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Improving Warehouse Resourcing Process

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“The long and winding road”

It certainly took its time. Two and a half years after the initial deadline of this work it is finally ready. So much has changed in this time. The entire process started when I decided to apply for the master’s degree program. I felt at that time that I was not improving professionally anymore. The work had become repetitive and mundane. Now after all this time from that late winter in 2018 my career has changed direction and furthermore the entire world around.

The time spent on this work had positive and negative effects. In a way some of the solutions presented in this work could not have been thought up in the original timeframe as the organisation and work has considerably evolved during these years. But at the same time the objective of this thesis has shifted several times and present consistency issues. I am still proud some of the solutions presented in this work although they are still untested in the real world.

I would like to thank the lecturers of the Industrial Management program. The courses offered gave me insight and a view to topics that I had not previously encountered in my professional life. This thanks extends to the many wonderful classmates that gave me great viewpoints and insights of others that work on this field.

I would also like to thank the now departed development manager Anssi Tura for several brainstorming sessions. In these sessions I could freely test ideas and get advice on the thesis process. For getting over the last steps to build the solution I would like to thank Vesa Korhonen, who was at that time the resourcing manager. With his help I could finally piece together the needed infrastructure and procedures to improve resourcing across the warehouse.

Finally, I could not have done this without the support of my beloved family. Although our child has been around only half of the time, I have been writing this work, they have lightened up my day and raised my spirit in these testing times.

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This thesis explores the objective of improving the case company's warehouse resourcing process. The previous resourcing activities were built organically around different parts of operations without a comprehensive process and standard tools. As the operations evolved through changes in customers and their needs, it was discovered that the workforce resourcing was inflexible and impairing financial goals.

The objective was first approached by describing the *de facto* resourcing process and mapping of activities and responsibilities relating to decision making. The findings where then discussed with different stakeholders to identify issues and weaknesses in the current practice of resourcing. The most pressing issues were agreed to be lack of process and tools, understanding of capacity planning and forecasting. These issues where then searched in literature to find ideas and solutions to them. A conceptual framework was constructed from the literature findings to be used with the operations to build a proposal for improvements.

The outcome of this thesis is a set of methods and tools along with a definition of roles and responsibilities. The suggestions include frameworks for performance management and resourcing decision making, a RACI-matrix, forecasting methods and anticipating capacity planning model.

With the use of tools and methods described in this thesis the warehouse could standardise its resourcing decision making process, release workload from frontline managers, increase mobility between its operations and right size its capacity. These actions could able the warehouse to cut down costs, increase worker efficiency with a more levelled workload and ultimately maintain the service promise of quality and on time delivery to the customers.

Keywords	Warehouse Resourcing, Forecasting, third-party logistics, Roles and Responsibilities, Agile Operations

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1 Introduction

A long withstanding trend with companies is to concentrate on their core competencies. As such for example manufacturing companies are concentrating on their production and products. Thus, operations with supporting role are often outsourced. One essential function is logistics. This allows companies to shift logistics costs from variables to more fixed.

Effectively a company will outsource its production variation and uncertainties to a service company. These service companies must be agile and preferably proactive in its resourcing. That is to say, the service company need solve the resourcing challenge that the customer has. If the customer could do this by itself there would be probably no need for outsourcing.

1.1 Business Context

The case company is a subdivision of a large international logistics company. The company provides logistics services for every conceivable need from postal services in Germany and consumer parcel delivery to forwarding, warehousing and haulage services to companies. The subdivision in this case is specialised in contract logistics for different sized companies. These services include among others warehousing, picking, packing and value-added services such as repacking, component assembly, customisation of products and spare part kitting.

Previously the case warehouse in Finland serviced multiple customers required to store and ship mostly finished products and spare parts with some value-added services. Due to one large customer switching its service provided the company decided to seek for expansion with another customer. This customer is a large international electronics manufacturing company providing machinery mostly to infrastructure, industrial and marine companies. The new contract awarded the case company all warehousing and subsequent services for the factory.

As of January 2019, it is estimated that 80 % of the outbound volume for the warehouse is generated from this one customer and thus makes it extremely important. However, the company has been unable to offer a realistic forecast of their order volumes and

furthermore places orders with lead times that are counted in hours thus presenting a challenge in resourcing.

1.2 Business Challenge, Objective and Outcome

The contractual obligations presented by the expansion of this major customer coupled with low-level of forecasting has led to serious financial difficulties as the case company has over-resourced its order picking operations to maintain needed service quality levels. The case company is struggling with flexibility issues regarding workforce as the true fluctuation of workload varies significantly monthly, weekly, and even by shift.

The objective of this thesis is to develop an operational model that enables the case company to improve the agility of its resources in times of demand fluctuation.

The outcome of this thesis is an operational model that can be copied to similar context throughout the case company's operations in Finland.

1.3 Thesis Outline

This thesis will use a qualitative research method to map out current process of resourcing. The research will be conducted by individual interviews, group workshops, documents on resourcing and personnel and data on workload variance.

The first section of this thesis described the business context, the challenge face by the company, the objective of this thesis and the desired outcome. In the second section the methodical approach of this thesis is presented. The section describes the theoretical base of design research and why it is used. Furthermore, the section outlines the data collected for this thesis.

The third describes the current state of the resourcing model. As there was lack of documentation on current model and how it was supposed to be exercised, an intensive interview round was made to find how the current model was affecting management decision making on all the operational levels. The findings were then grouped by sub-categories in this thesis and explored in more detail. Also, additional questionaries were prepared to collect more information for the proposal building stage.

The third chapter ends with a summary of key issues found in the current state analysis. Based on these findings knowledge and insight were researched for the fourth chapter. This chapter contains the theoretical background used as a base for the proposal building. The end of the chapter includes this works conceptual framework that ties the literature to the issues at hand.

With the aid of the current state analysis, additional questionaries and the conceptual framework, the proposal was built. The process started with a workshop with key management stakeholders and continued with unofficial discussions with relevant people when the solutions were constructed. The process and the findings are described in the fifth chapter.

In the sixth chapter the built proposal with all the elements where then presented to the key management personnel for validation and feedback. This section describes the received feedback and the final proposal after the changes made based on the suggestions.

The last chapter contains the executive summary and suggestions for the company to move forward with implementing the ideas presented in this work. Furthermore, the chapter includes the evaluation of this work based on the criteria defined by the methodological chapter. Finally, the chapter ends with the closing words for this work.

2 Method and Material

This chapter covers the chose research approach, how data was collected, and analysis methods used in this Thesis. The chapter also describes the criteria used for the evaluation of this thesis.

2.1 Research Approach

Research is a systematic process to understand underlying facts in any given subject. Research can be used to compile a general theoretical understanding of a subject or to identify influencing factors on a perceived phenomenon. In business sense research is needed to identify the actual needs of improvement. Without a coherent and systematic research issues might be understood incorrectly and thus suggested improvements might not have the desired effect.

Depending on the nature of the issue in question, an optimal research method has to be chosen. The chosen method gives a framework on what kind of data is collected and how it is managed. There are two extremes in research methods: quantitative and qualitative research. Quantitative research needs a predefined theory on phenomenon which can be applied to the data collected (Kananen 2017: 33). Qualitative research, however, does not have an applied theory and its goal is to study a phenomenon with no previous knowledge (Kananen 2017: 31).

In a study on a business challenge, it can be seen that a more practical approach is needed. A company is relatively isolated unit in this case of a study. Previous knowledge on similar issues can be used to solve the issues at hand and data gathered from the company can be used to test these theories and best practices. Thus, in this thesis design research described by Kananen (2017) is used.

Design research is a good fit for a business challenge as it does not try to generalise. The findings and the solutions are tied only to the phenomenon in the context of the study. Design research, as other mixed research methods such as action research, seeks to affect change in the organisation. The change might be eliminating or developing something. The aim is to go further than describing or understanding an issue. The result must discover solutions to the current state. (Kananen 2017: 46-47)

Design research is in a sense leaning heavily on qualitative research due to the nature of the approach. Describing the issues found in the resourcing process uses empirical evidence gathered with interviews. The goal of the research is to find different elements that affect the process and issues that contribute to perceived shortcomings. Numerical data can be used as a part of the analysis. But as the numerical data is not analysed using a predefined theory, it is merely to illustrate and validate anecdotal claims of the issues.

In conclusion the research of this thesis utilises several data sources such as interviews, workshops, and questionnaires. These qualitative data was then augmented with quantitative data to understand the magnitude of the issues in the resourcing process.

2.2 Research Design

This section describes how the research was conducted from setting the objective to validating the proposal. The objective is to develop a process to enable the company to better manage its resourcing with a customer which does not offer reliable forecasting of its capacity needs. The process is illustrated in figure 1 below.

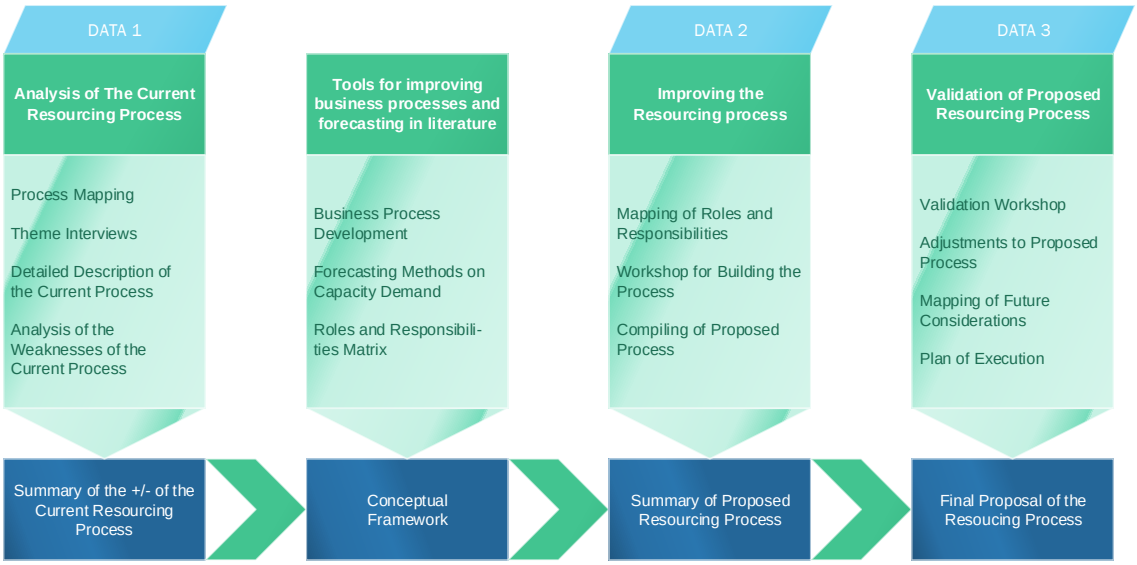

Figure 1. Illustration of the research design

Data 1 of the research was a two-part event. The first part was done to define the current resourcing process in use. This was needed because there is no definite documentation of the process as the process has been constructed *ad hoc*. In the second part of the

current state analysis the defined process was shown to various stakeholders that are directly or indirectly linked to resourcing. These interviews were made in a free manner without ready-made questions. A rough process was presented to the operations managers to comment on. The improved process was then taken into a second round with all stakeholders for identifying strengths and weaknesses. After these discussions findings were brought together for analysis and for triangulating weaknesses across the process levels.

After the current state analysis was ready key areas of improvements where decided. These areas where to become the pillars in the new proposed resourcing process and literature for these key findings were investigated to build a conceptual framework for the thesis.

When the conceptual framework was finished a workshop with key stakeholders were held to build a preliminary proposal of the new model. In addition, interviews were conducted separately to determine roles and responsibilities of different stakeholders in the proposed process. This is considered as Data 2.

The next step was to write a draft of the proposal based on the data 2 materials. This draft was presented to key stakeholders for validation. Comments from this round is considered as data 3 and used to draft the final version of the proposed process.

2.3 Data Collection and Analysis

As seen in figure 1, this thesis is built on three data collection rounds. Data was collected with various methods including personal and group interviews, ad hoc discussions, and questionaries. Details on data collection 1 is seen in table 1 below.

	Data 1, for the Current state analysis (Section 3)				
	Participants	Data type	Topic, description	Date, length	Documented as
1	Operations Managers	Workshop	Defining and drafting the current resourcing process.	Jan 2019, 2 hours	Field notes and recording
2	Development Manager	Face to face Interview	Discussion on current resourcing process and its shortcomings.	Feb 2019, 45min	Field notes
3	Supervisors	Discussion	Walkthrough of current resourcing process and discussion on cons and pros on every level.	Feb 2019, 60 min	Recording
4	HR Manager	Discussion	Walkthrough of current resourcing process and reflecting on strategic dimension.	Feb 2019, 45min	Recording
5	Site Manager and Operations Managers	Discussion	Walkthrough of current resourcing process and discussion on cons and pros on every level.	Feb 2019, 90 min	Recording
6	Coordinators	Discussion	Walkthrough of current resourcing process and discussion on cons and pros on every level.	Feb 2019, 45min	Recording

Table 1. Details of data collection 1

The first part was to construct a rudimentary understanding of the current resourcing process and activities relating to it. The workshop was conducted with operation managers. These findings were then taken back to all management levels that have a role in the resourcing process. The goal was to find weaknesses in the current process and to map any influencers on the process functionality.

