappear. As neither of these approaches work for the companies, there is a third way in the middle, which enables companies to improve their decision-making processes, without frustrating managers on who has the right to make decisions. Kesler et al. have created an approach, which includes a new operating model, shown in Table 2 below, accompanied with better conversations and guardrails to support the conversations. (Kesler et al. 2016: 36-37)

Table 2. Four types of operating governance and degrees of integration (Kesler et al. 2016).

	Fully Integrated Single Business	Closely Related Portfolio	Loosely Related	Holding Company/ Conglomerate
Strategy	Single strategy guides all P&L units with minor variations	Complementary business portfolio and core strategy with variations	Diverse, relatively autonomous businesses with limited strategic similarities	Structuring cheap finance, buying and selling separate assets; no common strategy across units
Governance & Organizational Design	Direction comes from organizational center All process and practices are common Single culture	Functions seek to drive scale, common process, and policy consistency Synergies expected at the front (shared customers), middle (shared technologies) and/or the back (shared infrastructure and operations)	Selected functions drive some scale benefits and some best practices in the areas of capital, talent, and knowledge Otherwise stand-alone businesses	Appoint the best people to run the businesses Business units return financials to parent No common processes Multiple cultures
Leadership Talent	Single talent pool for leadership jobs Numerous synergies expected	High degrees of cross-organization movement of talent with common process & metrics	Limited movement of talent across units at senior levels	No movement of talent across units No synergies expected
Rewards Philosophy	Single design, limited need for variations Central administration	Single design, with variations in practices as necessary Mixed administration	Harmonized variations in design with business unit administration	High variability; no need for harmonization
Company Examples	Apple, Cisco, Coca-Cola, Toyota, Marriott	P&G, IBM, Nike, Google, PepsiCo	GE, Philips, Unilever, Johnson & Johnson	Berkshire Hathaway, Private Equity
	High integration		Low Integration	

In Table 2, Kesler et al. (2016) introduce four types of operating models with high and low degrees of integration. They argue that in smaller units, managers tend to think that their units are, or should be, in a loosely related model. Focusing just on their own work they think that company-wide modes of operation decrease their sovereignty and do not create value to their work. Enterprise level managers on the other hand tend to think that the same company is closely related and see potential in standardizing operations and being able to move and allocate resources when and where they are needed. As these views affect the operating models, it is essential to agree on the operating model in order to assign decision rights. Regarding the conversations, it is essential to put the right

employees to the right meetings and share all the information that is necessary to get the best results. The composition of these meetings and teams also needs to be constantly monitored. With guardrails comes the greatest difference to RAPID and RACI. All managers do not have to be involved in every decision and they could just trust in the expertise of others. Some companies do not want to give a single person decision rights to affect the whole company, but instead give decision guardrails to help managers work together.

One example of this kind of guardrails is the straight path from decision to execution, without going back to discussions over decisions unless completely necessary. Even in this model someone has to be nominated with the last vote in order to avoid endless discussions while finding total agreement. (Kesler et al. 2016: 37-39) While RAPID and RACI are good tools for decision making, for complex situations they are not flexible enough and companies need to explore their processes first, in order to adjust the roles and responsibilities more closely to the aims of process improvement.

4.5 Conceptual Framework

This sub-section summarizes the key inputs identified from relevant literature on the topic of improving the purchasing processes and forecasting practices. The identified relevant elements are merged into the conceptual framework that introduces the approaches and tools to be applied for the proposal building later in this study, in Section 5.

Key ideas and techniques identified for improving the purchasing processes and forecasting practices are shown in Figure 11, in the conceptual framework of this study. The conceptual framework gives a visual representation of the selected key ideas and techniques significant for this thesis. The conceptual framework is shown on the next page, in Figure 11.

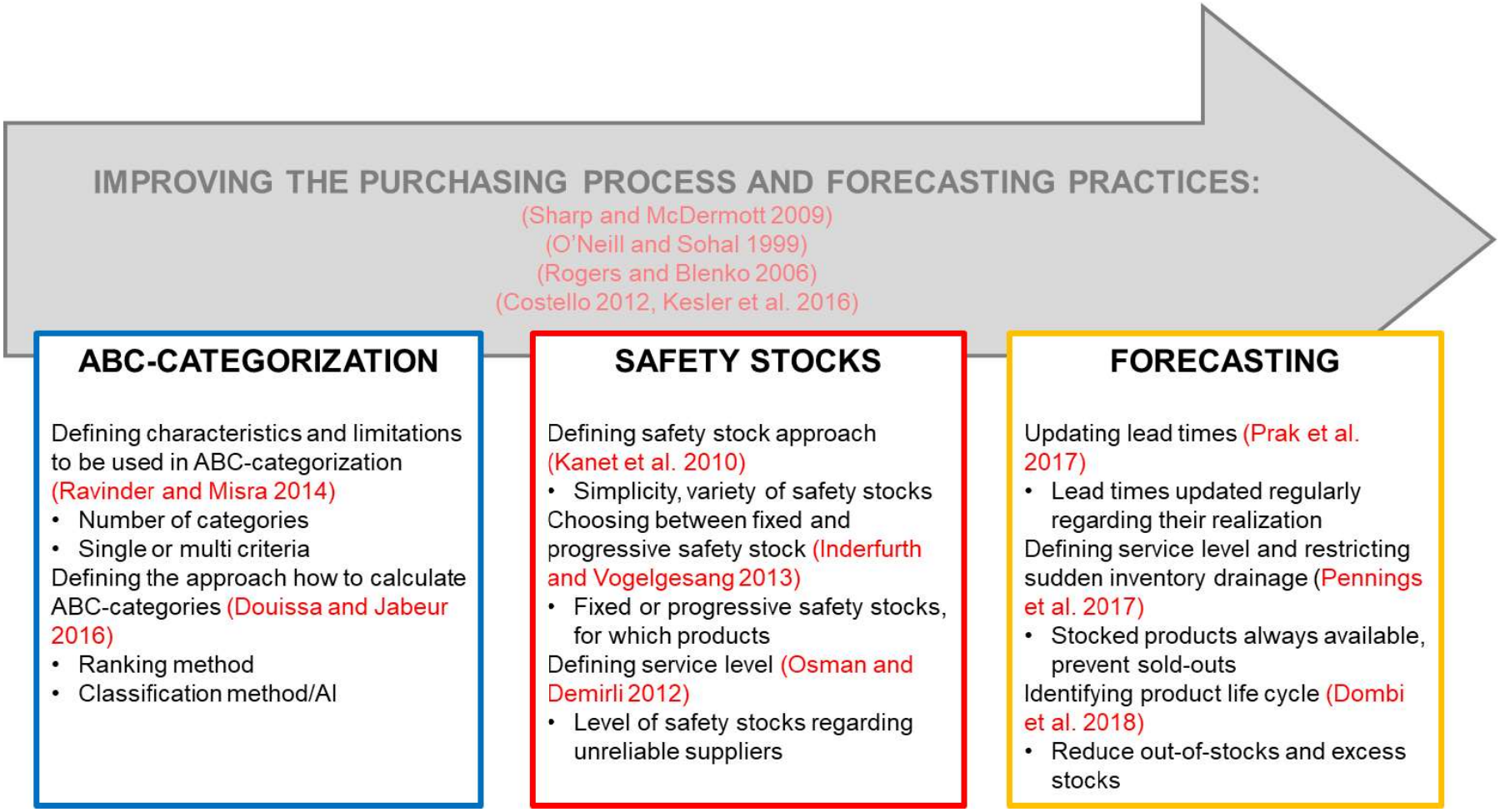

Figure 11. Conceptual framework for improvements in the purchasing process and forecasting practices in this study.

Metropolia

As seen in Figure 11, the conceptual framework consists of four parts. The primary focus related to improving the purchasing process and forecasting practices. Based on literature, the three main steps need to be taken, which, to some extent, overlap and interrelate with each other: 1) ABC-categorization, 2) safety stocks and 3) forecasting.

The first focus area, ABC-categorization, includes two elements: first, *Defining characteristics and limitations* to be used in ABC-categorization. These characteristics include defining the number of categories to be used in the future as well as choosing between single and multicriteria to be used when categorizing products. Second, ABC-categorization should include *Defining the approach how to calculate ABC-categories*, is it done with ranking method or classification method.

The second part is Safety stocks, which includes *Defining safety stock approach*, which is about how simple or varied the safety stock calculations are made. Accordingly, *Choosing between fixed and progressive safety stock* for different products is the next step. The last part is *Defining service level* regarding products from unreliable suppliers.

The third part of improvement efforts relate to Forecasting and includes *Updating lead times*, as in updating them according to factual lead time in product history and not just what is originally expected. Another part is *Defining service level* and restricting sudden inventory drainage to always keep some inventory for stocked products. The last part in forecasting is *Identifying the product life cycle*. It would help increasing stocks when a product is needed more and reduce stocks when a product is not sold anymore.

Next, this conceptual framework is applied for building the proposal in Section 5 in order to improve the weaknesses identified in CSA. The proposal building is discussed in Section 5.

5 Building Improvement Proposal for the Purchasing Process and Forecasting Practices for the Case Company

This section merges the results of the current state analysis and the conceptual framework towards the building of the proposal. The first sub-section contains the overview of the proposal building stage. The second sub-section reviews the findings of Data collection 2. The third sub-section presents the proposals for improvement of the Purchasing process and forecasting practices.

5.1 Overview of the Proposal Building Stage

The proposal building was conducted in several steps, starting with reviewing Data 1 field notes and results. Then, the applicable aspects from literature were reviewed and included into the proposal building. After that, the findings and ideas were discussed in a workshop with key stakeholders. At this stage, the stakeholders were involved in proposal building by providing suggestions for the proposal. These findings are discussed below in Section 5.2. At the end, the results of all of these steps were gathered and utilized as guidelines and help in order to build the proposal for improving the purchasing process in the case company.

The proposal building stage started by presenting the results of the CSA and the findings of the CF to the stakeholders in a workshop. People participating in the workshop included the Purchasing manager and ERP Project manager in addition to the researcher of this Thesis.

5.2 Findings of Data Collection 2

The findings of Data collection 2 directed the way to the proposal building. Data 2 includes suggestions and ideas from key stakeholders collected from discussions in a workshop regarding this stage. The suggestions and ideas are related to the three interrelated key issues (ABC-calculations, safety stocks and forecasting) found in the CSA stage which also made the major part of the conceptual framework. As the three key issues were fundamental parts of Sections 3 and 4, the same logic was carried out in Section 5, and the suggestions and ideas were separated and arranged accordingly. The findings from Data 2 made the basis of the initial proposal depicted next.