After key topics of improvements were chosen a summary of the current state analysis was constructed. These findings were then used as a base for data 2 collection. The details of data 2 can be seen in table 2 below.

	Data 2, for Proposal building (Section 5)				
	Participants	Data type	Topic, description	Date, length	Documented as
7	Operational Management	Form	Preliminary study on perceived roles and responsibilities	April 2019	Excel-files
8	Operational Management	Form	Mapping of perceived process functionality on different time frames.	April 2019	Excel-files
9	Operational Management	Workshop	Proposal building	May 2019, 2 hours	Field notes and recordings
10	Resourcing Manager	Discussions	Discussions on meeting procedures and tools.	February 2020	Field notes
11	Resourcing Manager	Discussions	Discussions on tools, especially relating to training.	August 2020	Field notes
12	Customer Representative	Discussions	Proof of concept on a forecasting method.	Oct 2020 – Feb 2021	E-mail and presentations
13	Resourcing Manager	Discussions	Discussion on tactical meetings	February 2021	-

Table 2. Details of data collection 2

The summary of findings was augmented with two form questionaries. First questionnaire asked the management to assign roles in a matrix for the persons that contribute to resourcing decisions. The second questionnaire asked the management to evaluate different resourcing related activities on different time frames to narrow down the scope of the proposal building.

The findings were then taken to a two-hour workshop with upper management of the site. The goal was to discuss and find solutions to different issues faced in the operation. After the workshop, the thesis project was put on hold and continued in 2020. As the situation had change somewhat in the organisation, further discussions were held regularly with the resourcing manager on practical solutions to issues that were still affecting the resourcing decision making. Furthermore, the customer was approached to re-start an old forecasting proof of concept study.

When the proposal was ready a summary presentation was made. The proposal was the presented to appropriate stakeholders. This is considered as data 3 as seen in table 3 below.

	Data 3, from Validation (Section 6)				
	Participants	Data type	Topic, description	Date, length	Documented as
14	Site Manager, Resource Manager, Site Development Manager	Group interview/ Final presentation	Validation, evaluation of the Proposal	May 2021	Field notes
15	HR Manager	Interview	Validation, evaluation of the Proposal	June 2021	Field notes

Table 3. Details of data collection 3

For the current state analysis (section 3) and proposal building stage (section 4) several data-based figures were constructed. The data behind the figures are real data but for business reasons the figures obscure the actual quantities. The data was used to validate and strengthen the anecdotal claims of the management.

Also, both current state analysis and proposal building uses tables and figures with mock data. This approach was used to have an easy representation of the issue in the context at hand without the need to build a data model on real data. Especially in proposal building the goal was to test the hypothesis presented in the solutions offered.

Most of the data analysis was done in the current state analysis to determine the current process and influencers for the shortcomings. However, this thesis most major numerical data analysis was one in proposal building stage regarding the proof-of-concept study on the forecasting method. The findings of the current state analysis are presented in section 3 below.

3 Analysis of the Current Resourcing Model

This section discusses the current state analysis of this thesis. The section is split into three parts: how this current state analysis was conducted, the current stat of the different levels of the resourcing model and the summary of the analysis.

3.1 Overview of the Current State Analysis Stage

To start the current state analysis an investigation to the resourcing model was needed. Research in documents regarding the resourcing model did not yield any relevant results. The first finding was that most of the tools and documents are done *ad hoc* and mostly outdated or not official. Thus, the second step of the current state analysis was to define the current resourcing model. This was done in a workshop session with two operations managers that are *de facto* owners of the process. A proposal of the model was presented at the start of the workshop and then updated to correspond as closely as possible to the current resourcing model with the relevant steps.

After the model was defined, it was taken to different stakeholders for evaluation to find out strengths and weaknesses of the current resourcing model. Firstly, a preliminary session was conducted with the development manager of the company to validate the logic for the upcoming sessions with other stakeholders. The first evaluation was done with supervisors that are executing short-term decisions in resourcing. The second session was conducted with the HR manager of the company to find any conflicts between the strategies of the company and the operational level. Observations from all the sessions were then taken back to the operations managers and the site manager to discuss more on challenges in long-term and tactical decision making and how it is impacting daily decision making in resourcing and furthermore on operational capabilities. The last round was conducted with coordinators whom in the role of frontline leadership are tasked to implement production plans and make *ad hoc* decision in resourcing through their shift.

3.2 Description of the Current Resourcing Model

For the complex nature of the current resourcing model a more simplified interpretation was constructed for the figure 2 below. The complexness and nearly non-existence of links between the levels of the model is a result of a process that has grown organically to solve challenges in resourcing due to a completely new type of customer needs.

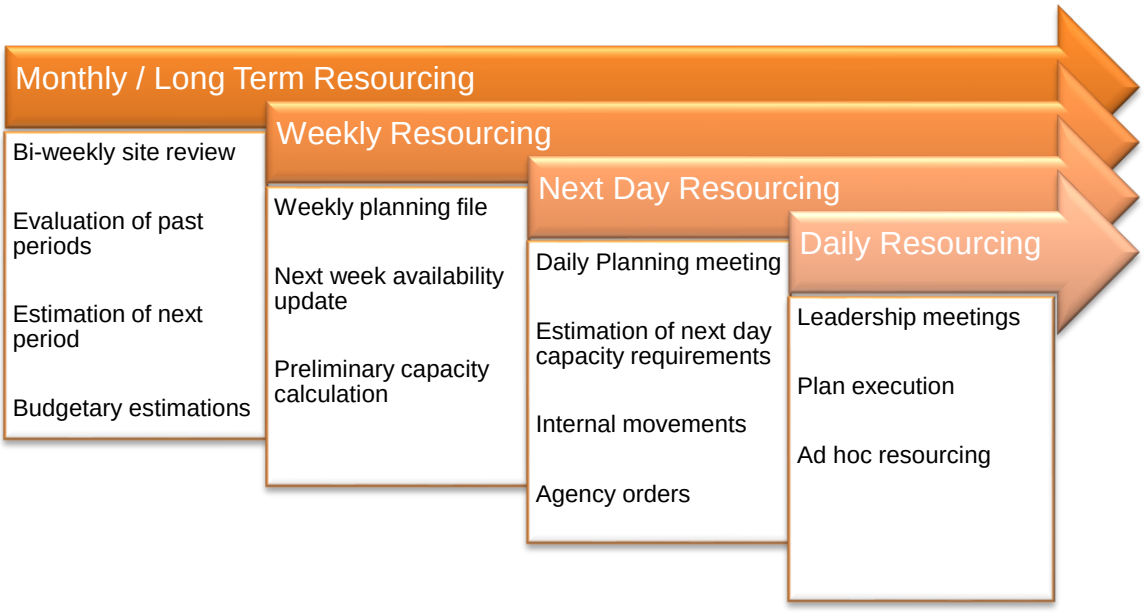

Figure 2. Current resourcing model

The first level of the resourcing model focuses on budgetary evaluation and to determine department and team personnel levels. Second level focuses only on reporting availability by team for the next week. Third level plans the workload for the next workday and makes decisions how to the operations can achieve the required capacity. The last level focuses on daily management in *ad hoc* situations.

Because the operations are somewhat hierarchical table 4 below represents the different stakeholders and their roles and responsibilities through the resourcing model with a simple RACI-analysis.

Management level	Same Day Planning	Next Day Planning	Weekly Planning	Long-Term Planning
Site Manager	C/I	C/I	-	R
Operations Managers	C/I	A	-	R
Supervisors	R	R	A	I
Coordinators	R/C/I	I	R	I

Table 4. Roles and responsibilities of stakeholders in current resourcing model

Table key: R = Responsible, A = Accountable, C = Consulted, I = Informed

It seems that there is no definite accountability in long-term planning. Top-level of management make decisions but no apparent owner of the tasks is present. Bottom-level of management mostly are just informed of the decisions. They do not have an active role in long-term planning. In weekly planning we see accountability through supervisors as they need to monitor if coordinators execute their task. Top-level of management are present at next day planning as the site manager is actively involved in operational planning and operations managers monitor if supervisors execute the intended plan. The coordinators role in to be informed is somewhat debatable as the plan execution is not always that apparent (this issue is explored further in section 3.6.). In same day level the roles become highly mixed. Top-level management frequently participate in rapid capacity planning during the day. Supervisors are expected to monitor the situation and make decisions. At the same time coordinators are pressured to make decisions but also in receiving them or answering inquiries on the situation.

The interviews produced four main themes that were raised on every management level. These are forecasting demand, understanding needed capacity, managing resources and overall process functionality. In the next chapters these themes are explored more closely.

3.3 Forecasting

Forecasting capacity needs is seen as one of the most problematic area of resource planning. At the moment there is no definite forecasting model in place in the operations. Different levels of planning and different departments utilise various tools and methods to plan its workload. This is due to fragmentation of operating procedures summarised in table 5.

Department	Customer Operations	Lead Time	Forecasting
1	Factory Production	From 2 hours up to several days	Part of the operations receive a forecast
2	Sub-Assembly	From Days to weeks	No forecast but sufficient visibility for open production orders
3	Accessories Sales	From days to several months	Forecast provided by customer but seen as inaccurate
4	Service Sales Sub-Assembly	From days to several months	Forecast provided by customer as a sales target

Table 5. Lead times and forecasting methods in different departments

Department 1 services mainly a local factory and a contractor factory in Finland. Some replenishment orders are shipped to a third factory outside of Finland. Others than the local factory usually place orders earlier than the shipping date and have fixed departure times every day. The local factory on the other hand orders with lead times ranging from few hours to a week.

The customer offers an order line estimation for its project-based production. This is provided once a week and has a rolling four-week weekly average estimation. It has been noted that these predictions are too inaccurate, and the weekly average do not reflect fluctuation between weekdays. The difference between actual order line averages by week against the customer forecast is shown below in figure 3. As the picking processes related to this forecast is the most profitable, it is a major concern.

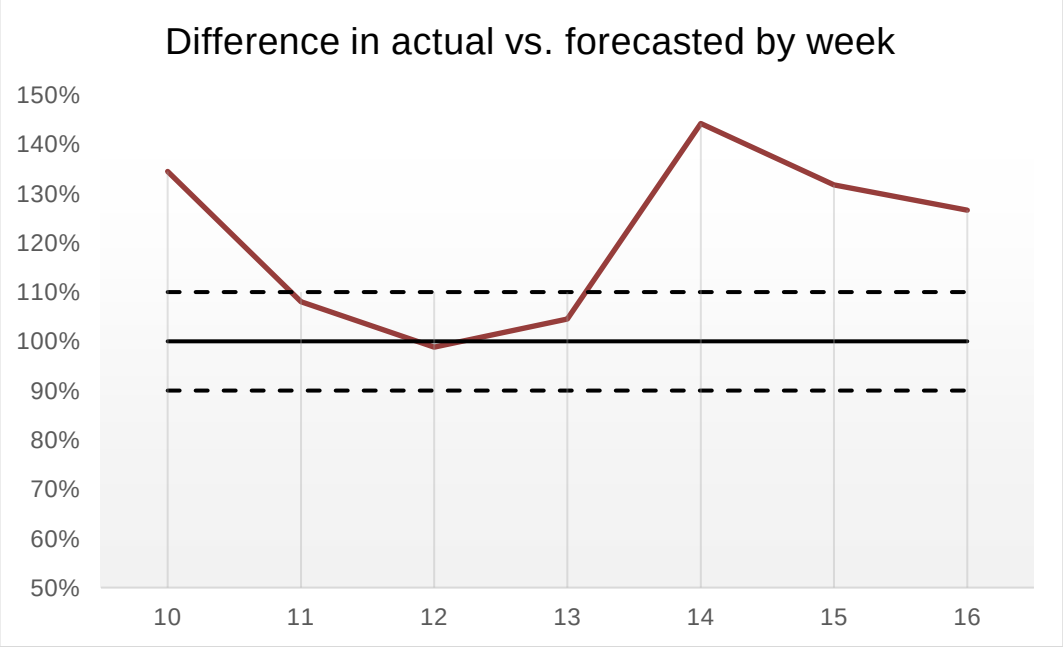

Figure 3. Difference in actual vs. forecasted order lines by weekly averages

As figure 4 shows three weeks hit inside the acceptable +-10% deviation of forecast. The highest week showing +44% more volume than forecasted. Furthermore, using a weekly average in this type of operations increases the inaccuracy as the deviation is even more pronounced on a weekday level. This is represented below in figure 4.

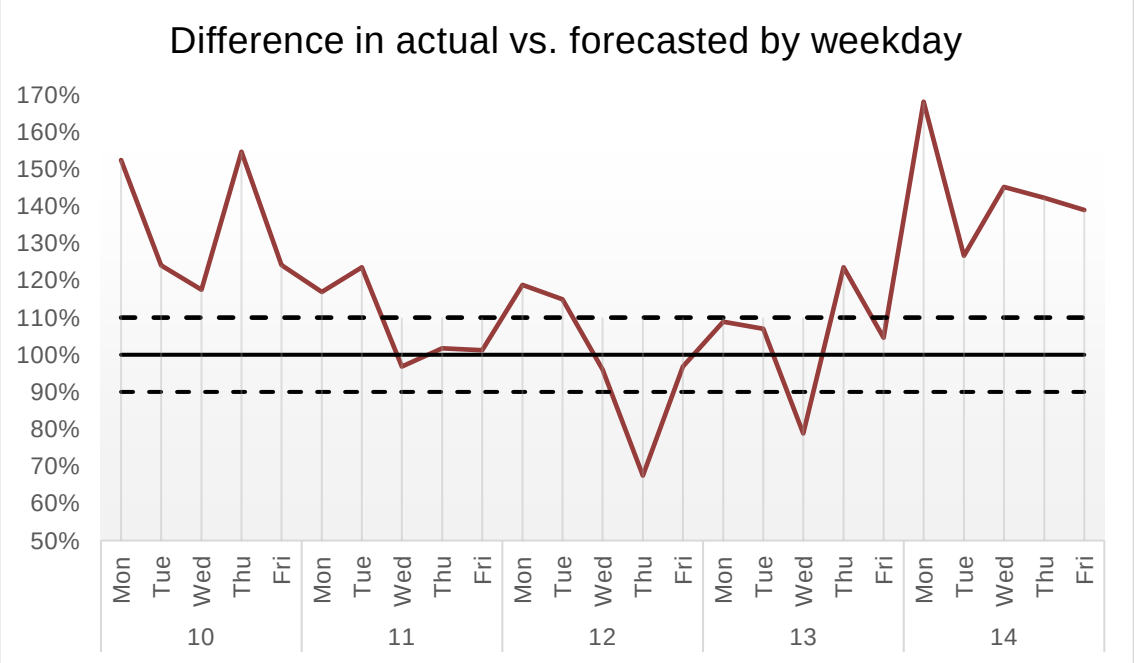

Figure 4. Difference in actual order lines vs. forecasted order lines by weekday

Only seven workdays out of 20 lands inside the acceptable +-10% deviation of forecasted weekly average. One Monday even experienced a hefty +68% more volume than predicted.

Department 2 is a sub-assembly for the factory operations and act on production orders coming from the customer system accessed at the warehouse. There is no apparent forecasting used but there is deemed to be a sufficient visibility for upcoming days of volume. The operations mainly work in advance, so it has the ability to even out any drops or spikes in orders.

Department 3 provides any accessories purchased by the end users and is such closely tied to the factory production. The operations work mainly in the customer IT system and due to security reasons access to the system is limited at the warehouse. Thus, the visibility provided in the system is not used in overall production planning. The customer

offers every day an updated report forecasting upcoming few weeks of capacity requirements. However, management associated with this department have experienced major discrepancies between the actual workload and what is reported.

Department 4 is the customer service division. The department ships updates, retrofits, and spare parts to installed systems around the world. The customer provides a sales target that roughly can be used in estimating upcoming trend. This department also produces sub-assemblies that can be done in advance so there is somewhat constant level of workload accessible all the time.

To summarise this section, it is easy to see that every department has its own type of work with different lead times and methods obtaining forecasts. Although there is information available on most of the operations there are issues that are presented in the table 6.

	Key issues in forecasting
1	Not all parts of the operations receive forecasts
2	Type of data available differs in form
3	Information sources are scattered in different systems
4	No method of collecting all the data in one planning tool
5	Customer interaction limited

Table 6. Key issues in forecasting

It can be concluded that a standardised method of collecting order data and possible forecasts is needed. Also, there is lack of clear communication channel and format with the customer to obtain qualitative forecast data. Also, it seems that the distinct fragmentation of the overall operations to different departments and sub-processes are leading to problems in forecasting capacity requirements. This is explored more in the next section.

3.4 Capacity Planning

During the discussions one point was raised frequently by the supervisor level. There is a major challenge to define actual capacity needs. At the time of conducting the current-state analysis the operations employed 20 different measured activities. All these activities were measured in order lines with targets ranging from 6 per hour up to 40 per hour. On some activities it is reasonable to use order lines as a measure, but an order line

does not indicate how much physical work is required from the worker. Consider a generic activity with different picking list compositions represented in table 7.

Order lines on picking list	Picked pieces	Picking locations	Simulated picking time	Order lines per hour
1	1	1	4min 30sec	13,33
2	50	2	13min 40sec	8,78
1	100	2	20min 20sec	2,95
10	220	15	54min 0sec	11,11

Table 7. Imagined picking list variations in a generic picking activity

Simulation assumes that distances between start and any picking locations is two minutes and between locations one minute. Actual distances in warehouse varies considerably. Picking one piece takes in average 10 seconds including any count confirmation. 20 seconds is included for any system activities as confirmations and printing. Please be noted that this simulation is done only for presentational reasons and is not part of a validated work phase study.

It can be argued that any of these picking lists are not comparable. The reason for this type of activity tracking and planning is that it is directly connected to sales and reporting. But it is not an accurate measure of actual workload. Targets are defined by average capability of picking and updated from time to time. Between picking lists, workers, and workdays the actual productivity varies considerably. Thus, it is worth noting that even though an acceptable order line forecast could be constructed it would not still lead to a comprehensive portrayal of needed capacity. This would of course lead to a better forecast of revenue.

Interviewees also highlighted the proportion of support activities and other workforce such as managers in relation to direct work. In other words, the activities that bring in the revenue directly. The distribution of hours is presented in figure 5.

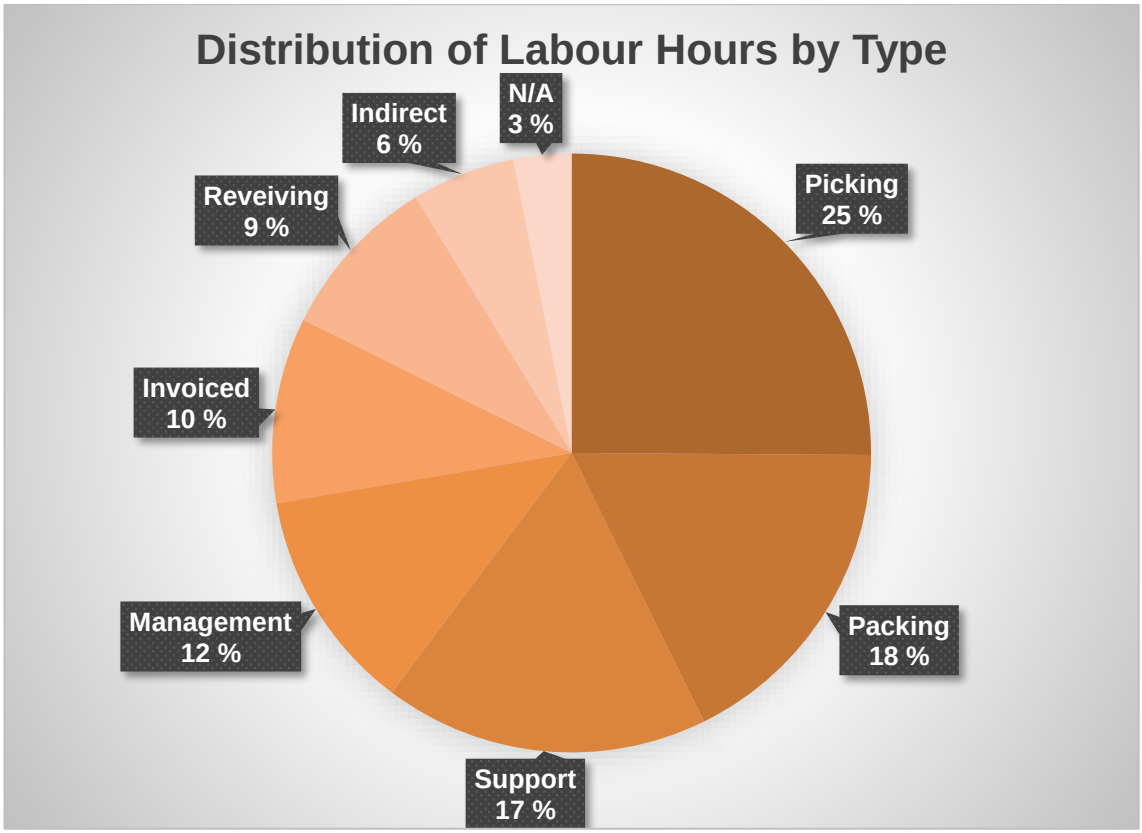

Figure 5. Distribution of labour hours by type

From figure 4 it can be seen that roughly 17 percent of all labour hours are support activities. The perceived problem is that there is no definite knowledge on how much support capacity is needed to run the operations. It has happened that in cases of volume spiking capacity has been borrowed from support activities and thus, it has caused problems later in operations. Therefore, it can be argued that the operations lack knowledge on actual capacity required to perform order picking. The key issues of capacity planning are summarised below in table 8.

	Key issues in capacity planning
1	Actual physical work is not planned and measured
2	Support activities are not planned according to actual need
3	Understanding support activities roles in throughput activities is limited

Table 8. Key issues in capacity planning

As seen from table 8 there are issues with understanding real capacity requirements and the roles and influence of support activities. It also influences how resources are actually managed. This is explored in detail in next section.

3.5 Resource Management

The actual resource management covers tasks regarding assigning work to individuals, deciding movements between the departments, issuing orders for temporary workforce from an agency and so on. In other words, the tasks that cover the daily resourcing process.

Different parts of the operations are constantly experiencing over-resourcing. This due to former problems in quality of the operations as the ramp-up and after it there where severe problems in keeping up with the lead times. Now it is portrayed to be an issue stemming from a silo effect as the departments and teams want to play it safe. Instead, the risks should be scaled and improve the agility of the whole operation by taking down psychological barriers. Of course, lack of an adequate forecast and problems defining real capacity requirements influence over-resourcing.

A relatively new sub-process has been implemented to combat gaps in capacity and demand. A contract with a certain agency offers the operations a possibility to order temporary workforce with a fast lead time. The main purpose of this sub-process is for the operations to be able to lower its baseline on a healthier level and use temporary workforce when capacity requirements need it. The process is still at its infancy after implementation, so the results have been somewhat mixed. Positives are that the process will likely function after the ramp-up phase but there are some concerns. Mainly on planning side. If the required capacity cannot be determined and thus the planning not intelligent and effective there are already indications that the process might raise costs if its only used as substituting sick leaves or other paid leaves. This of course means that if it is used to substitute an own DSC worker the cost of any task is basically more than double.

Many respondents were concerned with the success with job rotation and improving the competence of the workforce. There have been many organisational developments to overcome the barriers mentioned earlier but it still seems that when people move through jobs and departments it is piled on same persons all the time. Those who are perceived to have the broadest skill set and best adaptability is often asked to take any task that is in need to be executed.

There is a genuine risk that the workload is not spreading evenly in the operations. These high performers are clocking most hours and best performance but might become disinterested in their role or even run the risk of compromised health or leaving for better balanced job potentials. On the flipside, there are employees that perform the same tasks every day. These people run the risk of occupational disease from repetitive physical tasks or seek job fulfilment in other companies to boost their working life.

Some argue that this is a strategic problem as the company has a HR strategy that define guidelines for managing competence and well-being at work. This strategy has not been implemented in daily operational life. Also, it is noted that there is a constant feel of pressure and time restraints that is a hindrance for determined development. As the operations managers say in unison:

> "We need to leave this culture of survival. Our resourcing based too much on over-achieving."

As per the quote it can be concluded that resourcing is leaning on trust that the workforce pulls the operations through a day in the end. But in the other hand it is believed that the operations are financially burdened by over-resourcing. The truth is somewhat unclear, but it is reasonable to deduce that the resourcing process does not provide enough support and tools for decision making.

Most of these sub-operational units does their own hiring with limited analysis on the overall needs of the operations. This leads to few different problems. People tasked in monitoring resourcing do not have immediate knowledge in overall FTE-levels. The most obvious long-term hindrance is that when people are hired directly to a specific team or a department, it usually means that this person is not really hired for the warehouse. So, the current hiring policy can strengthen the division between sub-operations and departments. The different issues in resource management are summarised in table 9.

	Key issues in resource management
1	Over-resourcing of operations due to silo effect
2	Barriers between departments a hindrance of internal movements
3	Challenges in developing competence in workforce
4	Piling of pressure on a small part of overachieving workforce
5	Purposeful functionality of ordering temporary workforce
6	Unclear roles regarding agency workforce orders

Table 9. Key issues in resource management

As seen in the table 9 there are several issues with resource management that are basically the result of when no single individual is tasked to develop and oversee the resourcing decisions made. This has strengthened the isolated nature of the departments and contributes to issues with workforce transferability. The current process functionality is explored further in the next section.