5.2.1 Improving ABC-Categorization

During the Data 2 stage, the workshop with key stakeholders was structured according to key issues found in current state analysis and researched in conceptual framework. The first issue was ABC-categorization. The findings regarding this issue are listed in Table 3 below and described in more detail after that.

Table 3. Key stakeholder suggestions for proposal building (Data 2) in relation to ABC-Categorization from the CSA (Data 1) and the key elements from CF.

	Key focus area from CS (from Data 1) and the element of CF	*Suggestions from stakeholders, categorized into groups (Data 2)*	*Description of the suggestion*
1	ABC-Categorization	a) Continue making calculations based on product history b) Implement Demand Planning tool c) External system producing data	The stakeholders suggested three different approaches in calculating product categories. Suggestions included making calculations based on product history, implementing new Demand Planning tool or using external system to produce the needed data for ERP to use.
2		More categories, defining parameters for categories and grouping similar products	Implementing more categories would give products more suitable groups. Defining new parameters for categories would help grouping similar products to the new categories. Parameter grouping needs testing.
3		Country and market-based product category calculations	The stakeholders suggested different product category calculations for different countries and for some different markets, e.g. laboratory products.

The first finding regarding the ABC-categorization was choosing the approach to calculating the data for categorization. The first approach would be making the calculations like before, based on product history with seasonal variations. The second approach would be implementing a so-called demand planning tool in the new ERP, which is another statistical technique. The challenge with implementing this tool is that it cannot be used as such, but in order to work, this tool would need similarly acting product groups

to be found in advance. The third approach would be producing calculation data externally and uploading it into ERP. All of these approaches need more research before choosing the most suitable approach for the company.

The second finding regarding the ABC-categorization was implementing more categories instead of the traditional three, A, B and C. As, at the moment, there are thousands of different products in the same categories, the rules of these categories do not work properly for all of them. Implementing more categories would help controlling and managing all of the products more efficiently as the rules of their categories would be more suitable for the products in each category. One of the key issues regarding this work is defining the parameters for each new category and finding similar products to these groups. Finding similar products is discussed more in-depth later. It is noteworthy that since the results in other findings and testing affect the category defining, the final number of categories cannot be conclusively determined yet.

The third finding regarding the ABC-categorization was implementing country and market-based ABC-calculations. As, at the moment, the ABC-categorization is calculated with average values of the whole warehouse serving four countries and through all products, many products fall to a lower category than what they are needed in their own main sales country or market. Making own calculations for products which are sold mainly to one country or to a certain market, matching the category to that specific country or market, would also upgrade the safety stocks and forecasting for these products, and simultaneously the service level and customer satisfaction. For a fully developed proposal, defining the products and markets for these calculations would need more research.

5.2.2 Improving Safety Stocks

The second issue revealed by the current state analysis and addressed in the conceptual framework was safety stocks. The findings from Data 2 regarding this issue are listed in Table 4 and described in more detail after that.

Table 4. Key stakeholder suggestions for proposal building (Data 2) in relation to Safety Stocks from the CSA (Data 1) and the key elements from CF.

	Key focus area from CS (from Data 1) and the element of CF	*Suggestions from stakeholders, categorized into groups (Data 2)*	*Description of the suggestion*
1	Safety Stocks	Using lead time factors, service levels and Min-Max levels	Based on stakeholders it is essential to define lead time factors and service levels for product categories. Some products could use min-max levels in order to reduce out-of-stock situations. Those levels also need to be defined.
2		Defining product groups to each safety stock approach	Gathering data from the report server to define product group safety stocks.
3		Defining limits for non-stock products and stocked products, forced minimum levels	Company needs to define values and limits for products to be placed as non-stock or stocked products. Some stocked products could need forced minimum levels.
4		Vendor tracking and accountability	In the future, after enough data gathered, vendors should be held accountable for severe delays in shipping.

The first finding regarding the safety stocks was about lead time factors and service levels of products. Currently lead time factors for categories A, B and C are 1, 0,5 and 0,2. These factors need to be redefined in any case, as currently some products are often left without safety stock value, but especially with implementing more categories overall to the new system, the factors would have to be redefined. For some products the safety stocks could be calculated regarding the desired service level. At the moment min-max levels are not in use in the main warehouse. They, however, could be useful for many products, especially some spare parts. For those products the planned purchase order would occur every time the stock level went below the predefined minimum stock level, and the planned purchase would always suggest the purchase quantity to be the exact amount to reach the predefined maximum stock level. This system would help preventing several out-of-stock situations for randomly sold products, like many spare parts which should always be available, but which would not get any safety stock values under current system. These min-max levels and the products to apply them to would also need to be defined before applying the system into use.

The second finding regarding the safety stocks was related to the first one. In order to group the products into these aforementioned safety stock approach groups, the parameters for these groups need to be defined. The actual safety stock levels for these groups also need to be defined, with helpful product data that can be obtained from the report server.

The third finding regarding the safety stocks was about the difference between stocked and non-stock products. Sometimes the sales quantities between stocked and non-stock products can be very similar, and it is not always obvious into which category the product should be put. The company should implement a project group to discuss about the issue and to define the parameters for the two categories to be implemented. The project group should include personnel from all departments that would be affected by the outcome in order to avoid conflicts and unpleasant surprises afterwards. Before the project group starts working, the product managers should define which products the company wants to keep as non-stock products regardless of the sales quantities as in what the company wants to offer to customers.

The fourth finding regarding safety stocks was vendor tracking and accountability. Some vendors are reliable, and shipments are received in promised lead time. But some vendors are not as reliable and that can cause problems to the case company. Out-of-stock situations increase when shipments are late, and customers get anxious waiting for products that should always be in stock, which causes the customer satisfaction to decrease. The safety stock levels in these situations are not high enough, which later could lead to ordering larger amounts from vendors in order to avoid out-of-stock situations, which then again causes overstocking. To increase efficiency of purchasing and reliability of safety stocks, the vendors could be held accountable for severe delays in shipping, especially when it has direct costs for the case company. In order for this kind of vendor accountability to be implemented, the vendor and shipping information should be tracked systematically for a long period of time to gain reliable data to show to the vendors in question and to help making such a deal with vendors.

5.2.3 Improving Forecasting

The third issue revealed by the current state analysis was forecasting. The findings from Data 2 regarding this issue are listed in Table 5 and described in more detail after that.

Table 5. Key stakeholder suggestions for proposal building (Data 2) in relation to Forecasting from the CSA (Data 1) and the key elements from CF.

	Key focus area from CS (from Data 1) and the element of CF	*Suggestions from stakeholders, categorized into groups (Data 2)*	*Description of the suggestion*
1	Forecasting	Usage of Seasonal Factors	The usage of seasonal factors depends on the outcome of the new ERP version. If the forecasting is calculated externally, seasonal factors can be implemented by forecasting row. If the statistical analyzing tool of ERP works, seasonal factors will not be needed.
2		Artificial forecasts and special marking for new products	Artificial forecasts for new products could be added if they can be reliably produced. These forecasts for replacing products could be easier to create. New products could be marked to make purchasers aware of their situation until the actual forecasting can be trusted.
3		Returning sales orders to another warehouse	The problem with retiring out-of-stock products getting sales order because of returning sales orders can be handled by returning them to another warehouse in the system.
4		Robot to clean transfer orders from retiring products	A robot could be implemented to remove transfer orders for retiring out-of-stock products and replace them with the replacing products.
5		Updating lead times	Lead times from suppliers should be tracked systematically by purchasers from reports.

The first finding regarding the forecasting was the usage of seasonal factors. The usage of seasonal factors in the new ERP is dependable on the final version of the new ERP. The seasonal factors could be calculated and implemented the same way as they are in the current system, but as has been discussed earlier in this thesis, it is not the best way to do it in the future. If the forecasting is calculated externally, seasonal factors can be implemented by forecasting row by product. If the statistical analyzing tool of the new ERP works, seasonal factors might not be even needed.

The second finding regarding the forecasting was artificial forecasts and special marking for new products. Artificial forecasts for new products could be added if they can be produced reliably enough. These forecasts could be easier to create for replacing products than to completely new products. If the old product has steady sales and it only

changed to a new model, for example, it is fair to assume that the new product will have similar sales and therefore similar forecasts for that new product can be implemented. For a completely new product defining forecast is significantly harder but should be possible to be done at some level by product managers, in order to help purchasers and to avoid out-of-stock situations right from the start. New products could also be marked to make purchasers aware of their situation until the actual forecasting can be trusted. After the product has gained enough transactions and historical data to provide reliable forecasts, the marking can be removed.

The third finding regarding the forecasting was about dealing with the returning sales orders. As found from the CSA, the returning sales orders from customers including retiring products have caused useless sales orders for products that are already retired and out-of-stock with replacing product being available, but in these cases not being indicated. This problem can be solved in the new ERP by returning the sales order to another warehouse in the ERP, even though physically it will return to the main warehouse. In order to avoid long waiting times for return orders to be closed, the products would be transferred back to the main warehouse in the ERP only after they have been physically received and stocked.

The fourth finding regarding the forecasting was implementing a robot to clean transfer orders from retiring products. Lack of indication of retired products on transfer orders is a problem in the current ERP. As the transfer order part of the new ERP will also be inflexible at some level and the indication might not be possible to implement, a robot to remove retiring out-of-stock products and replace them with replacing products afterwards is the next best and very much possible solution for this problem.

The fifth finding regarding the forecasting was updating lead times. Lead times from suppliers should be tracked systematically by purchasers from reports. Reports could be obtained from the report server, but the report server is unfamiliar for many users and needs more familiarizing and tutoring before it can be fully implemented. This issue is discussed in more detail in the next section.

5.2.4 Other Improvements

Several other ideas for improvement were given during the Data 2 workshop. The findings from Data 2 regarding these ideas are listed in Table 6 below and described in more detail after that.

Table 6. Key stakeholder suggestions for proposal building (Data 2) in relation to other issues from the CSA (Data 1), the key elements from CF and ideas in Data 2.