3.6 Process Functionality

The current resourcing process is relatively loose collection of tools and practices that have been drawn up for the particular operations over time. Some levels are in line with guidelines offered by the recently implemented operations management system (OMS) such as the bi-weekly site management review or the next day planning. However, these levels of planning would exist even without the OMS and have more foundation in old ways of performing resourcing. Thus, the current resourcing process is not a coherent process that provides tools, roles, and guidelines for achieving the process objective.

Different levels of the process seem to function independently of another. Long-Term resourcing focuses on budgetary issues in making strategic decisions. In other words, capability of the operations is measured in revenue and costs and the difference between these are controlled. This level of planning does not directly influence other levels of planning. Issues raised from this level are seen below in table 10.

	Process Issues in Long-Term Resourcing
1	Decision making considers mostly budgetary situation
2	Not directly connected to operational level
3	No clear communication channel with customer to co-operate in planning of resources
4	No strategic planning of personnel (e.g., competence advancements, agency personnel roles, job rotation)

Table 10. Process issues in long-term resourcing

The second level of the process dictates tasks done for weekly level planning. As noted earlier this level does not get any direct input from the long-term level. Any volume predictions made on the long-term level is not transferred to weekly level. Only available personnel and team composition is carried over to the planning file. The accuracy of this is however dependent on how fast T&A system and HR follow-up is updated and if relevant employees are notified.

On this level the only task is assigned to the coordinators. They are expected to inform via the planning file the availability of their subordinates. This means that no actual planning is done on this level as no capacity requirement calculations is made at this level. Validating the data inputted at this level has also proven to be difficult. As the planning tool is an excel-file, the base data is usually carried over from the previous week. Furthermore, availability is often subject to changes as abrupt absences cannot be predicted. Issues are summarised below in table 11.

	Process Issues in Weekly Resourcing
1	Not connected to long-term resourcing
2	Not connected to operational level
3	The level has no clear objective
4	Stage hard to validate

Table 11. Process issues in weekly resourcing

Next day planning is considered to be fairly functional. Supervisors make volume predictions based on past days of activities and open order line status. Availability prediction of personnel for the next day is fairly accurate. Any discrepancies can be managed by making internal moves between departments or issuing agency orders for temporary workforce.

Issues encountered are associated with feasibility of the planning. Firstly, the current model relies heavily on how the operations conduct reporting as the whole planning excel

is based on how follows-up of daily operations is recorded. Secondly, defined activities are the result of how the customer has setup its operations and processes.

Questions were raised during the interviews is the operations capability of defining and understanding real capacity requirements as the planning is done on customer process level, not on the level of actual physical work. Furthermore, it was highlighted that most unmeasured support activities employ mostly undefined magnitude of workers that are often borrowed in outbound activities when excess capacity is needed. There are no definite calculations how long certain support activities can be neglected before it disrupts the operations. Hence, there is an apparent lack of understanding of real capacity requirements. Encountered issues are summarised in table 12 below.

	Process Issues in Next Day Resourcing
1	No direct connection to previous levels
2	Only somewhat connected to daily level
3	No calculation of real capacity requirements
4	Guidelines and procedure for over and under capacity situation lacking

Table 12. Process issues in next day resourcing

The last step is daily resourcing which is carried out mainly in an *ad hoc* nature. Barring any unprecedented problems in warehousing operations through high level of abrupt absences or IT system issues, the operations are considered to function efficiently in making decision during the day. Support tools as live view of workload, staffing of different picking machinery and regular leadership meetings provides a platform for the decision making.

However, as parts of the operations acts completely with 2-4-hour lead times there can be severe spiking in orders. It is estimated that this is the same time span that can be somewhat be predicted. This means, for example, that during any given shift it is not possible to plan ahead the workload of upcoming shifts. Thus, decision is often done in reaction. This also leads to the question, what are the operations planning if it does reflect only partially actual work that occurs.

Clear guidelines for actions in anomalous situations are expected. For example, what to do if order level drops significantly or if another department is lagging. How much resources and for how long should be transferred? It is highlighted that often one person is transferred for an extended period that does not really close the gap instead of several

persons for a short time. This is also a result of barrier between departments and a desire to protect own department. The findings on same day resourcing are summarised in table 13 below.

	Process Issues in Same Day Resourcing
1	Plan does not often reflect actual work
2	Coordinators are tasked with constant resourcing decisions as order line status does not necessarily reflect actual needed capacity
3	Barriers exist between parts of the operations that restrain dynamic movement of work-force
4	Guidelines and procedure for over and under capacity situation lacking

Table 13. Process issues in same day resourcing

3.7 Key Findings from the Current State Analysis

The current state analysis yielded numerous observations throughout the current re-sourcing process. Every management level seemed to agree on strengths and weak-nesses of the process though some difference in subject emphasis occurred.

The positive areas regarded the overall functioning of the warehouse and team-level cooperation. This has partly been achieved by constant over-resourcing and limited movement of resourcing. At this point quality is on a healthy level but several issues are hampering financial development of the operations. These key issues are summarised below in table 14.

#	Type	Issues
1	Process Functional-ity	HR strategy, resourcing sub-processes/tasks and operational re-sourcing tasks not integrated into a coherent process Appropriate planning scope not determined No decision-making process regarding resource movements
2	Roles and Respon-sibilities	Unclear roles and responsibilities
3	Capacity Planning / Forecasting	Lack of analytical method to determine customer capacity needs Fragmentation of customer operations complicate forecasting No overall understanding of all core activities Limited customer co-planning

Table 14. Key Issues of CSA

These findings were then taken into consideration when doing research in relevant liter-ature. In the next section practices and ideas to tackle these issues will be presented. The section will result in a conceptual framework for this thesis.

4 Existing Knowledge on Business Process Management

Data 1 identified three core issues. Firstly, no validated resourcing process is set in the organisation. Thus, every decision concerning resourcing and capacity, is resolved with Ad Hoc methods. Secondly, there is a lack of data to support decision making because no systematic forecasting method and capacity planning tool is used in the organisation. Thirdly, because of the Ad Hoc nature of decision making, the roles and responsibilities varies from case to case resulting in confusion and inefficient decisions.

This chapter discusses existing knowledge on process improvement, forecasting, capacity planning, and role assignment. During the current state analysis, it became evident that the process needs to be built from scratch. Thus, this section will explore some of the core ideas presented in business process reengineering. Furthermore, this section will discuss basics of forecasting, capacity planning and role assignment.

4.1 Business Processes Reengineering

The idea of business processes has been around since the 1980's (Bititci et al. 2005: 853) and according to Bititci et al. (2005: 853) has been popularised by authors such as Michael Hammer in the 1990's. The concept is widely researched and has multiple definitions of what is a Business Process. Bititci et al. (2005: 853) proposes a definition that encompasses the core elements of different authors:

> A business process is a series of continuous or intermittent cross-functional activities that are naturally connected together with work flowing through these activities for a particular outcome/purpose.

Traditional processes are usually focusing on certain work-related activities and tasks. The process describes the order of the activities and possible rules for advancing from a stage to the next. Business processes focuses more on a higher level that encompasses different tasks and activities needed to produce a certain service or a product. Business processes has distinct emphasis on how these different activities are interconnected and how the work flowing through from activity to activity can have an efficient and effective result. (Bititci et al. 2005: 853)

Business process reengineering emphasises on how this interconnectivity can be improved by organisational changes and employing IT-solutions to simplify information exchange. In the next section Basics of business process reengineering and its distinction

to other change programs is discussed. Furthermore, core ideas of process development and enablers are discussed.

4.1.1 The concept of Business Process Reengineering

Michael Hammer (1990) made the notion that companies had for years restructured and downsized its operations to tackle changes in the business environment. The results were mixed and ineffective. The proposition was that a change of attitude and a real questioning of the core elements in an organisation was key to achieve proper change.

Business process reengineering was popular in the 1990's and as the definition for business process also reengineering has several definitions. Grover and Malhotra (1997: 197) suggested that there are four essential elements in reengineering. Firstly, it must have a significant impact on the organisation. Secondly, it focuses on the business process rather than functions. Thirdly, the objective is to achieve significant improvement in performance. Fourthly, IT is a critical enabler.

Reengineering differs from other change programs with its goal of radical change. For example, downsizing considers only staffing. Restructuring considers only changes in the organisation relationships. Automation seeks to speed up work. Total Quality Management improves activities and quality of the work. (Grover and Malhotra 1997: 197-198)

Hammer (1990) argues that these traditional change programs keep the old business processes intact and real change does not occur. Furthermore, automation does not actually improve activities. It just mechanises and speeds up tasks that can be redundant.

Reengineering was a change management trend of the 1990's and contemporary trends have emerged for its place. One reason might be that as reengineering challenges traditional hierarchical organisations. After two decades companies have evolved with concepts such as lean and agility, thus radical changes might not be as needed today. Nevertheless, there are prominent ideas that can be used when evaluating meaningful change in a process discussed by Grover and Malhotra (1997).

4.1.2 Conducting a Reengineering Project

In essence a reengineering project does not differ greatly from any process management projects. Any significant change needs backing of the management, analysis of the current state, definition of the new process and desired goals and lastly a plan on needed time, resources, and implementation.

What is special about reengineering is its focus on organisational development. Reengineering demands a new way of thinking that challenges traditional vertical organisations and emphasises on the horizontal nature of business processes (Grover and Malhotra 1997: 200). A representation of this cross-functional nature is seen in the figure X below.

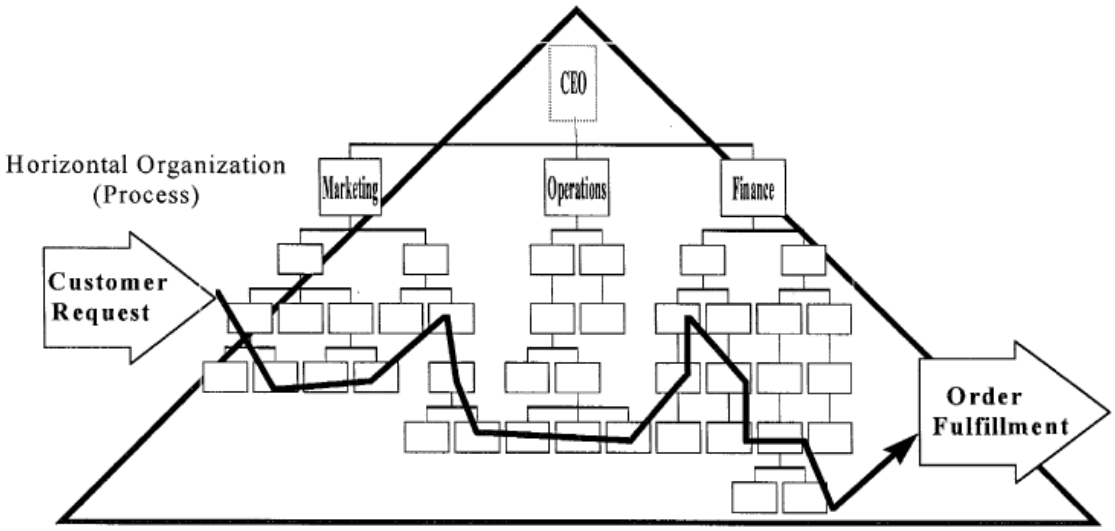

Figure 6. Process flow in an organisation (Grover and Malhotra 1997: 200)

A more traditional conduct of a process could see the functions as isolated entities considering only their own activities related to the flow. This can lead to development done only on function level with a goal of improving function level performance. The function wont necessary consider the impact to the whole chain. Furthermore, if the process needs higher level recurring decision making to resume to the next stage, it could slow down the process considerably.

Thus, in reengineering, business process is seen as an input-output activity with customer in both ends of the process. Customers can be internal or external to the organisation. Processes that are important to the customer should have an owner to avoid

confusion and suboptimization. By empowering skilled workforce, the organisation could integrate decision making in the work itself and reduce lead-time with abolishing vertical decision making. Lastly integration between functions could improve understanding of the process as a whole and reduce inefficiencies seen with isolated functions. (Grover and Malhotra 1997: 199-200)

Grover and Malhotra (1997) divide a generic reengineering project to six stages: preparation, process-think, creation, technical design, social design, and implementation. Preparation highlights the need of executive level consensus on the project and understanding of the cross-functional nature of it. Process-think consists of methods and tools to define what processes might be worth looking into considering their importance to the customer. Creation stage analyses the competence of the current process and seeks the means for development or if a complete redesign is needed. (Grover and Malhotra 1997: 201-205)

The interesting parts of the generic reengineering concept are the stages of technical and social design. These plans highlight the radical changes that a reengineering project desires to achieve. The technical design describes what is needed on technical level and the social design describes how the people are adjusted into the new systems and procedures.

The technical design includes resource needs, performance metrics, system design, integration, etc. The social design considers the people dimension. Such as the roles and responsibilities in the new process, what training is needed, organisational structures, etc. These two elements are essentially change management in its core. (Grover and Malhotra 1997: 202-204)

4.1.3 Enablers of Reengineering

Achieving a reengineering project is not necessarily easy or even appropriate for every company. Conducting a project of this magnitude needs understanding and management. Grover and Malhotra (1997: 205) suggests that there are two enablers of business process reengineering: IT enablers and organisational enablers.

Reengineered processes typically are cross-functional. Processes can be serial or parallel with input-output relationships consisting of transferring information or physical objects. Grover and Malhotra (1997:205) argues that the goal of a reengineering project is to maximise parallel coupling and increase information exchange. This means that processes with lots of sequential steps might be slow as the work is always subject to work completed in the preceding steps.

Modern IT solutions can be utilised to achieve more parallel coupling. Shared collaboration tools and databases provides an opportunity to work independently from other participants in the process (Grover and Malhotra 1997: 205-206). In essence workflow enabled collaborative systems can reduce physical decoupling even further as tasks can be presented and completed without the need of person to oversee them.

However, the use of IT to simplify existing procedures is probably not enough. Traditional processes tend to have lots of vertical movement where a manager needs to evaluate and approve the stage before the process can proceed (Grover and Malhotra 1997: 206). Vertical movement might slow down the process and remove the decision power from the people that are key in performing the process. Grover and Malhotra (1997: 206) suggest the use of organisational enablers to mitigate the issues. The solution can be a cross-functional team, a case manager, or a process generalist.

The advantage of a cross-functional team is that the members can act as an interface to their respective functions and increase responsiveness in the work. The company might try to fade the functional border with employing a case manager that has the overview of the status of the process. The case manager could then coordinate the work of functional specialist and act as a single point of contact. Even more radical could be to utilise process generalists that work cross-functional concentrating on that process. This could eliminate the need for functional specialists. (Grover and Malhotra 1997: 206-207)

Combining the use of organisational enablers such as case managers and process generalist, the company can increase responsiveness. The inefficient functional interfaces would be abolished and replaced with better overall process management. These organisational changes coupled with IT enablers to enhance information sharing and collaborative work further integrate the functions to the process. However, to achieve the final goal, there are also a need for change in the human resource systems. With more empowered people that are given decision power where the problem occurs, any reward

system and performance measurements have to switch focus from functional performance to process performance. (Grover and Malhotra 1997: 207)

4.2 Capacity Planning

Capacity planning requires understanding on demand, forecasting and capacity allocation. Customer demand might be realised in the supply chain with a considerate latency. Thus, forecasting is important to try to anticipate the customer demand even before the actual demand realises. The forecast must be translated to a capacity plan in production. The company has to choose the method how to allocate capacity for customer demand.

In this sub-section the concept demand is first explored. Then basics of forecasting is discussed, and a relatively easy but possibly effective method of advance order forecasting is presented. The final part discusses agile capacity planning.

4.2.1 Understanding Demand

Demand for shorter lead times produces different challenges as how to effectively plan capacity but uncertainty in the business is what causes problems in forecasting. A stable demand produces more accurate forecasts than uncertain demand (Christopher 2011: 83). Of course, forecasts are always prone to error and as figure 7 shows the longer the scope the error increases drastically.

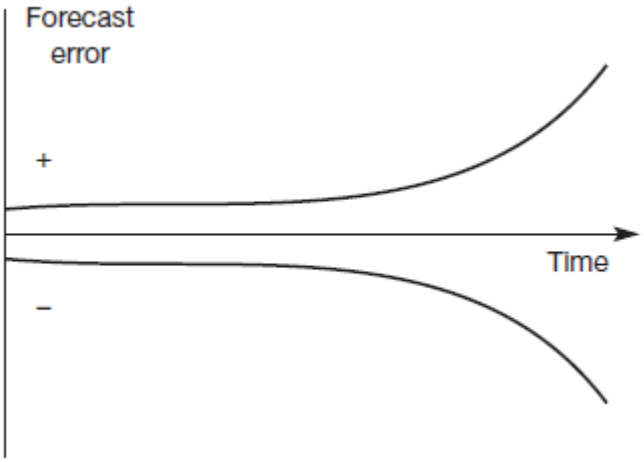

Figure 7. forecast error increases with time (Christopher 2011: 84)

Thus, it is important to separate actual demand and forecasting demand. Demand is something the end customer is experiences at any given time. Demand is not necessarily apparent in the supply-chain and information on demand distorts as it moves upstream. This due to customers order behaviour. A customer might have a relatively stable usage pattern but places orders at irregular times and varying quantitates. (Christopher 2011: 86)

Supply chain visibility is a key concept here and it is influenced by where the demand penetration point is in the supply chain. Christopher (2011: 85) describes the penetration point as:

> "The simplest definition of the demand penetration point is that it occurs at that point in the logistics chain where real demand meets the plan. Upstream from this point everything is driven by a forecast and/or a plan. Downstream we can respond to customer demand."

Thus, the main challenge for a supplier is to try to push the penetration point upstream to increase visibility on true upcoming demand and gain better understanding of customer requirements (Christopher 2011: 85-86). Thus, we can conclude that using only order data as a forecast is limited as in many cases it is not possible to draw relations to any new orders. This Christopher (2011: 86) calls the information iceberg which is seen in fig. xx.

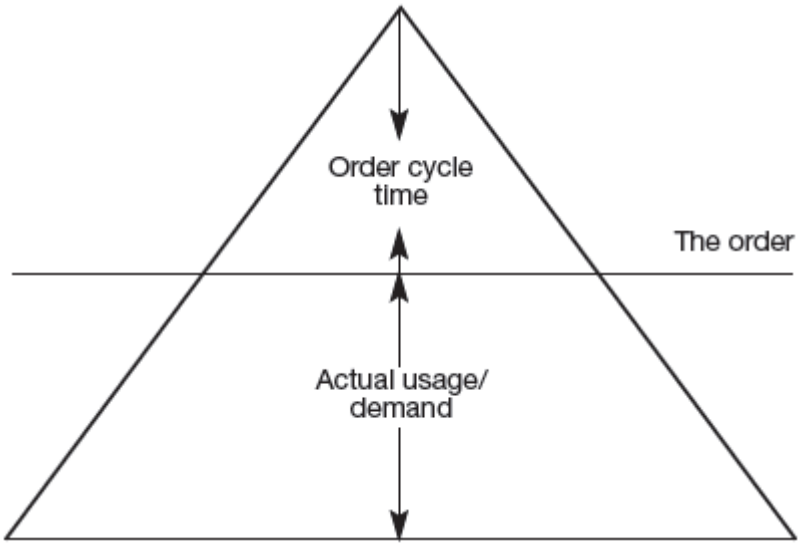

Figure 8. The information iceberg (Christopher 2011: 86)

A supplier sees only the tip of the iceberg i.e., what is over the surface. If there is no visibility under the surface, the supplier cannot be prepared for any order behaviour changes due to fluctuations in actual demand. Christopher (2011: 87-88) argues that the longer the distance to actual demand the higher level of capacity and inventory must be held to be able to react to orders. This increases costs for the supplying companies as there is pressure to increase capacity and inventory.

In other hand, if visibility in the supply chain can be increased and thus move the demand penetration point closer forward in the supply chain, it is possible to construct the supply chain to be more responsive and faster (Christopher 2011: 88). It is probable that this would reduce costs and wastage with suppliers. There are now indications that companies are acknowledging opportunities in sharing information between partners (Christopher 2011: 87) and it is even perceived as one of the most important strategic priority (Gates et al. 2016: 19-20, Gates et al. 2018: 18) for companies.

4.2.2 Forecasting

Most companies employ some level of forecasting. But as the business environment is increasingly more volatile there are pressure to seek more accurate forecasting.

Customer order cycle influences how forecasting can be achieved. Customer order cycle is defined as the time a customer is prepared to wait for the order fulfilment (Christopher 2011: 84). This time varies depending on the nature of the business and the products in question and can be anything from hours to months. In example if the customer typically places orders four weeks before the delivery, any credible forecasting scope cannot be longer than the typical four weeks lead time (Utley and May 2009: 34).

Thus, companies seek to combat uncertainty in demand by carrying a certain amount of inventory which results in costs (Christopher 2011: 84). Same can be applied to resourcing. If the order visibility is limited, a company might be required to maintain excess capacity to be prepared for OTD and quality requirements.

Of course, opening the supply chain for transparency is not an easy task. Digital readiness of partners needs to be evaluated extensively (Gates et al. 2018: 17) as some companies might not be able to provide means for reliable and secure data transfer or

have capabilities to use data (KPMG 2014: 18-20). Key factors to consider are in example ERP maturity and systems that enables integration (Gates et al. 2018: 17) and cyber readiness to combat difficulty in transfer of information securely (Gates et al. 2018: 17-18).

But if companies can deepen the partnership and increase supply chain visibility mutual advantages can be gained. When the visibility extends further upstream a customer can seek even shorter lead times and the supplier can match these demands more easily with lower costs (Christopher 2011: 86-87).

4.2.3 Use of Advance Order Data in Forecasting

Increasing computational power and the emergence of user-friendly business analytics tools have made data-driven analysis and forecasting easier to organisations. This might tempt companies to build complex forecasting models.

However, Utley and May (2010: 33) have noted that most complex models have not been implemented as they need specialists. Instead, organisation should seek to utilise more efficiently existing data in a way that is understandable for managers to make decisions.

Utley and May (2010) propose a method of utilising advance order data to build a forecasting model. They argue that accurate forecasting is not possible for a longer period than the typical longest lead time (Utley and May 2010: 34).

Most companies utilise time series models that considers historical trends as a base for future predictions. These can of course have important implications in the planning of operations but have a significant shortcoming. Time series models assume that there is undefined causality in the data (Wacker and Lummus 2002: 1016). This means that the model does not include the reasons why the demand is fluctuating. It just assumes this will happen.

Causal models try to understand what and why is influencing the forecast. It utilises variables that are assumed to have causal effect on demand. But these models might become too complex and rely too much on accurate understanding of indicators and variables that affect the forecast. Thus, the actual forecast is as good as the prediction of the underlying variables. (Wacker and Lummus 2002: 1016)

Using advance order data is relatively simple method to use in relatively short-term forecasting and used in operational planning. The first question is that what is the typical lead time of a customer. In the example below it is determined to be 1-4 weeks before delivery. The second question is how much units are ordered by week. (Utley and May 2010: 34)

	Week 1	Week 2	Week 3	Week 4	Actual total demand for week 5
	h=4	h=3	h=2	h=1	
Weekly Demand in Units	12	21	20	25	
Cumulative Demand in Units	12	33	53	78	80
Cumulative Proportions	.15	.4125	.6625	.975	1.000

Figure 9. Weekly Demand, Cumulative Demand, and Cumulative Proportions (Utley and May 2010: 34)

The third question is how the demand builds up cumulatively during the weeks. This cumulative demand can be evaluated against the total realised demand in week five to determine the proportion of realised demand. In example, as seen in figure 9, two weeks before delivery 66,25% of the demand was known. (Utley and May 2010: 34)

This method is a multiplicative model and in its simplest form assumes that the cumulative build-up remains the same. This might not always be the case, as customer behaviour can change. Utley and May (2010: 35) suggests that the proportion part of the equation can be updated by exponential smoothing. The same can be approached by an additive model where the total demand is the sum of known and unknown components.

Utley and May (2010: 36) suggests that the multiplicative model is more accurate when the company can influence in advance (e.g., with a price promotion) the customer. The additive model is seen more accurate in situation where demand is fluctuating by apparent randomness. Utley and May describe a more advanced regressive model to calculate the cumulative demand in the article but in the context of this thesis a multiplicative model is tested.

4.2.4 Agile Capacity Planning

Companies utilises several strategies in its operations. One key strategy is related to supply chain responsiveness and customer satisfaction. Even though most literature discusses supply chains in the perspective of a manufacturing company, any company inside the supply chain must choose a strategy of its own to be able to respond to the customer's needs and expectations.

Lean thinking is one prominent approach adopted from the Japanese car manufacturer Toyota. Lean was developed in the 1950's to reduce waste in engine manufacturing and later the approach was accommodated to consider whole supply chains (Hines et al. 2004: 994).

In contemporary lean thinking the key focus is on customer value. What activities are creating value for the customer and what are not. Wasteful activities should be eliminated but it is ultimately the customer who defines what is valuable (Hines et al. 2004: 995-997). However, critics of lean has usually noted its low tolerance of variability in demand (Hines et al 2004: 998; Christopher and Towill 2001: 236). One of the reasons is that leans pursuit of reducing waste means that to utilise capacity the demand must be rather stable. Lean approaches as mixed model scheduling and level scheduling have been introduced to try to control demand (Hines et al. 2004: 1000) rather than to be responsive to it.

Thus, if the company operates in a volatile marketplace and has adopted a lean approach, they might end up with stock outs if the production lacks agility. Whereas lean manufacturing could consider utilising strategic inventory as a waste due to costs it could also be seen that lost sales are costs as well (Christopher and Towill 2001: 238). Christopher and Towill (2001) suggest that lean and agility can be combined to a hybrid strategy. This means that the company could use some basic tools to employ lean in part of the operations to minimize waste but still be agile where it matters. Christopher and Towill (2001: 239-242) discusses three tools: the Pareto curve approach, de-coupling point, and separation of surge and base demands.