	Key focus area from CS (from Data 1)	*Suggestions from stakeholders, categorized into groups (Data 2)*	*Description of the suggestion*
1	Other Issues	Replenishing orders from service representatives' warehouses	Transfer orders from the main warehouse to service representatives' warehouses could be automated. This would need defining min-max levels for products in their warehouses. This would also create the purchasing needs for purchasing department instantly.
2		Develop and widen the usage of the report server	Using the information that can be gathered from the report server is essential for data reliability and development. The usage of this material should be tutored and supervised.
3		Implementing Job Queues	New ERP allows implementing job queues which could help purchasers to better keep track of the most urgent tasks.
4		Stocking the products which are left in the non-stock shelf location	For several reasons some non-stock-products are left in the non-stock shelf location for a long period of time. This creates problems in the warehouse, especially in order picking. These products could be stocked to individual shelf locations until they are sold.
5		Responsibility in product life cycles	The best way to organize product life cycle monitoring is to hire a new employee to be responsible of product life cycles, retiring products and choosing and updating between stocked or non-stock product.
6		Sales restrictions to decrease inventory drainage cases and sales orders shipped at the same order as they were made	Straight sales restrictions to avoid out-of-stock situations with huge single sales orders would be inefficient but avoiding these situations should come from guidelines to sales persons. In the new ERP the oldest sales orders are picked and shipped first to decrease waiting time in out-of-stock situations.

One of the other ideas and improvement suggestions was to implement automatic transfer orders from the main warehouse to the warehouses of service representatives. In order to implement this system, however, min-max levels for all products affected by this change in all of those warehouses should be defined beforehand. This system can be implemented later, after gathering enough information, and it would probably only include most sold products, at least in the beginning, but it would improve product transfers and make it more efficient. It would also indicate purchasing department swiftly as the need for possible purchase order would be provided instantly, shortening delivery time and decreasing out-of-stock situations.

Another idea was that the existing report server should be put into better and wider use than it currently is. Using the information that can be gathered from the report server is essential for data reliability and development. As the content and usability of the report server is unknown and unfamiliar for many possible users, the use of this material should be tutored and supervised.

The next idea was implementing job queues for purchasers in the new ERP. The new ERP allows implementing job queues which could help purchasers to better keep track of the most urgent tasks. These tasks could include urgent purchase orders, confirming unconfirmed purchase orders and checking back orders. The usability of this job queue tool remains uncertain until the new ERP is implemented and needs more information and research.

Yet another suggestion during Data 2 workshop was stocking the products which are left in the non-stock shelf location. For several reasons some non-stock-products are left in the non-stock shelf location for a long period of time. This creates problems in the warehouse, especially in order picking. Sometimes products are also lost and have to be ordered again from the vendor, which increases the waiting time for the customer unnecessarily. These products could be stocked to individual shelf locations until they are sold, and their shelf location could be changed back to the non-stock location after the stock balance has been returned to zero.

Additionally, it was suggested to assign a certain employee to be responsible for monitoring and adjusting product life cycle. This could be a new employee or an existing resource. The same employee could also be responsible for monitoring retiring products, assigning replacing products and stopping retiring products in purchasing and in sales

at the right time. The same employee could also monitor the sales quantities of seldom sold stocked products if they should be changed to non-stock products and vice versa. This employee would have a good overall picture of the product situation and it would give purchasers more resources for other important issues.

One more idea in Data 2 related to inventory drainage cases, when one customer purchases the whole inventory at once and leaves possible other customers waiting for a new delivery from vendor to arrive until their orders could be handled, which naturally leads to back orders. Sales quantity restrictions could be implemented but they would not serve their purpose so only solution for this is emphasizing instructions and guidelines to sales department, in order to dividing large sales orders in two or more batches to avoid inventory drainage and back orders. The new ERP also allows back orders to be delivered in the same order as the orders were made so all customers can be treated equally regarding back orders, comparing to the current situation where back orders were shipped almost randomly.

5.3 Proposal Draft

The proposal draft with improvement suggestions for the purchasing process and forecasting practices of the case company is depicted in Figure 12.

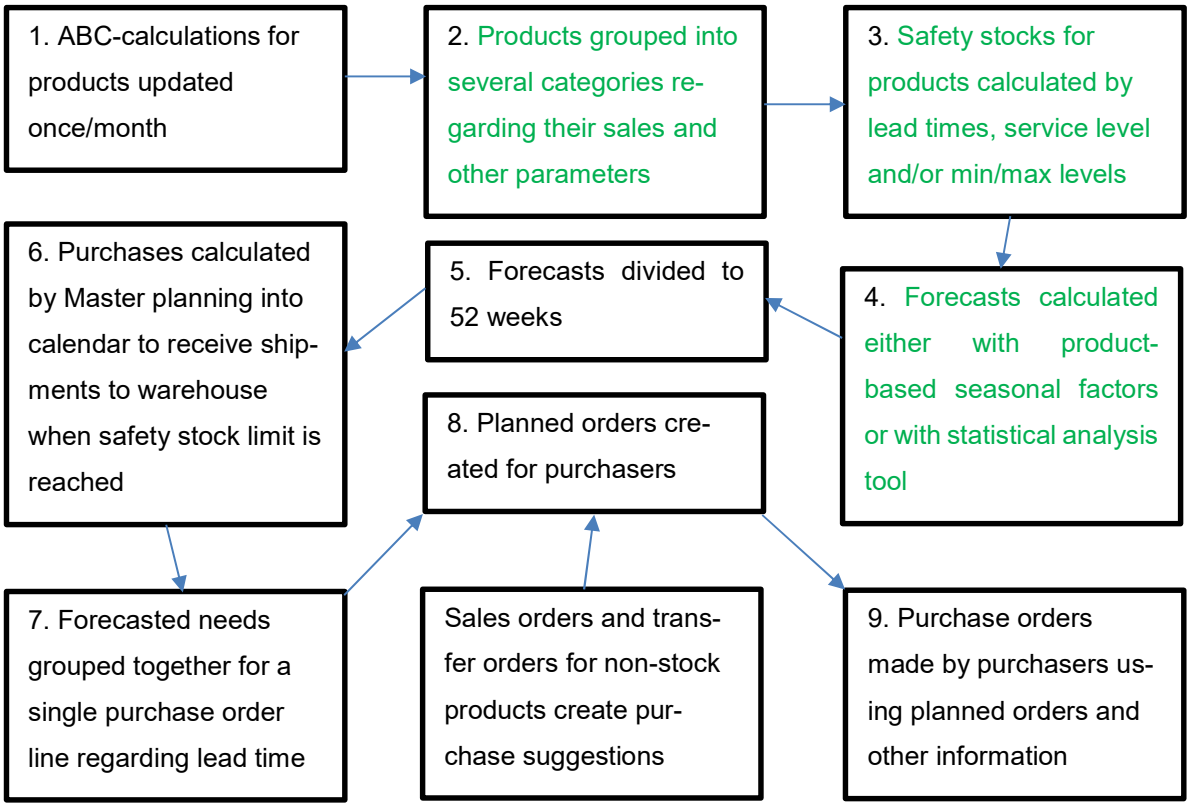

Figure 12. Proposal for the improved purchasing process in the case company.

As seen from the improved process map in Figure 12, there are three steps with key issues identified in the CSA stage (highlighted in Figure 12) and updated according to the improvement suggestions found in Data 2. A more in-depth view on the improvement suggestions is introduced next.

As mentioned earlier, the first step in the process to be improved was the ABC-categorization of products. A more detailed picture of this step is described in Figure 13.

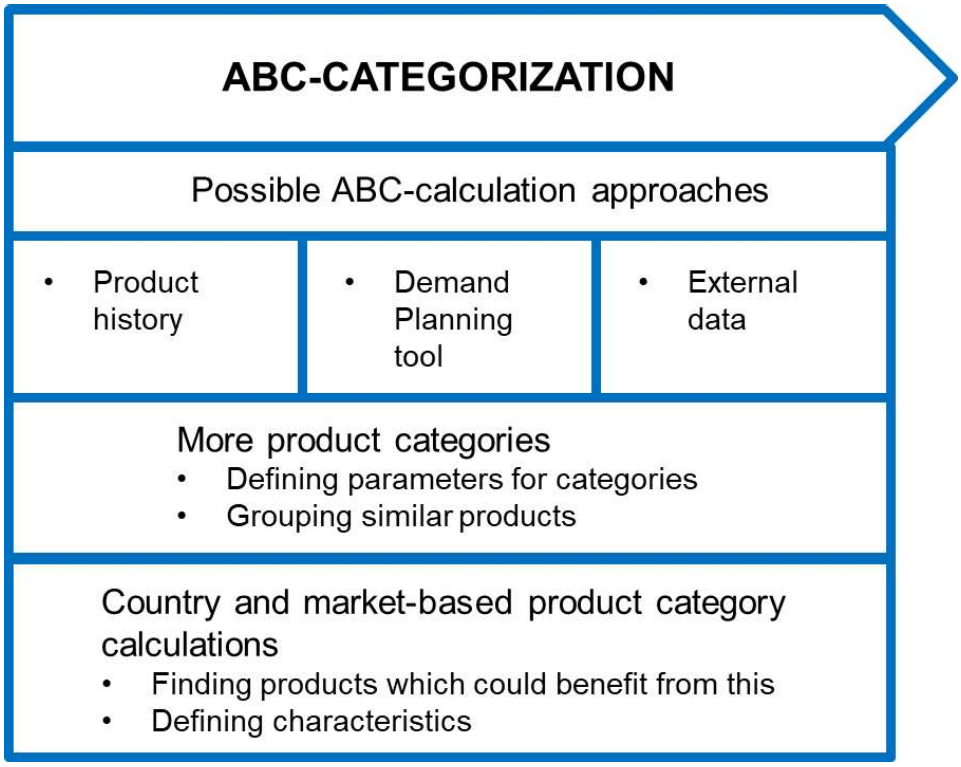

Figure 13. Proposal for improving product categorization.

The product categorization starts with choosing the calculation approach. As seen in Figure 13, there are different possible approaches for product category calculations. The first approach is to continue making calculations based on the product history. This would be the easiest approach, at least for the majority of products. Next approach would be done with a Demand Planning tool, but the specifics of this tool are uncertain at the moment. Another approach would be making calculations externally and uploading them into the ERP. The details, however, of this approach are unknown at the moment. The products need more categories and these new categories need parameters in order to group similar products into these categories. Additionally, the country and market-based category calculations could be added to improve the service level of products that are only sold to a single country or on single market.

Next step in the process map was related to safety stocks. This proposal also has several improvement suggestions. These improvements are described in Figure 14.

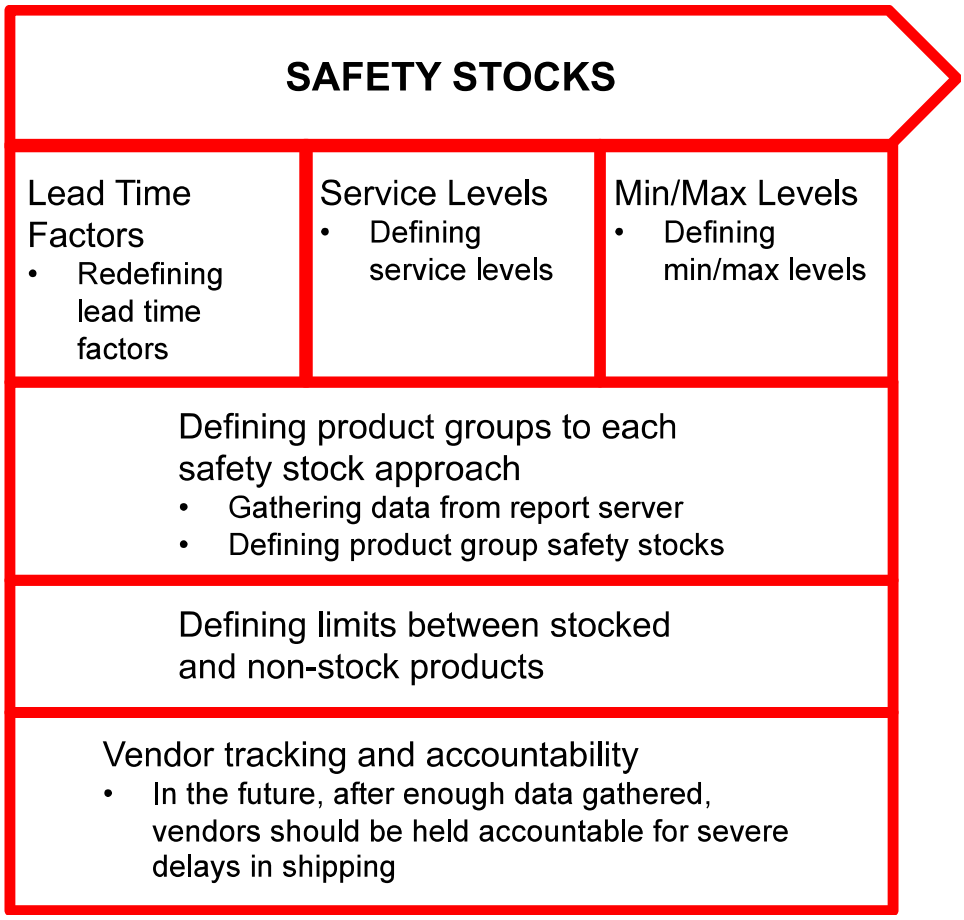

Figure 14. Proposal for improving safety stocks.

Safety stocks could be calculated in three different ways, as indicated in Figure 14. Safety stocks could be calculated by their lead time factors, as they are currently done. As the current safety stocks are not working properly, the lead time factors should be redefined. Increasing the product categories, as mentioned in Figure 13, already leads to redefining these factors, but they need updating in any case.

Another way for calculating safety stocks is to calculate them by service levels. As this would be a new approach for the case company, the service levels would need to be defined in advance. The third approach is implementing min/max levels for products, which could help keeping stock for less commonly sold products, but those min/max levels would need to be defined also. At the same time, the product groups should be found to be implemented into each safety stock approach. This would need gathering data from the report server.

Although the theoretical limits between the stocked and non-stock products exist, in reality, the difference between them is unclear. The case company should implement a

project group in order to define these limits in a way that is satisfactory for every department.

One more thing regarding safety stocks is vendor tracking and accountability. In the future, when enough data has been gathered, the vendors could be held accountable for severe delays regarding shipping.

The third step in the purchasing process was the forecasting improvement proposal, described in Figure 15.

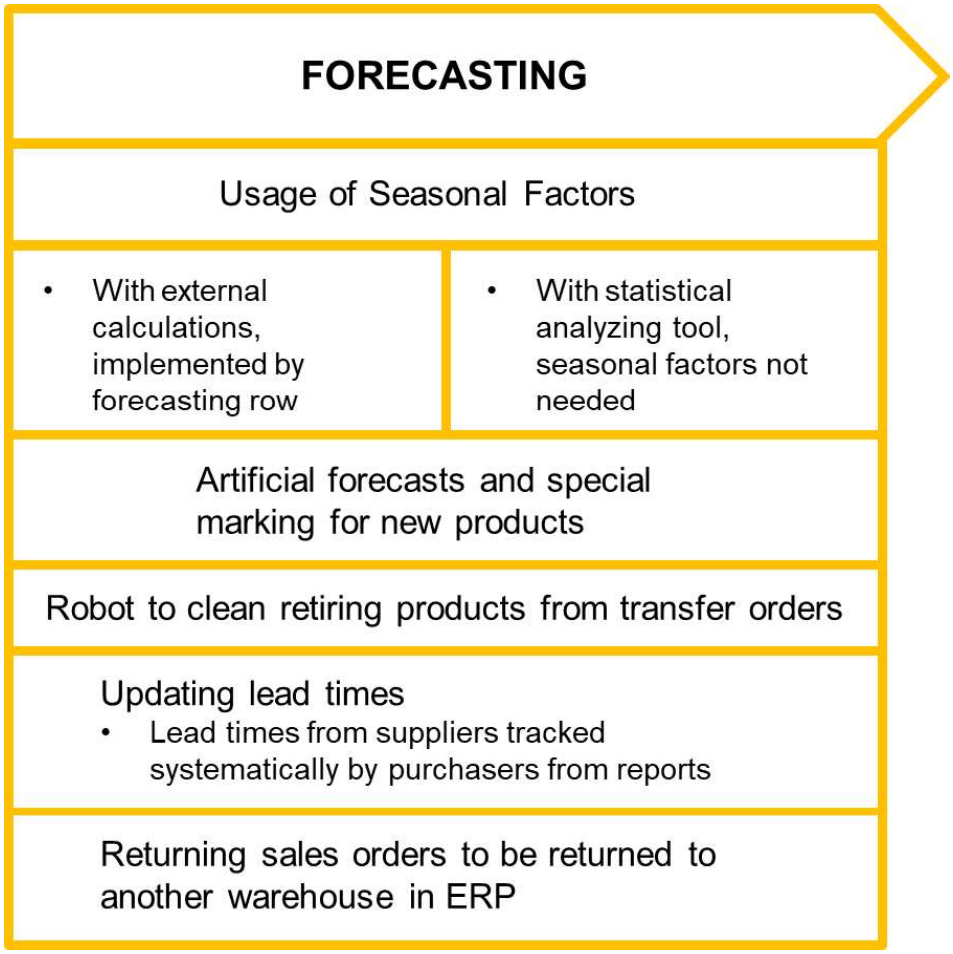

Figure 15. Proposal for improving forecasting.

As seen in Figure 15, one of the issues in forecasting is the usage of seasonal factors in the forecasting calculations. In the upcoming ERP, there would be two ways to approach seasonal factors. If the forecasting is calculated externally, the seasonal factors could be

implemented to products by forecasting row. If, on the other hand, a statistical analyzing tool is implemented in the new ERP, the seasonal factors would not be needed.

Another part of forecasting is the new products and artificial forecasts. When a new product is purely replacing the old product by changing model or only the vendor item number, and the expectation for sales quantities is to continue at the same level, the forecast for this new, replacing product could be copied from the old, retiring product. Other new products could get artificial forecasts also, if product managers could give definite enough expectations for forecasting. For other new products, a special marking would be used to indicate the need for special attention until the natural forecasting can be trusted. For the retiring products, a robot could be implemented to remove them from transfer orders and automatically replace them with new products.

The purchasers should track suppliers systematically from reports from the report server in order to keep track of the actual lead times. That way the lead times for suppliers could be updated more efficiently. The last part in improving forecasting is the returning sales orders that have been distracting the forecasting. In the new ERP, the returning sales orders would not be returning to the main warehouse but added to the inventory after they have been stocked and are again available for sales.

Several other improvement ideas, related to several areas in purchasing and forecasting, also came up during the Data 2 phase. These suggestions can be seen in Figure 16.

Replenishing orders from service representatives' warehouses • Transfer orders from the main warehouse automated • Defining min/max levels	Developing and widening the use of the report server • Usage of this material should be tutored and supervised	Implementing Job Queues
Stocking the products which are left in the non-stock shelf location • Shelf location returned to non-stock shelf when inventory empty	Product life cycle responsibility role • Assigning replacing products and stopping old products • Monitoring and changing products between stocked and non-stock	Sales restrictions in inventory drainage cases and sales order shipping • Instructions and guidelines to sales department • Back orders shipped at the same order as they were made

Figure 16. Proposal for other improvements.

One of the other ideas was to automate the transfer orders from the main warehouse to the warehouses of the service representatives. Although the responsibility of defining the products to include in this system, and the min/max levels for those products, lies within the service department of the case company, the implementation into the ERP falls to the people working with upgrading the new ERP. The automation and min/max levels would also speed up the information flow in the order pipe line, helping the purchasing process with quicker response to product needs.

The usage of the report server in the case company and at the purchasing department is varied and inconsistent. In order to do their work more efficiently and consistently, the purchasers need to be familiarized with the report server and how to use it to their advantage.

Another improvement suggestion was implementing job queues in the new ERP for purchasers. The reality of the possible job queue is still unknown, but it should help purchasers to better keep track of the urgent tasks in their work.

Also, one improvement suggestion in the warehouse would be stocking the products that have been in the non-stock shelf location for a longer period of time in order to help the workload in the warehouse. That would also help the work of purchasers when the order picking would take less time and the inventory errors could be reduced.

Additionally, since the product life cycle has not been monitored systematically enough in the case company, the role of product life cycle responsibility could be introduced. This role would assign replacing products for retiring products and stop the retired products in the ERP in purchasing and sales when the time is right. Monitoring the product life cycle would also include changing the products between stocked and non-stock product status regarding their sales and other information.

The last suggestion for improvements related to back orders. As straight sales restrictions on sales quantities would be inefficient, practically the only option to avoid inventory drainage cases would be setting instructions and guidelines to the sales department for those occasions. Also, in the new ERP the back orders would be shipped in the same order that they have been made, which would decrease the waiting time for some customers.