The Pareto Law states that 80 percent of total volume is generated by 20 percent of products. Vice versa the last 20 percent of volume is generated by 80 percent of products. Thus, Christopher and Towill (2001: 240) suggests that the 20 percent products are

more predictable in consumption and could be using lean approach. The remaining 80 percent of products are moving slower and therefore needs more responsive methods in manufacturing.

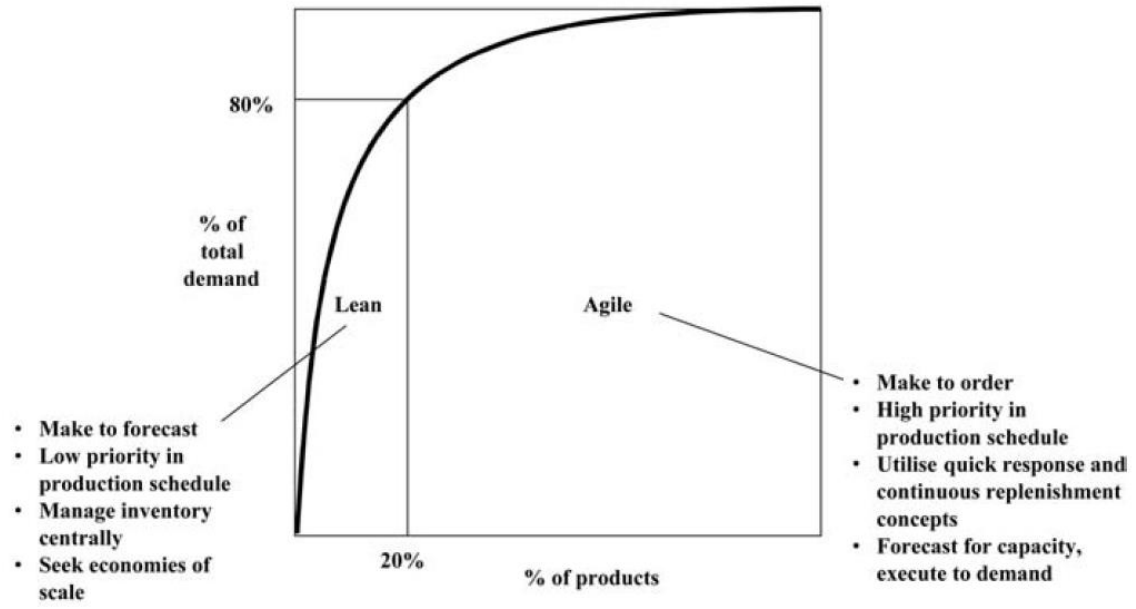

Figure 10. The Pareto Distribution (Christopher and Towill 2001: 240)

The de-coupling point approach suggests that a company keeps a strategic inventory of half-finished products and when the actual orders are placed, final assembly and customisation is done. A company could therefore utilise lean methods up to the inventory and agile methods from the point on when actual customer demand is known. (Christopher and Towill 2001: 240-241)

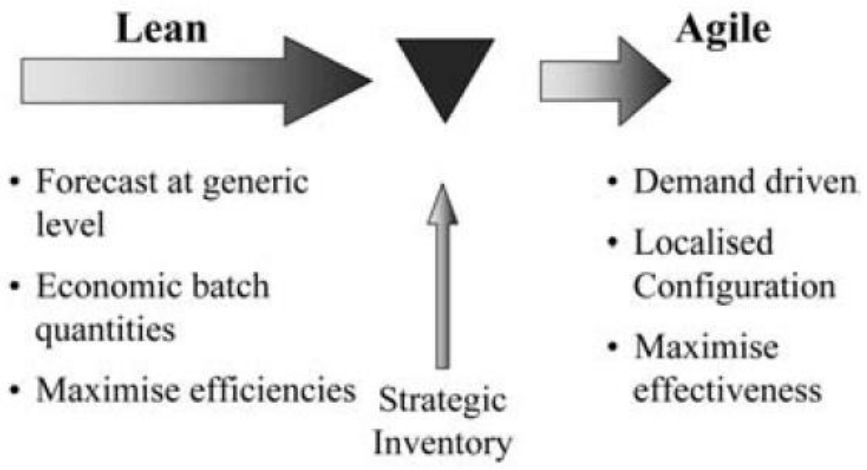

Figure 11. The Decoupling Point (Christopher and Towill 2001: 240)

Of course, a requirement is that the company is able to build its products in a modular fashion that utilises rather generic base that can easily be customised later on. This method could reduce the risk of obsolescence in the inventory if a particular configuration is not in demand.

Separation of surge and base demand is a method for level scheduling. The basic idea is that base demand can be predicted and the capacity for it could be planned by lean principles. Surge demand however is hard to predict, and various actions can be used to deal with it. Base demand could be sourced from a low-cost country and surge demand could be manufactured near the market that generates it. A second method could be separation by space or time. In the first method surge demand is manufactured in separate production lines. The second method uses slack time to produce base stock. (Christopher and Towill 2001: 241)

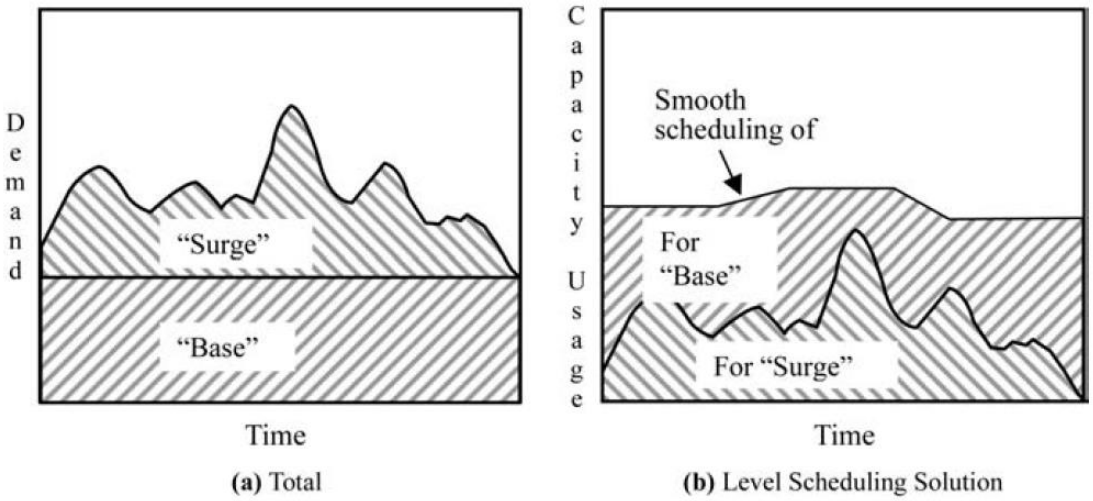

Figure 12. Responding to Base and Surge Demand (Christopher and Towill 2001: 241)

These different methods could be utilised together in several ways, and they are not considered as mutually exclusive. However, in the end these strategies can work better in certain situations and environments. The customer affordability and availability are important part of selecting a strategy. (Christopher and Towill 2001: 242)

4.3 Roles and Responsibilities

To achieve efficient decision making, an organisation needs to assign roles and responsibilities accordingly. This is especially important in projects but also in cross-functional business processes, were decision making authority might come under scrutiny.

At first a distinction between a job description and roles must be made. A role does not list all the different activities or tasks. A role description describes the unique aspects of the role and what is its expected value to the organisation. (Galbraith et al. 2002: 101)

In general, a role has two dimensions: outcome and responsibilities. Outcomes are what is the goal for the role to perform. Responsibilities are then task's that the role needs to execute to achieve its desired goal. (Galbraith et al. 2002: 101-102)

In defining roles interdependencies must be considered. For example, is another person's work affected by the timeliness and quality of another person's actions? This means that there are interfaces between persons in the organisation, and if these are

not effectively managed, it might disrupt process workflows. (Galbraith et al. 2002: 103-104)

Whether the organisation is working with cross-functional business processes or complex projects, it needs a clear set of roles and responsibilities. This will ensure the decisions are made by the right people with the accepted lead time, reduce confusion and improve the effectiveness of the workflow. There are several methods and models to map and assign roles and responsibilities.

One common technique to define responsibilities for roles is responsibility charting (Galbraith et al. 2002: 107). Responsibility charting is also known as a RACI-matrix (Costello 2012: 61). RACI is an acronym for: **R**esponsible, **A**ccountable, **C**onsulted, **I**nformed. These definitions are described in more detail in table 15.

	Key	Description
R	Responsible	The person who is responsible for the decision making.
A	Accountable	The person who is accountable for the decision making but do not necessarily make them.
C	Consulted	A person that is consulted prior to the decision making.
I	Informed	A person that has to be informed after the decision making.

Table 15. RACI descriptions (Galbraith et al. 2002 : 107)

A responsible is the person or a role that ultimately makes the decision. For every decision there must always be a responsible and only one person or a role can be responsible (Galbraith et al. 2002: 107). An accountable is a person that is in the end accountable for the decision making (e.g., a senior manager) and there can only be one accountable (Galbraith et al. 2002: 107; Costello 2012: 61). With these strict rules an organisation can reduce confusion on decision making procedures.

The other two labels seen in the table 15 are consulted and informed. A person assigned to be consulted is required to give input prior to any decision making (Galbraith et al. 2002: 107). Costello (2012: 61) suggest a more active definition of the C-label: contributor, who would be an expert on the subject matter. People who are labelled as informed would be required to get information of the made decisions. Typically, the persons labelled as responsible would also be responsible for communicating the decisions (Costello 2021: 61).

In some cases, the organisation can include a fifth role, the veto, to the list. A person with veto power can block a decision. It is important to note the difference with the veto power assigned in the matrix to that power a manager higher up in the hierarchy naturally observes. The veto power is given to certain person or role only in the context of a specific decision. (Galbraith et al. 2002 : 107)

Implementing a responsibility assignment to an organisation might need understanding of change management as the result might differ greatly from the current state in the organisation. An organisation can pursue defining the roles and responsibilities in different ways but ultimately people participation can be beneficial.

The organisation could approach the subject with a matrix of roles and responsibilities and ask the people to label the matrix as they see it. Found differences can be discussed further to find a common ground. In the future a responsibilities matrix can be used to solve disputes and even make easier defining job descriptions. (Galbraith et al 2002: 107-108)

4.4 Conceptual Framework of This Thesis

The conceptual framework is a way of combining different elements found in literature. The output is a summary of ideas, best practice, and knowledge on the selected topics and how they are related to the study at hand. In the context of this study the conceptual framework is describing the core findings that were discovered to tackle issues found in the current state analysis. It will guide the proposal building stage with the goal of improving the agility of the resourcing activities. The framework is seen in figure 13 below.

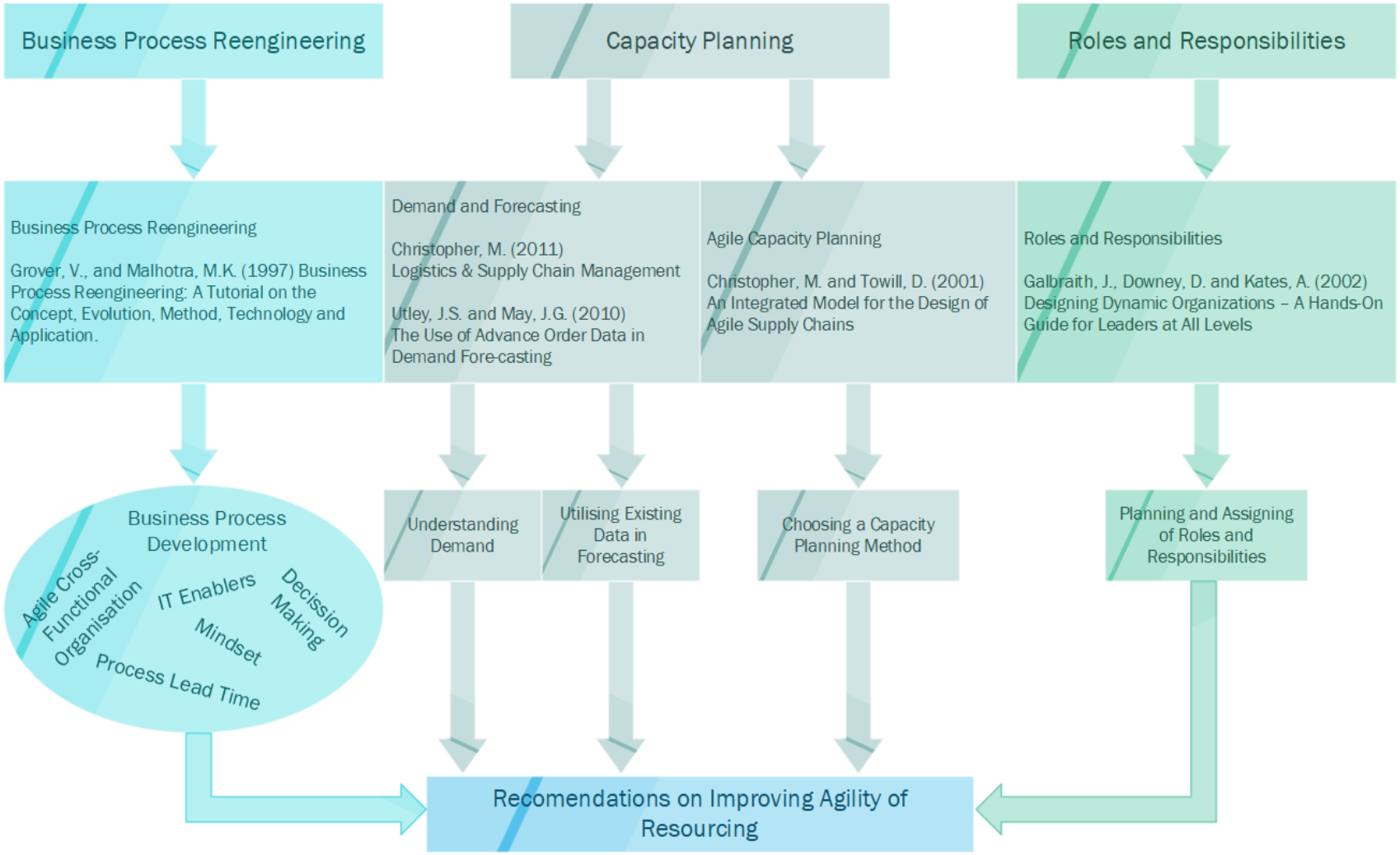

Figure 13. Conceptual framework of this thesis

The issues found in the current state analysis were divided to three categories: process functionality, forecasting and capacity planning, and roles and responsibilities. These elements were researched in the literature to find theoretical knowledge but with the context of the case company in mind.

First element considered improving the process functionality. As there was a lack of functioning process and issues with cross-functional activities, the concept of business process reengineering was researched. The knowledge presented in this work do not deliver a finished model on how the setup should be made, rather what are the key enablers to achieve agile and transparent decision-making utilising IT solutions and people empowerment.

Second element addressed the issue of low forecast visibility and lack of a coherent capacity planning method. Researched sources included theoretical knowledge on understanding demand and the importance of forecasting. As the company needs to build its own forecasting models, it was studied how to utilise existing data in simple forecasting model could be done. Furthermore, agile capacity planning was explored to find ideas on how to manage production with several operations with different lead times to smooth out the peaks and valleys of demand.

Third element comprised on how to assign roles and responsibilities with a RACI-matrix approach. The issue was that roles and responsibilities were unclear in cross-functional resourcing activities. Thus, there was a need to define the responsibilities and key stakeholders in decision making scopes.

In the next section the process of building the proposal is discussed. The findings of the current state analysis and the theoretical background were taken to a workshop with the key stake holders in the resourcing activities to find solutions to problems.

5 Building a More Agile Resourcing Process

This section merges the results of the current state analysis and the conceptual framework towards the building of the proposal using Data 2.

5.1 Overview of the Proposal Building Stage

In the current state analysis, it was found out that there was no coherent process or procedures to manage resourcing decisions. The key drivers of the problem were identified to be isolated nature of the departments and thus lack of clear roles and responsibilities. Furthermore, there was no forecast in use and thus a lack of understanding real capacity needs.

As it was seen that the historical forecasting was too unpredictable, a more advanced forecasting techniques were researched. It was also believed that involving the customer in close co-operation would be beneficial. Also, it seemed that the process needed a larger overhaul. Ideas on managing cross-functional processes and what enables an organisation to be agile was seen into.

To manage the scope of the proposal, a questionnaire was presented to the operational management. The goal was to find common ground on roles and responsibilities and what resourcing activities had the least trust.

These findings were taken into a workshop with a limited participatory of the management and discussed further. The workshop was presented with a proposal on roles and responsibilities for validation. The second objective was to choose from the resourcing activities a timeframe and key activities to develop into a proposal. Short-term visibility, agility of decision making, and cross-functional co-planning were seen as the elements with highest reward.

Thus, the key directions the proposal building stage took was to work out a framework for a resourcing process that has relevant enablers to function effectively. These were the realisation of the cross-functional nature, defining forecasting methods and capacity planning logic, and assigning roles and responsibilities.

The outcome of this stage was a suggestion of a new framework for the resourcing process, assignment of roles and responsibilities, a model for forecasting and overview of key procedures and practices.

5.2 Findings of Data Collection 2 (drawing together Data 1, CFW and Data 2)

The primary core of the proposal building stage was a workshop where findings of the current state analysis was presented. The audience consisted of supervisors and the site management. Key discussions revolved around the main focus areas chosen in the end of chapter three. The exact perspective shifted on some issues when solutions were discussed. Key suggestions are outlined in table 16 below.

	Key focus area from CS (from Data 1)	Suggestions from stakeholders (Data 2)	Description of the suggestion
1	Appropriate planning scope not determined	Planning scope of next few days.	Supervisors and operation managers agreed that most efficient planning scope is only the next few days. A longer time period was not deemed functional and there was belief that overall trends are sufficient.
2	Unclear Roles	Integrate the site. Define resourcing roles.	Operation Managers suggested that the site resourcing should be guided by the resource manager that was at this point concentrating only on part of the site. Also, it was seen that a single point of contact between supervisors and the agencies was needed to simplify recruitment.
3	Limited customer co-planning	Involve the customer to find a forecasting method.	Related to an earlier proof of concept study with the customer it was suggested that a new project should be suggested to the customer.
4	No method for capacity planning method	a) Co-planning between the departments. b) Tools for capacity planning.	Related to the discussion on integrating the site it was seen that planning should be done together. Every department should present their plan and justify its decisions. A tool for capacity calculations is suggested to ensure transparency and reduce anecdotal arguments.
5	No process for managing resource movements	Co-planning between the departments.	Based on the forecasts and current operational status the departments should be more active in transferring excess capacity to others. As one operation manager said “playing safe for my own department” must be reduced.

Table 16. Summary of suggestions gathered in the workshop

Some of the findings were discarded quite early. One of them was the problem that there was a lack of understanding of real capacity. This would have meant an extensive analysis on all activities that contribute or stem from picking activities. During the workshop this was not seen as an interesting direction.

Instead, in the discussion the operation managers brought up that they had problem with the flexibility of the resources at hand. Part of the problem was due to issues with transferring resources between departments but also because insufficient training. Some workers had extensive knowledge of several activities, and some were experts on few. This meant that when a multi-talented worker was absent, there were serious problems to accommodate the need.

After the workshop, some parts of the proposal were formed but later there were several other discussions and forums that influenced the results. The main being a proof-of-concept project with the customer in late 2020. Also, during the proposal building of this thesis, some of the actions proposed in the workshop, such as integrating the operations and grounding the resource managers influence on the operations, was initiated. In this time several discussions on procedures and tools were held with the resource manager which contributed to this proposal.

The proposal is divided into three elements. The first seeks to improve the issues in process functionality. The second element considers the capacity planning with high emphasis on forecasting techniques. The third element describes roles and responsibilities in the organisation regarding the resourcing activities and process management. The key suggestions made during the building stage are illustrated in figure 14 below.

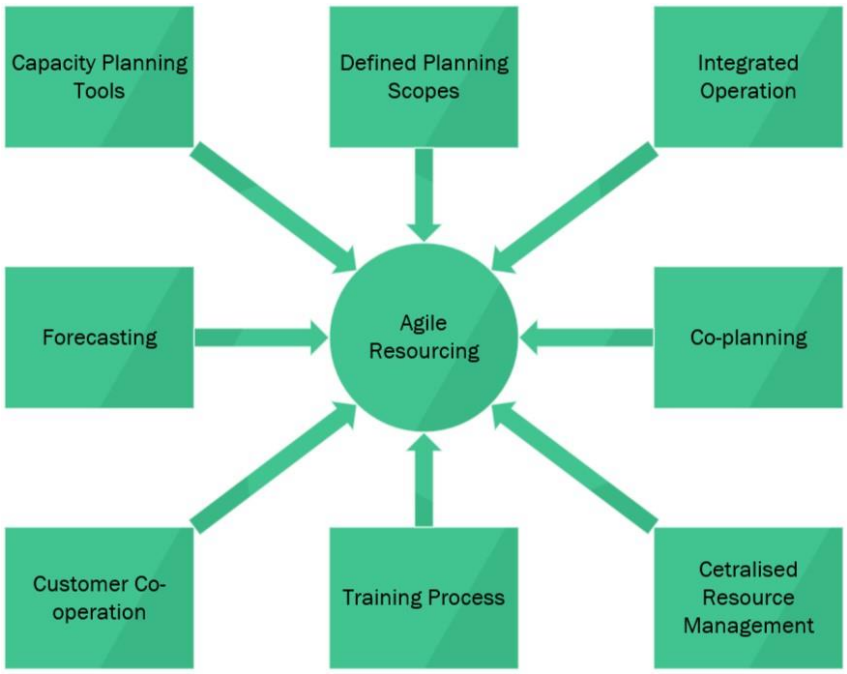

Figure 14. Suggested components for agile resourcing

With the different components decided and the primary scope planning scope of the resourcing process was agreed upon, the solution was constructed. The proposal is divided to three sections. The process, forecasting and capacity planning, and roles and responsibilities.

5.3 First Element of Proposal – Building the Process

The first element of the proposal considers the resourcing process itself. During the development of the proposal, it was seen that there is no definitive solution to a resourcing process. One key issue is that resourcing, and capacity planning is done on different management levels and by varying timeframes and detail.

In this sub-section a framework for resourcing is proposed. The idea is for the operations to understand what elements effect the capacity on any timeframe and the need of a feedback loop to develop these elements in a continuous improvement fashion. Furthermore, procedures for resourcing decision are described. The last part considers training, as it is a key sub-process for achieving quality and agile capacity.

5.3.1 Framework of the Resourcing Process

The issues encountered on the previous resourcing activities had a root cause in fragmentation of the operation, lack of a process and procedures, and several layers of planning. Planning was done on current workday and on a weekly scope. Furthermore, there were ad hoc planning activities covering months, summertime, holiday period or the next year.

Most of these timeframes presides in the proposal but this means that no definite process is proposed to cover all the timeframes. The timeframe logic with a feedback loop is presented in figure 15 below.

Figure 15. Timeframes in the new resourcing process

The idea is that every decision level must affect the next level and so on. The goal is to ensure that decisions on any level is carried on to the next and thus the decisions are not in conflict. At the same time, a feedback loop must be set in place to feed information back up the chain. The information is processed performance data with an emphasis on resourcing so higher levels of planning can take actions on deviations.

Resourcing can also be seen as a business process with an input from the customer. In essence it is the companion of the delivery process, as delivering of an order need resources. Thus, resourcing should be seen as activity that gives value to the customer and improve that value, resourcing as a process must be iterative. As seen in the figure 16 below, warehouse capacity is influenced by certain elements and on the other hand

enabled by certain elements. A feedback loop ensure that these elements are developed to improve the capacity and operations capabilities.

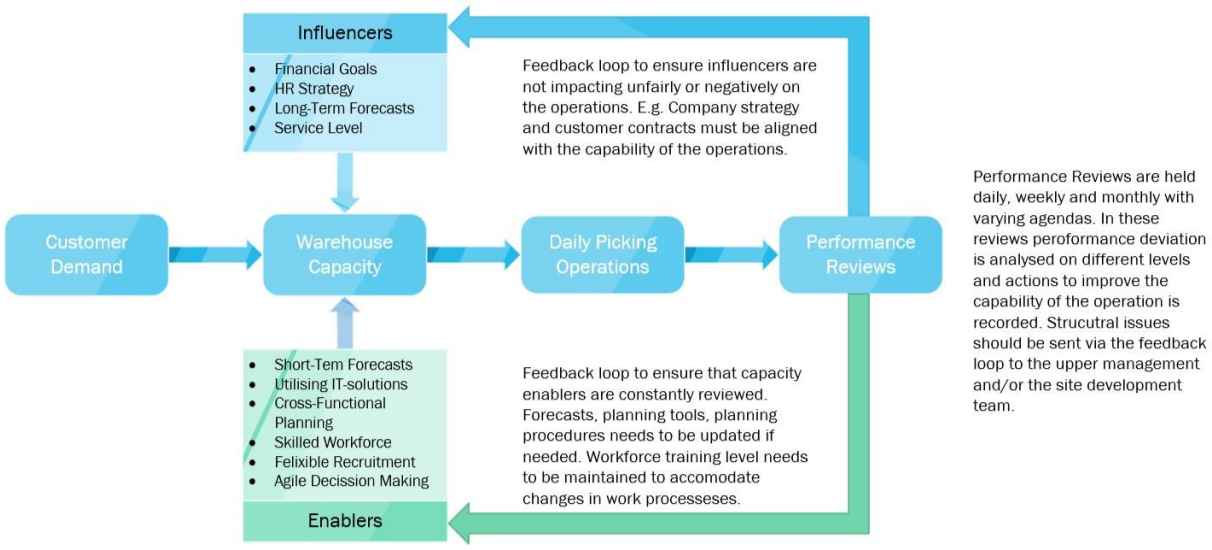

Figure 16. Resourcing Process Framework

The input of the process is customer demand. This demand is realised on various levels of time frames from same day deliveries to advance orders and make-to-stock orders. How these different picking operations and timeframes are managed, varies somewhat, and is discussed later on of this proposal. However, the capacity of the warehouse and decision making about the capacity does not in general differ.