While the outcome of the final version of the new ERP remains unknown, it is extremely challenging to suggest exact improvements. Still, this information gives a good starting point for Data 3, validation of the improvement suggestion, which is reported in Section 6.

6 Validation of the Proposal

This section reports on the results of the validation stage and points to further developments to the initial Proposal, presented in Section 5. This section is structured with the same logic as Section 5. The first sub-section contains the overview of the proposal validation stage. The second sub-section reviews the findings of Data collection 3. At the end of this section, the final proposal and recommendations are presented.

6.1 Overview of the Validation Stage

This section reviews and reports the validation of the initial improvement proposal developed in Section 5. Validation was carried out by organizing a workshop (Data collection 3), to key stakeholders in order to receive evaluation and feedback of the initial improvement proposal. The key stakeholders participating the workshop were the same as in the earlier Data collection stages, including the Purchasing manager and the ERP project manager, as well as the researcher of this thesis.

The key issues found during the CSA stage, ABC-calculations, safety stocks and forecasting, made the focus areas of the CF and the initial proposal building. The validation phase was conducted in two steps. First, the initial improvement proposal, which was built based on the findings in Data collection 2, was presented to the stakeholders in a workshop. During the workshop the improvement suggestions for the purchasing process and forecasting practices were introduced and discussed. Field notes and recording of the workshop were also made.

Second, the feedback on the initial improvement proposal was analyzed. The final improvement proposal was built based on the analysis of the feedback. The findings of the Data collection 3 workshop are reported in Section 6.2 and the final improvement proposal is presented in Section 6.3.

6.2 Findings of Data Collection 3

The findings of Data collection 3 directed the way to creating the final improvement proposal. Data 3 includes feedback from key stakeholders collected from discussions in a workshop regarding this stage. Feedback and new suggestions are mostly related to the three interrelated key issues (ABC-calculations, safety stocks and forecasting) found in

the CSA stage which also made the major part of the conceptual framework and Data collection 2. As the three key issues were fundamental parts of Sections 3, 4 and 5, the same logic was carried out in Section 6, and the improvement suggestions were separated and arranged accordingly. The findings from Data 3 made the basis of the final improvement proposal.

6.2.1 Improving ABC-Categorization

As in Data 2 stage, during the Data 3 stage, the workshop with key stakeholders was structured according to key issues found in current state analysis. The first issue was ABC-categorization. The findings regarding this issue are listed in Table 7 below and described in more detail after that.

Table 7. Key stakeholder feedback and new suggestions for final improvement proposal (Data 3) in relation to initial improvement suggestions on ABC-Categorization from the Data collection 2 stage.

	Key focus area from CS (from Data 1) and the element of CF	*Suggestions from stakeholders, categorized into groups (Data 3)*	*Description of the suggestion*
1	ABC-Categorization	a) Continue making calculations based on product history b) External system producing data	As a correction to the previous stage, there were two different approaches in calculating product categories. Suggestions included making calculations based on product history or using external system to produce the needed data for the ERP to use.
2		More categories, defining parameters for categories and grouping similar products	Defining new parameters for categories would help grouping similar products to the new categories. Data can be gathered from product history. Parameter grouping needs testing. The most urgent task of the improvement suggestions.
3		Country and market-based product category calculations	The stakeholders suggested country and market-based calculations for some products sold in different markets, category and calculation combinations need testing.

The first finding regarding the ABC-categorization was choosing the approach to calculating the data for categorization. During the Data 2 happened a misunderstanding and there are actually two possible approaches for ABC-calculations. The first approach

would be making the calculations like before, based on product history with seasonal variations. The second approach would be producing calculation data externally and uploading it into ERP. In any case, the company will implement relativity to the calculations. As the sales have been growing steadily, the percentage limits in the calculations should allow the system to choose the right category for each product more easily, comparing to fixed numbers of sales orders. The calculations in themselves in the ERP are already set and defined, including several possible options for categories.

The second finding regarding the ABC-categorization was implementing more categories instead of the traditional three, A, B and C. The suggestion for new categorization is to first implement six basic categories, ABCDEF. As defining the definitive parameters for each of these categories is challenging, the system needs to be tested heavily with the whole product range in order to find the products that cannot be operated accurately and efficiently enough within these basic categories. Organizing these products into groups will help creating special categories on top of the basic categories. This leads to the third finding, implementing different calculations to products that are concentrated in one country or market, like some laboratory products. Finding the right combinations of categories and calculations within these special groups requires testing also.

6.2.2 Improving Safety Stocks

The second issue focused on at the Data collection 2 stage was safety stocks. The findings from Data collection 3 regarding this issue are listed in Table 8 below and described in more detail after that.

Table 8. Key stakeholder feedback and new suggestions for final improvement proposal (Data 3) in relation to initial improvement suggestions on Safety Stocks from the Data collection 2 stage.

	Key focus area from CS (from Data 1) and the element of CF	*Suggestions from stakeholders, categorized into groups (Data 3)*	*Description of the suggestion*
1	Safety Stocks	Using lead time factors, service levels and Min-Max levels, forced minimum levels	The lead time factors need to be redefined, even though they would be adjusted regarding the ABC-categorization change. Service levels need to be tested and documented. The usage of min-max levels is not recommended in most cases. Some stocked products could need forced minimum levels.

2		Defining product groups to each safety stock approach	Gathering data from the report server to define product group safety stocks. Finding the most suitable parameters. Finding balance between the quantity of different safety stock groups and journals needed to update them in the ERP.
3		Defining limits for non-stock products and stocked products	Company needs to define values and limits for products to be placed as non-stock or stocked products. Assigning a project group to define limits.
4		Vendor tracking and accountability	In the future, after enough data gathered, vendors should be held accountable for severe delays in shipping

The first finding regarding the safety stocks was about lead time factors and service levels of products. Currently lead time factors for categories A, B and C are 1, 0,5 and 0,2. These factors need to be redefined in any case, as currently some products are often left without safety stock value, but especially with implementing more categories overall to the new system, the factors would have to be redefined. Using the lead time factors for the products would be the easiest way of calculating the safety stocks, and it could be used for the majority of products. Using the lead time factor also requires the lead times to be correct and up to date. This issue will be discussed more in the next section. For some products, however, the safety stocks could be calculated regarding the desired service level. The categorizing of products between these two approaches, as well as defining the service levels, needs testing before implementing.

At the moment min-max levels are not in use in the main warehouse. As it turns out, regarding the stakeholders, this approach should not be encouraged. Although it has some benefits regarding the minimum stock level, the problem arises with the predefined maximum stock level. As using min/max levels, the system would always fill the stock from the current level (below the minimum level) to the maximum level, the planned purchase quantities might get arbitrary, and as the min/max levels would be updated and managed manually, it would increase the workload in the company to keep them up to date. And while it is not a completely ruled out option, the better approach to avoid zero level safety stocks would be forced minimum levels. This would allow the products to stay in normal safety stock calculations, by lead time or service level, based on their sales. This would also allow the purchasers to adjust the purchase quantities more freely and improve the forecasting for these products. After the calculations, the products that

would not get a safety stock regarding these calculations could be listed and forced minimum levels could be added to their safety stocks.

The second finding regarding the safety stocks was related to the first one. In order to group the products into these aforementioned safety stock approach groups, the parameters for these groups need to be defined. The actual safety stock levels for these groups also need to be defined, with helpful product data that can be obtained from the report server. Finding the balance between the number of safety stock groups and journals in the system is also important, as more safety stock groups would make purchasing more accurate but every journal regarding them increases the workload. In the future, after carefully defining the parameters for all safety stock groups, a robot could be implemented to manage the products into all different safety stock groups, updating the grouping continuously.

The third finding regarding the safety stocks was about the difference between stocked and non-stock products. Sometimes the sales quantities between stocked and non-stock products can be very similar, and it is not always obvious into which category the product should be put. Although a limit value of sales order numbers per year between these products has existed in the company, in reality it has become obscure, and does not always reflect the actual needs. The company should implement a project group to discuss about the issue and to define the parameters for the two categories to be implemented. The project group should include personnel from all departments that would be affected by the outcome in order to avoid conflicts and unpleasant surprises afterwards. Before the project group starts working, the product managers should define which products the company wants to keep as non-stock products regardless of the sales quantities as in what the company wants to offer to customers. Managing and updating the status of a product regarding the stocking should be designated to a certain role in the company. This will be discussed more in Section 6.2.4.

The fourth finding regarding safety stocks was vendor tracking and accountability. Some vendors are reliable, and shipments are received in promised lead time. But some vendors are not as reliable and that can cause problems to the case company. Out-of-stock situations increase when shipments are late, and customers get anxious waiting for products that should always be in stock, which causes the customer satisfaction to decrease. The safety stock levels in these situations are not high enough, which later could lead to ordering larger amounts from vendors in order to avoid out-of-stock situations, which

then again causes overstocking. To increase efficiency of purchasing and reliability of safety stocks, the vendors could be held accountable for severe delays in shipping, especially when it has direct costs for the case company. In order for this kind of vendor accountability to be implemented, the vendor and shipping information should be tracked systematically for a long period of time to gain reliable data to show to the vendors in question and to help making such a deal with vendors. In the ERP the information of the date of arrival of the shipment should also be made more visible and separated from the date of the shipping being handled and stocked. This information can be obtained from the report server.

6.2.3 Improving Forecasting

The third issue focused on at the Data collection 2 was forecasting. The findings from Data collection 3 regarding this issue are listed in Table 9 below and described in more detail after that.

Table 9. Key stakeholder feedback and new suggestions for final improvement proposal (Data 3) in relation to initial improvement suggestions on Forecasting from the Data collection 2 stage.

	Key focus area from CS (from Data 1) and the element of CF	*Suggestions from stakeholders, categorized into groups (Data 3)*	*Description of the suggestion*
1	Forecasting	Usage of Seasonal Factors	The usage of seasonal factors depends on the outcome of the new ERP version. If the forecasting is calculated externally, seasonal factors can be implemented by forecasting row. If the statistical analyzing tool (Demand Planner) of the ERP works, seasonal factors will not be needed.
2		Artificial forecasts and special marking for new products	Artificial forecasts for new products could be added if they can be produced reliably enough. Forecasts for replacing products could be copied from retiring products. New products could be marked to make purchasers aware of their situation until the actual forecasting can be trusted.
3		Returning sales orders without interfering forecasts	The problem with retiring out-of-stock products getting sales order because of returning sales orders can be handled by changing the return order process. In the new ERP the returning products would not be visible or affect inventories and forecasts until they have

			been stocked and are actually available for sales.
4		Robot to remove retiring products from transfer orders Replenishing orders from service representatives' warehouses	A robot could be implemented to remove retiring out-of-stock products from transfer orders and replace them with the replacing products. Transfer orders from the main warehouse to service representatives' warehouses could be automated. This would need defining min-max levels for products in their warehouses. This would also create the purchasing needs for purchasing department instantly.
5		Updating lead times	Lead times from suppliers should be tracked systematically by purchasers from reports.

The first finding regarding the forecasting was the usage of seasonal factors. The usage of seasonal factors in the new ERP is dependable on the final version of the new ERP. The seasonal factors could be calculated and implemented the same way as they are in the current system, but as has been discussed earlier in this thesis, it is not the best way to do it in the future. If the forecasting is calculated externally, seasonal factors can be implemented to the system by forecasting row by product. If the statistical analyzing tool, Demand Planner, of the new ERP works, seasonal factors might not be even needed. Additionally, some vendors require minimum volume in purchasing every month through the year, which contradicts the seasonal factors, so with these vendors the seasonal factors could be removed completely to make the forecasting and purchasing for them steady all year round. Nonetheless, these issues will be revisited in the future when there is more information available.

The second finding regarding the forecasting was artificial forecasts and special marking for new products. Artificial forecasts for new products could be added if they can be produced reliably enough. These forecasts could be easier to create for replacing products than to completely new products. If the old product has steady sales and it only changed to a new model or just a product number, for example, it is fair to assume that the new product will have similar sales, and therefore similar forecasts for that new product can be implemented. The forecast from the old product can be copied to the new replacing product by replacing the product number to the forecasting row of the old product.

For a completely new product defining forecast is significantly harder but should be possible to be done at some level by product managers, in order to help purchasers and to avoid out-of-stock situations right from the start. As the product managers mark the first order quantity for a product when creating them, it would be natural to assume that they could also give an estimate for the future sales and forecasting at the same time. In the new ERP the new products could also be marked to make purchasers aware of their situation until the actual forecasting can be trusted. After the product has gained enough transactions and historical data to provide reliable forecasts, the marking can be removed. Also, in the product categorization, another category could be implemented for new products with the new product marking to help their forecasting by separating them from other products.

The third finding regarding the forecasting was about dealing with the returning sales orders. As found from the CSA, the returning sales orders from customers including retiring products have caused useless sales orders for products that are already retired and out-of-stock with replacing product being available, but in these cases not being indicated. This problem can be solved in the new ERP by changing the return order process. In the new ERP the returning products would not be visible or affect inventories and forecasts until they have been stocked in the main warehouse and are actually available for sales.

The fourth finding regarding the forecasting was implementing a robot to remove retiring products, that are already out-of-stock, from transfer orders. Lack of indication of retired products on transfer orders is a problem in the current ERP. As the transfer order part of the new ERP will also be inflexible at some level and the indication might not be possible to implement, a robot to remove retiring out-of-stock products and replace them with replacing products afterwards is the next best and very much possible solution for this problem.

As the transfer orders are mostly made from the main warehouse to the service representatives, the next improvement suggestion is also related to them. These transfer orders could be automated to make product transfers more efficient. It would also indicate the purchasing department swiftly as the need for possible purchase order would be provided instantly, shortening delivery time and decreasing out-of-stock situations. The technical changes can be made in the ERP later, but the min-max levels for all products

affected by this change in all of those warehouses should be defined beforehand, and this information should be defined by the Service department.

The fifth finding regarding the forecasting was updating lead times. Lead times from suppliers should be tracked systematically by purchasers from reports. As a task it is clear, but the process needs developing. Reports could be obtained from the report server, but the report server is unfamiliar for many users and needs more familiarizing and tutoring before it can be fully implemented. This issue is discussed in more detail in the next section. Monitoring two lead times, from vendor to the warehouse, and from vendor to stock, would also allow the company to measure internal efficiency.

6.2.4 Other Improvements

Several other ideas for improvement were given during the Data 2 workshop and revisited during the Data 3 workshop. The findings from Data 3 regarding these ideas are listed in Table 10 below and described in more detail after that.

Table 10. Key stakeholder feedback and new suggestions for final improvement proposal (Data 3) in relation to other issues from the Data collection 2 stage.

	Key focus area from CS (from Data 1)	*Suggestions from stakeholders, categorized into groups (Data 3)*	*Description of the suggestion*
1	Other Issues	Develop and widen the usage of the report server	Using the information that can be gathered from the report server is essential for data reliability and process development. The usage of this material should be tutored and supervised. Requires defining needs and ensuring accessibility.
2		Implementing Job Queues	New ERP allows implementing job queues which could help purchasers to better keep track of the most urgent tasks.
3		Responsibility in product life cycles	The best way to organize product life cycle monitoring is to assign a responsibility role, which would be responsible of product life cycles, retiring products and choosing and updating between stocked or non-stock product.
4		Stocking the products which are left in the	For several reasons some non-stock-products are left in the non-stock shelf location for a long period of time. This creates problems in the warehouse, especially in order

		non-stock shelf location	picking. These products could be stocked to individual shelf locations until they are sold.
5		Creating a clear chart sheet for product categorization, safety stocks and forecasting, another chart for purchasing process measurements	A clear chart sheet for product categorization, safety stocks and forecasting would help recognizing the right categories and parameters for the new products. Purchasers could also use a chart for vendor measurements, KPI's and other indicators.
6		Sales and Operations Planning	It would be useful to implement Sales and Operations Planning entity, as a discussion forum between sales, purchasing, product management and warehouse. This could, among other aspects, help reduce communication gaps between departments.
7		Sales restrictions to decrease inventory drainage cases and sales orders shipped at the same order as they were made	Straight sales restrictions to avoid out-of-stock situations with huge single sales orders would be inefficient but avoiding these situations should come from guidelines to sales persons. In the new ERP the oldest sales orders are picked and shipped first to decrease waiting time in out-of-stock situations.

One of the other ideas and improvement suggestions was that the existing report server should be put into better and wider use than it currently is. Using the information that can be gathered from the report server is essential for data reliability and development. There are also several tools available to use in managing the data. As the content and usability of the report server is unknown and unfamiliar for many possible users, the use of this material should be tutored and supervised. Defining needs and ensuring accessibility is the first step in this process.

The next idea was implementing job queues for purchasers in the new ERP. The new ERP allows implementing job queues which could help purchasers to better keep track of the most urgent tasks. These tasks could include making urgent purchase orders, confirming unconfirmed purchase orders, checking back orders, tracking lead times and updating delivery dates. The usability of this job queue tool remains uncertain until the new ERP is implemented and needs more information and research.

Another idea was to assign a responsibility role to be responsible for monitoring and adjusting product life cycle. This could be a new employee or an existing resource. The same employee could also be responsible for monitoring retiring products, assigning replacing products and stopping retiring products in purchasing and in sales at the right time. The same employee could also monitor the sales quantities of seldom sold stocked products if they should be changed to non-stock products and vice versa. This employee would have a good overall picture of the product situation and it would give purchasers more resources for other important issues.

Yet another suggestion during Data 2 workshop was stocking the products which are left in the non-stock shelf location. For several reasons some non-stock-products are left in the non-stock shelf location for a long period of time. This creates problems in the warehouse, especially in order picking. Sometimes products are also lost and have to be ordered again from the vendor, which increases the waiting time for the customer unnecessarily. These products could be stocked to individual shelf locations until they are sold, and their shelf location could be changed back to the non-stock location after the stock balance has been returned to zero.

Some completely new ideas were also created during the Data collection 3 workshop. One of these ideas was to create a clear chart sheet for product categorization, safety stocks and forecasting, including the defined limits between different categories and parameters for non-stock products. This would help product managers and purchasers, among others, to define into which categories new, and current, products should be placed. It could also include more specific information about managing the forecasts and product classifications. Another chart could be made for purchasers for vendor measurements, KPI's and other indicators.

Another new idea was to implement Sales and Operations Planning entity, as a discussion forum between sales, purchasing, product management and warehouse. This could, among other aspects, help reduce communication gaps between departments. This should lead the departments to work in the same direction which would make the whole company more efficient and could reduce costs and increase customer satisfaction.

One idea in Data 2 related to inventory drainage cases, when one customer purchases the whole inventory at once and leaves possible other customers waiting for a new delivery from vendor to arrive until their orders could be handled, which naturally leads to

back orders. Sales quantity restrictions could be implemented but they would not serve their purpose so only solution for this is emphasizing instructions and guidelines to sales department, in order to dividing large sales orders in two or more batches to avoid inventory drainage and back orders. The new ERP also allows back orders to be delivered in the same order as the orders were made so all customers can be treated equally regarding back orders, comparing to the current situation where back orders were shipped almost randomly. This issue did not receive any updates in Data 3 and will be set aside as a minor issue regarding this thesis.

6.3 Final Proposal

Based on the improvement suggestions and other findings during Data 3 stage, the final proposal for developing the purchasing process and forecasting practices has been made. The first step of the final proposal consists of product categorization, but in order to keep the content of this thesis consistent, it is referred to as ABC-categorization in the figures, regardless of the number of categories. A more detailed picture of this step is described in Figure 17.

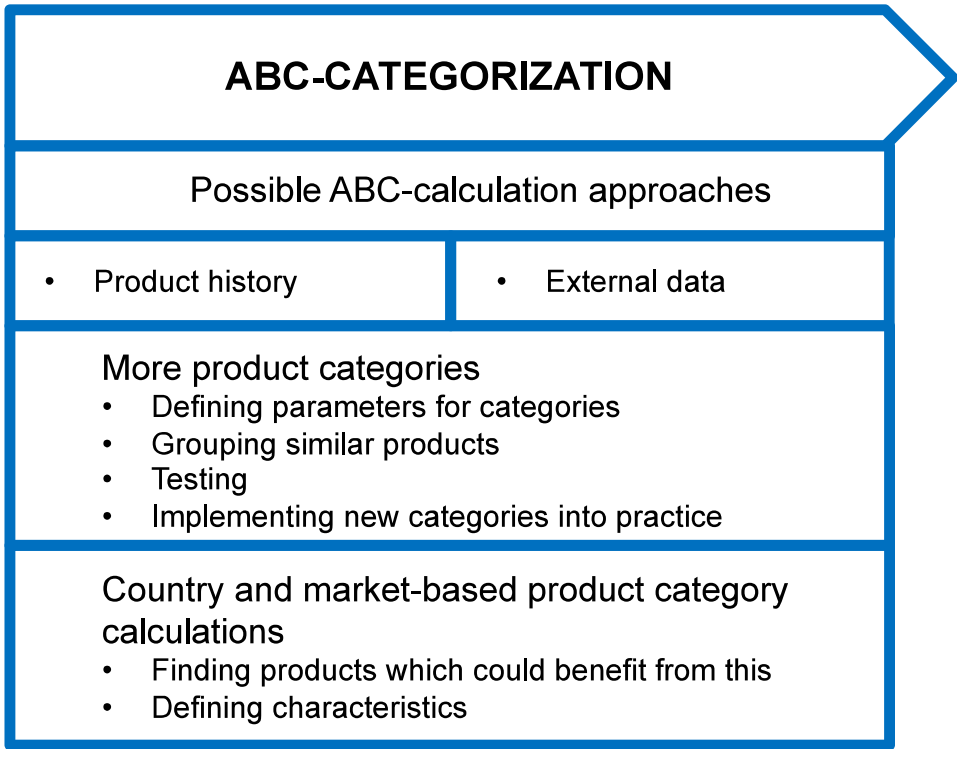

Figure 17. Final proposal for improving product categorization.

The product categorization starts with choosing the calculation approach. As seen in Figure 17, there are two different possible approaches for product category calculations. The first approach is to continue making calculations based on the product history. This would be the easiest approach, at least for the majority of products. Another approach would be making calculations externally and uploading them into the ERP. The details, however, of this approach are unknown at the moment. The products need more categories and these new categories need parameters in order to group similar products into these categories. The final proposal is to implement six basic categories with several additional categories, based on the need that will be revealed by intensive testing. Additionally, the country and market-based category calculations could be added to improve the service level of products that are only sold to a single country or on single market.

Next step of the final proposal consists of safety stocks. There are several improvement suggestions in this final proposal. A more detailed picture of this step is described in Figure 18.

Figure 18. Final proposal for improving safety stocks.

Safety stocks could be calculated in three different ways, as indicated in Figure 18. Safety stocks could be calculated by their lead time factors, as they are currently done. As the current safety stocks are not working properly, the lead time factors should be redefined. Increasing the product categories, as mentioned in Figure 17, already leads to redefining these factors, but they need updating in any case.

Another way for calculating safety stocks is to calculate them by service levels. As this is a new approach for the case company, the service levels need to be defined and tested in advance. The third approach is implementing forced minimum levels for products, which would not get safety stock with the other two approaches. After the calculations, the products that would not get a safety stock regarding these calculations, could be listed and forced minimum levels could be added to their safety stocks. Finding these products in advance, by gathering data from the report server, would help the process.

Although the theoretical limits between the stocked and non-stock products exist, in reality the difference between them is unclear. The case company should implement a project group in order to define these limits in a way that is satisfactory for every department. The project group should include personnel from all departments in order to avoid unpleasant surprises later on.

One more thing regarding safety stocks is vendor tracking and accountability. To increase efficiency of purchasing and reliability of safety stocks, the vendors could be held accountable for severe delays in shipping, especially when it has direct costs for the case company. In the future, when enough data has been gathered, this information could be transferred into useful leverage when negotiating with vendors.

The third step in the final proposal consists of forecasting. A more detailed picture of this step is described in Figure 19.

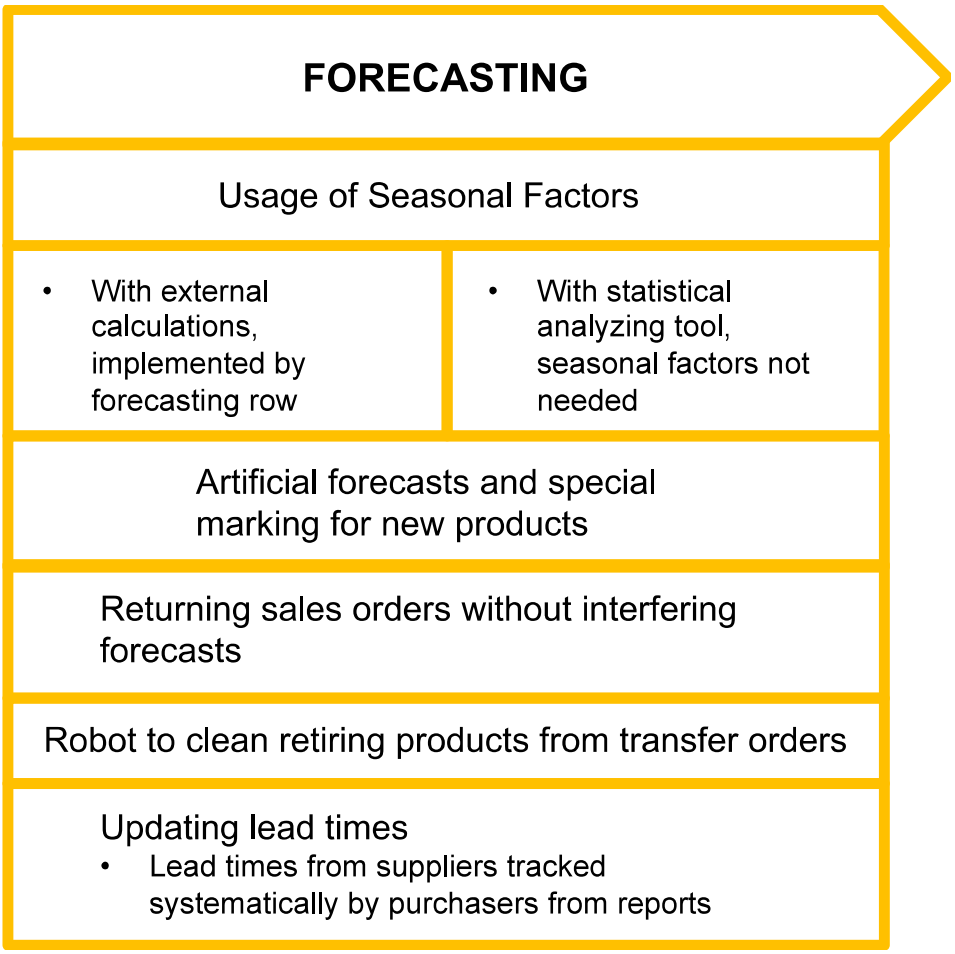

Figure 19. Final proposal for improving forecasting.

As seen in Figure 19, one of the issues in forecasting is the usage of seasonal factors in the forecasting calculations. In the upcoming ERP, there would be two ways to approach seasonal factors. If the forecasting is calculated externally, the seasonal factors could be implemented to products by forecasting row. If, on the other hand, a statistical analyzing tool, Demand Planner, is implemented and works in the new ERP, the seasonal factors would not be needed, but the final results on this issue will be defined later during the implementation process of the new ERP.

Another part of forecasting is the new products and artificial forecasts. When a new product is purely replacing the old product by changing model or only the vendor item number, and the expectation for sales quantities is to continue at the same level, the forecast for this new, replacing product could be copied from the old, retiring product. This could be done by replacing the product number to the forecasting row of the old product. For other new products, as the product managers mark the first order quantity for a product when

creating them, they could also give an estimate for the future sales and forecasting at the same time. For other new products, a special marking would be used to indicate the need for special attention until the natural forecasting can be trusted.

In the new ERP, the problem with the returning sales orders can be solved by changing the return order process. In the new ERP the returning products would not be visible or affect inventories and forecasts until they have been stocked in the main warehouse and are actually available for sales.

For the retiring products, a robot could be implemented to remove them from transfer orders and automatically replace them with new products. Transfer orders from the main warehouse to the warehouses of the service representatives could be automated to make product transfers more efficient and reduce purchasing time. The min-max levels for all products affected by this change in all of those warehouses should be defined by the Service department.

The purchasers should track suppliers systematically from reports from the report server in order to keep track of the actual lead times. That way the lead times for suppliers could be updated more efficiently. Efficient use of the report server for this purpose requires guidance for the purchasers.

Several other improvement ideas, related to several areas in purchasing and forecasting, also came up during the Data 2 and Data 3 phases. Updated improvements can be seen in Figure 20.

Developing and widening the usage of the report server • Usage of this material should be tutored and supervised	Implementing Job Queues • Keep track of urgent purchase orders, unconfirmed orders, back orders, lead times and delivery dates	Product life cycle responsibility role • Assigning replacing products and stopping old products • Monitoring and changing products between stocked and non-stock
Stocking the products which are left in the non-stock shelf location • Shelf location returned to non-stock shelf when inventory empty	Creating a clear chart sheet for product categorization, safety stocks and forecasting • another chart for purchasing indicators	Implementation of Sales and Operations Planning • A discussion forum between sales, purchasing, product management and warehouse

Figure 20. Final proposal for other improvements.

One of the other improvements in Figure 20 is that the existing report server should be put into better and wider use than it currently is. As the content and usability of the report server is unknown and unfamiliar for many possible users, the use of this material should be tutored and supervised. Defining needs and ensuring accessibility is the first step in this process.

The next improvement is implementing job queues for purchasers in the new ERP. The new ERP allows implementing job queues which could help purchasers to better keep track of the most urgent tasks. Despite the currently uncertain content of this tool in the new ERP, the probability of this working as suspected is high, so all the work regarding this should be aimed to that end. However, the usability of this tool needs more information and research.

Another improvement is to assign a responsibility role to be responsible for monitoring and adjusting product life cycle. This role would assign replacing products for retiring products and stop the retired products in the ERP in purchasing and sales when the time is right. Monitoring the product life cycle would also include changing the products between stocked and non-stock product status regarding their sales and other information.

Yet another suggestion is stocking the products which are left in the non-stock shelf location. These products could be stocked to individual shelf locations until they are sold, and their shelf location could be changed back to the non-stock location after the stock

balance has been returned to zero. That would also help the work of purchasers when the order picking would take less time and the inventory errors could be reduced.

One of the new ideas was to create a clear chart sheet for product categorization, safety stocks and forecasting, including the defined limits between different categories and parameters for non-stock products. This would help to define into which categories products should be placed. It could also include more specific information about managing the forecasts and product classifications. Another chart could be made for purchasers for vendor measurements, KPI's and other indicators.

Another new idea was to implement Sales and Operations Planning entity, as a discussion forum between sales, purchasing, product management and warehouse. This could help reduce communication gaps between departments. This should lead the departments to work in the same direction which would make the whole company more efficient and could reduce costs and increase customer satisfaction.

To summarize Section 6, the final improvement proposal was constructed after validation and is described in Figure 21.

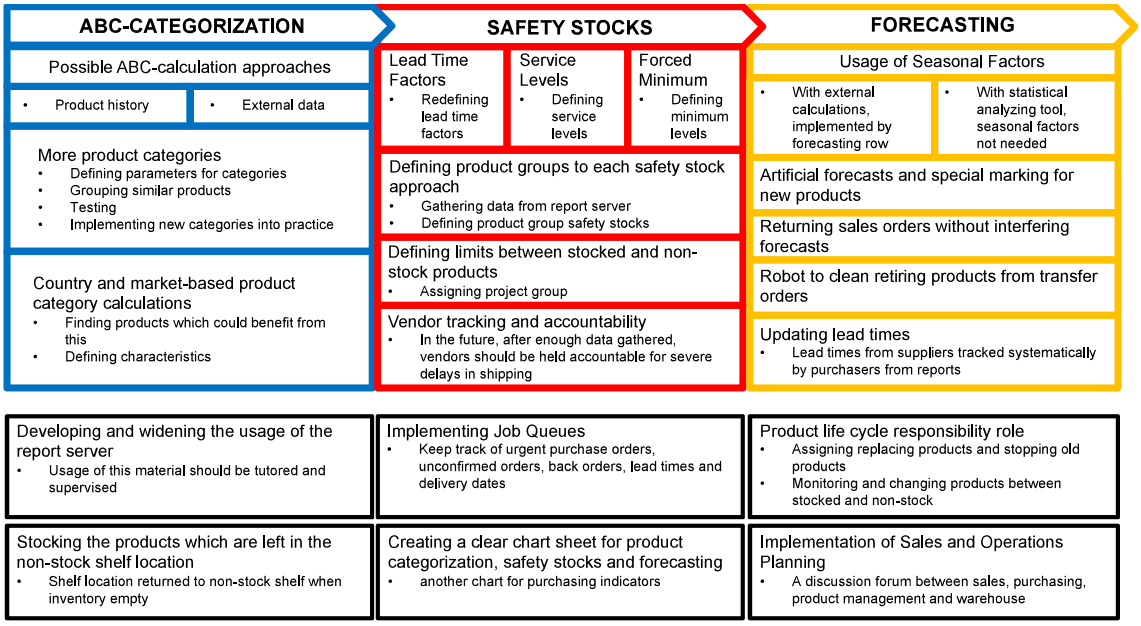

Figure 21. Summary of the final improvement proposal.

As seen in Figure 21, the final proposal consisted of four elements. Three of them were more directly connected to certain steps in the purchasing process and the fourth element included other improvements regarding purchasing process, forecasting practices and overall efficiency of the company.

Regarding the purchasing process, the proposal includes various improvements, e.g. increasing the number of product categories, defining product groups for different safety stock approaches, and creating artificial forecasts for new products. Additionally, the proposal also includes other improvements to help increase efficiency and reliability of the company operations.

The findings of Data 2 were validated in Data 3 workshop and the results were presented in Section 6 as the final improvement proposal for development of purchasing process and forecasting practices of the case company. The conclusions of the thesis will be presented in Section 7.

7 Conclusions

This section gives a summary of the findings and results of this thesis. It also includes suggestions for the case company how to proceed regarding these results. That is followed by thesis evaluation and closing words.

7.1 Executive Summary

This thesis explored purchasing process and forecasting practices in the context of retail business. In certain retail business, customers can be cities, private customers and company chains. Many common products are sold in big quantities and often evenly throughout the year. It means that sales can be forecasted quite reliably. However, with more uncommon products, and especially with spare parts, the demand varies quite strongly, and this causes significant problems when making forecasts. The case company is the leading supplier in its field in Finland. The case company provides the latest technology equipment and software, daily supplies and comprehensive support services for professionals. The case company in Finland also serves sister companies in Estonia, Sweden and Norway. This puts a great deal of pressure to the purchasing department regarding the purchasing process and forecasting.

The business challenge in the case company is that the increasing product range, sales volume and varying needs, especially for the spare parts, too often cause out-of-stock situations, but also overstocking. This increases pressure for the whole purchasing department, but especially regarding the spare part purchasing. The company is also in the process of upgrading the ERP system to a newer version in 2019. This brings the company both challenges and possibilities as the new system allows the purchasing department to implement more and better features in the new system. Key development areas are increasing the quality and accuracy of the purchasing forecasts and decrease out-of-stock situations and overstocking in order to reduce costs and increase customer satisfaction. This also includes changing the product classification system to allow more variation within the product range regarding their purchase forecasts. The objective of this thesis is to develop the purchasing process and forecasting practices in order to increase their quality and accuracy.

The research approach chosen for this thesis was design research, which is not its own research methodology but a method of approach which uses both qualitative and quantitative research methods. The research was executed in four parts, including three data collection rounds. Data was gathered mainly in three workshops with key stakeholders.

Although for the majority of the most sold products, the current system has worked well, the current state analysis of the purchasing process revealed three key issues that needed the most attention in this research. They were ABC-categorization, safety stocks and forecasting. The literature search focused on these three key areas, along with process development and other relevant literature. The outcome of CSA and literature was conceptual framework, which was used as the basis for the improvement proposal. The final improvement proposal was constructed after validation.

The initial improvement proposal was validated in a workshop with the key stakeholders. The improvement suggestions were discussed, and new viewpoints were given when needed. Completely new improvement suggestions were also suggested. The proposed improvements were included into the final improvement proposal.

If implemented, the improvements should have a significant effect on the case company. Although there is a lot of work to do before all of the proposed improvements can take place, the overall benefits can be seen already beforehand.

7.2 Managerial Implications

This study provides improvements for the challenges in the purchasing process and forecasting practices of the case company. Currently some parts of the process lack efficiency, tracking and documentation, which can lead to unnecessarily long lead times, out-of-stock situations and decreasing of customer satisfaction.

This study presents improvements for the key issues regarding these challenges, found during the research. The proposal consists of improved process steps and other improvement suggestions. As a result of this research, the company will have guidelines to improve the efficiency and reliability of the performance of the company. All of the improvement propositions are well justified, so if the company implements all proposed improvements, the positive implications for the whole company, and especially the purchasing department could be remarkable.

In order to implement the proposed improvements into practice, the company should give the specified employees enough time and resources to work with them. First, and the most important task, is to define the new product categories, as this is the key issue to be solved in order to improve all the related issues. This requires considerable amount of testing. Second, the other related issues should be approached, e.g. the new safety stock parameters and other product groupings. The other improvements could be managed simultaneously or after these more urgent improvements have been solved, depending on the issue and time tables. The least urgent improvements, like vendor tracking and Sales and Operations Planning, could be implemented later, but should not be forgotten.

7.3 Thesis Evaluation

This thesis was constructed and written in a systematic and thorough manner, following the structure and guidelines of research methodology, research design and other guidance obtained during the process. The research design was simple and precise and followed thoroughly. The current state was researched thoroughly, and a good depiction was created. The literature review was done finding and using numerous related sources, although more sources could have been used for some parts, especially for the ABC-categorization. The initial improvement proposal was organized based on the current state analysis, literature review and improvement suggestions from key stakeholders. The initial improvement proposal was validated by the key stakeholders, and received only minor changes, which shows that the initial proposal was conducted properly and with suitable improvement suggestions. The final improvement proposal was then made in regards of the validation. During the research the scope of this thesis became wide, and the material and findings were massive. This restricted the results being more on managerial level, as opposed to being extremely specific on certain issues, but in the end, it can be seen, that the outcome of the thesis meets the objective set for it in the beginning. Overall more improvements in the proposal also give the company better view on all of the concerns going forward.

7.4 Validity and Reliability

A study that involves research into scope needs to discuss the evaluation criteria for its research process and the quality of findings. In research methodology, there are various criteria to evaluate the quality of research, the most frequently used of which are validity,

reliability, logic and relevance. The research quality of this study, according to the criteria, is discussed below.

Validity means that the right issues are analyzed and explored. As Kananen (2013) describes, the problem with qualitative research evaluation is that validity and reliability criteria are more difficult to assess than in quantitative research.

Reliability represents the consistency of the study results and if the results would be replicated in a new research. These both criteria in quantitative research include the feature of being able to generalize and transfer to similar cases. Since this study is more qualitative and is based on specific issues for a specific company, these two concepts cannot be applied as such, but *credibility* via validity and reliability comes from documentation. In general, more credibility is achieved by giving the material for the key stakeholders to read and interpret in order to ensure similar results. *Transferability* can also be increased with realistic portrayal of the research set up and objective and also good description of the current situation and overall picture of the company and the industry.

In this thesis, the study is more qualitative than quantitative research, so the evaluation criteria also follows more closely the qualitative research evaluation. In this study, several steps were planned to be made in order to ensure validity of the results. Multiple sources were used, and materials and methods were chosen according to the type of study. Interviews, workshops, internal documentation and guidelines, KPI's and own observations produced the base structure for the analysis of the data gathered during the research. The stakeholders selected to the interviews and workshops represented the best knowledge in the company towards the business issue, processes and system preferences. *Generalization* was made possible by contemplating the results with the conceptual framework and the current state analysis.

Similarly, reliability of this thesis was increased by using several data sources. The stakeholders were given the chance to evaluate the findings from the data analysis and objectivity of the research and researcher. The data was gathered into a database with visual clarifications which enabled better improvement suggestions going forward.

In this study, *Logic* of this research is observable in the execution of the research design which was created in Section 2.2. Finally, *Relevance* of this research comes from the case company which received the improvement proposal to a relevant business issue.

7.5 Closing Words

This study is significant for the case company as it helps identifying the current issues regarding the purchasing process and forecasting practices, as well as the challenges considering the upcoming ERP version change. An efficient and reliable purchasing department is a key issue for a retail business in a global world where competition between companies is tougher than ever. This study has elaborated deeper understanding of purchasing and the many aspects related to it. Applying the proposed improvements can help the company achieve significant savings, increase efficiency and customer satisfaction. In the future, the improvements proposed in this thesis need to be re-evaluated and new improvements considered again in regards of the current situation of the company and the industry at the time.

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