A demand must be met with a capacity. Capacity levels are influenced by more long-term factors. The company strategy sets financial objectives and HR strategy influences on personnel levels and the use of agency workers etc. Furthermore, long-term forecasting given by the customer and the company own historical predictions play a role in determining base capacity. Lastly, the contract agreements such as service level and different key performance indicators influences base capacity.

With a base capacity that is relatively hard to change due to the influencers, the company needs enablers that uses the resources as effective as possible. Minimising waste time but also ensuring the contractual obligations are met.

Enablers are a more precise short-term forecast that is linked directly to customer behaviour. IT-solutions that presents and eases the use of data about demand and personnel availability. Furthermore, tools that speeds up decision making and eases the management of resources across the organisation, even between other sites of the company, be it internal transfers or short-term agency contracts. Lastly, the workforce skills have to be up to date to ensure that cross-functional picking operations are smooth, and a loss of few key workers does not have an impact on performance.

Regular performance reviews will then analyse the deviation from work and financial perspectives. The questions are what drives over or underperformance? What actions are needed that the capacity at hand is utilised as efficiently as possible? Also, it is important to note if there is a financial impact from the performance. It is possible that even when the workforce is performing at the level required, but due to contractual or strategical aspects, the result is financial underperformance.

Thus, a feedback loop of the performance deviation should be sent back to the influencers and the enablers to achieve continuous improvement throughout the organisation. In the next sub-sections different enablers and activities are described the basis of best practice in the company.

5.3.2 Decision Making Procedures

This section outlines the occasions were resourcing decisions are made. From the operational point of view there are two core forums where decisions are discussed and made and one external process. These meetings are in use and defined by the operations. The ideas described in this thesis are proposals for conduct for these meetings.

The daily performance meeting is the first line of decision making but its scope is short. The biweekly tactical meeting discusses more long-term decisions. Also, this thesis will propose a tool for recording, managing, and executing resourcing requests that emerge between the planning occasions or are not in the scope of the decision making.

Performance Meetings

There are three performance related meetings defined by the OMS directives. These meetings are done daily, weekly, and monthly. The general logic of the daily capacity meeting is depicted in the figure 17 below.

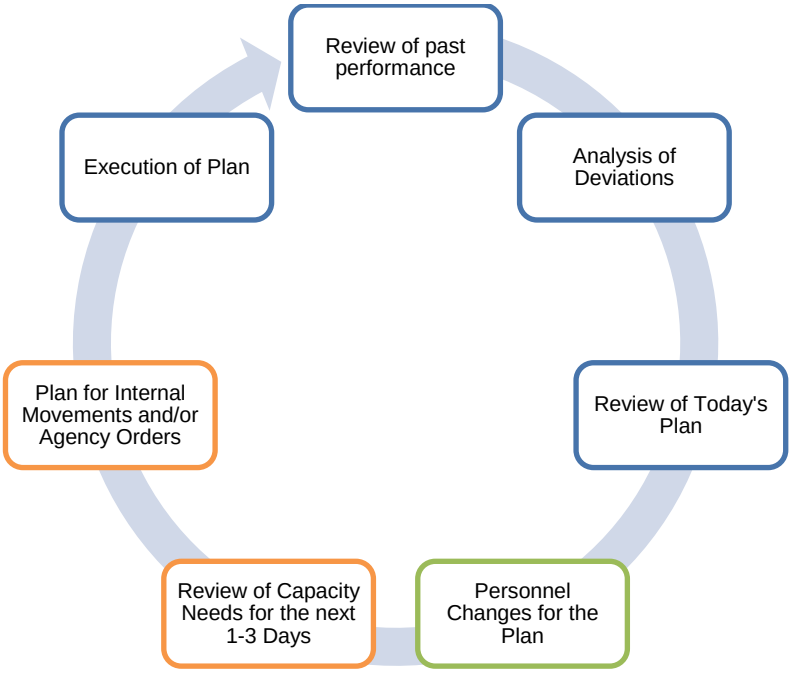

Figure 17. Activities of the Daily Performance Meeting

The first part of the meeting is discussion of yesterday's performance and deviations. After the brief analysis, an update for the current day is discussed. Decisions of internal transfers are made in cross-functional manner. The later part is a review of the upcoming days with the help of an up-to-date forecast. A pre-plan of changes in capacity allocations are made at this stage for the next days. Also, the agency orders are updated, and pool workers are notified of open work slots.

In addition, there are weekly and monthly performance meetings, but this thesis does not consider them at this point. The main goal of the weekly meeting is to find deviations in the performance data and discuss technical aspects regarding how the work is measured. The monthly meeting discusses various metrics that are reported outside the organisation. Mostly, no resourcing decisions are made in these meetings.

Tactical Planning

The biweekly tactical meeting is the main resourcing influencing meeting. The thesis proposes an eight-step process for the conduct. The process framework is displayed in the figure 18.

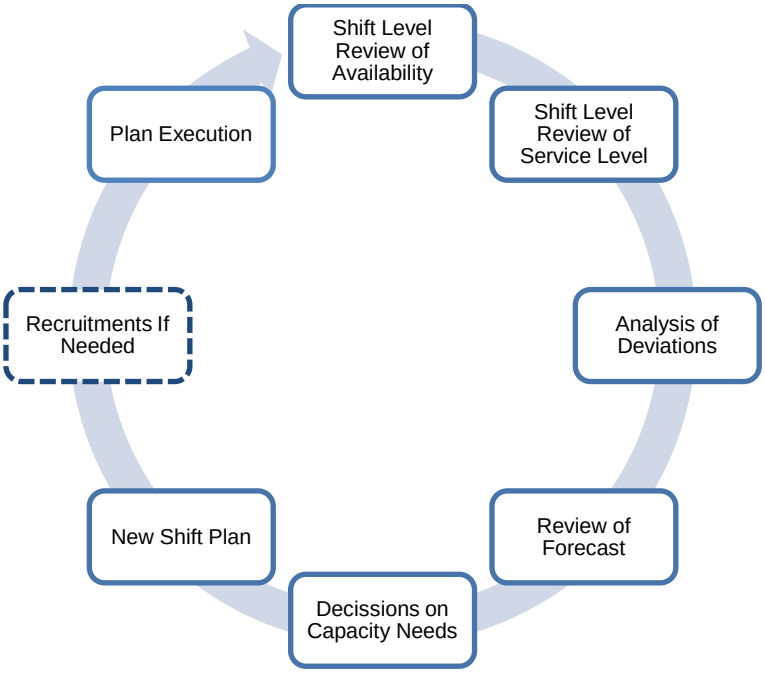

Figure 18. Tactical Meeting Framework

The first two steps of the meeting should consider the personnel availability (performed shifts, lost shifts due to absence, and overtime used) and achieved service level (output volume, on-time-delivery level, and other contractual metrics). The analysis is done on shift level to understand is the balance between shifts and departments adequate.

After deviations have been discussed, a review of the forecast is done. Based on the shift performance and predicted capacity needs, decisions are made to allocate capacity. The decisions can range from transfers between shifts and departments, new agency recruits or contract terminations. With the shift plan ready, and possible agency orders or contract changes recorded, the plan can be executed.

Strategical Planning

Strategical planning in the sense of this thesis will consider any decisions on capacity levels that are done by the upper management. The basis of the decisions are long-term forecasts, contractual obligations, HR strategy, and financial goals.

The scope of thesis is to offer solutions to the operations to maximize the effectiveness of the resources at their disposal. Thus, no suggestions are made to the strategical process. However, a suggestion of a feedback loop is presented in the sub-section 5.1. The general idea is that the operations should feed as much information as possible to ease long-term strategical planning.

Resource Orders

Due to the need to manage tightly but with agility recruitment and long-term transfers, a new tool for resource needs should be built. The tools are mainly for the use of coordinators and supervisors that can place an order on resource needs immediately a need is identified.

The general idea for the requester is to inform via SharePoint-form of the need. The form asks the requester the quantity of the workers, the needed skill level, and is the need constant or temporary. A reason for the request is required too. E.g., has a worker resigned, or is there a long-term absence that needs to be filled accordingly?

The request is then directed to the resourcing team that evaluates the request. The resourcing manager decides on the outcome. The outcome can be a temporary or permanent transfer from another department, a recruit or rejection of the request. The solution is then routed to the operations manager that accepts it or rejects it. If the solution is accepted, a task is assigned to the process coordinator that do the necessary steps to initiate a transfer or recruitment.

5.3.3 Training

One important aspect found out during the proposal building stage was the need of understanding what training the workforce needs. There was perceived a significant unbalance between the skills of workers. A process for tracking workforce skills should be built.

The tool would offer management a general understanding of different skills available in the operation. To understand if the available skills are adequate, a review system must be constructed. There are several goals that can be achieved with insight provided with the system such as skill utilisation and skill capacity.

Skill utilisation represents a person level mix of skills used derived from performance data. The supervisors can take actions if a person is using mostly one skill and in need of job rotation. On the other hand, if a person has been trained to a skill but do not use it in certain amount of time, the skill might expire.

Skill capacity is a measure of skill coverage in the operation. Past picking activities are measured against the potential skill capacity. The goal is to identify picking activities that are vulnerable due to absences and management can thus assign more workforce into job rotation and training. Also, it is important not to overtrain the workforce. If a certain picking activity has a heavy overcapacity of skilled workers, the management should direct training into more vulnerable or changing activities.

5.4 Second Element of Proposal – Forecasting and Capacity Planning

One of the key elements to agile capacity planning and right-levelled resource decisions is an accurate enough forecast. Furthermore, the forecast must be translated into capacity needs and managed accordingly.

In this sub-section forecasting techniques are proposed for different parts of the operation and an illustration for the needed data architecture. The latter part of this sub-section discusses the capacity planning.

5.4.1 Forecasting

During the current state analysis picking operations were divided by customer lead-times and shipping destination. Through the discussions few key groupings have been made to establish a rudimentary level forecasting model. These are factory production picking divided to same day and advance order deliveries, make-to-stock deliveries, and make-to-sale deliveries. During the discussions factory production was perceived to have the lowest visibility added with short lead-times so this thesis has extra emphasis on those operations.

Same Day Deliveries

Same day is seen as the highest priority by the organisation. It has the lowest visibility as the customer does not offer any kind of forecasting other than anecdotal. The lead-times are few hours at the shortest so the capacity requirements can vary quite extensively during the day.

Traditionally capacity was built on historical analysis with simple running averages and subjective feel. However, during the thesis process a collaborative model with the customer has been in development. The general idea of the method is to link customer production with order behaviour. A first proof of concept was done back in 2018 with the premise that there is a causal link with production capacity and replenishment orders. This project was scrapped due to time constraints. In 2020 the idea was taken on the table again in a discussion with a customer representative, and the new proposal is built based on the old proof of concept.

The new model dives deeper into the production and order data. The premise is that every product uses a defined quantity of different components and most of the components are handled with RFID-boxes in a *Kanban*-process. Thus, every product consumes these handling units on a predefined frequency. A concept of *Expected Order Lines* was developed for the proof-of-concept study.

The idea of the concept is that every product has its unique factor of accumulated order lines. Simply put, if a product uses one piece of ten different components delivered with a batch size of ten, one product would accumulate to one order line and ten products would accumulate ten order lines and so on. So, in general the model would tell that every box has been replenished after manufacturing of ten products.

However, the products use different quantities of components that are delivered in different batch sizes. For example, seen in table 17 one product type has 21 individual RFID IDs of common parts that accumulate roughly 1,75 order lines.

RFID ID	Pcs / Product	Pcs / Handling Unit	Factor
G0881	1	20	0,05
G0882	1	20	0,05
O0001	3	30	0,10
O0003	1	5	0,20
O0612	2	26	0,08
O0614	6	100	0,06
O0615	3	50	0,06
O0618	6	24	0,25
O0619	8	40	0,20
O0620	3	40	0,08
O0621	1	20	0,05
O0630	3	100	0,03
O0631	5	300	0,02
O0632	5	100	0,05
O0633	1	20	0,05
O0634	1	20	0,05
O0635	1	15	0,07
O0637	1	15	0,07
O0639	1	15	0,07
O0800	3	24	0,13
O0802	2	36	0,06
		Total	1,75

Table 17. List of common parts on one product category

This factor was then used to calculate from production plan quantities an estimate of order lines and compared with actual order lines ordered on the same date. The hypothesis is that it is reasonable to expect around 18 order lines per ten products manufactured. The result can be seen in figure 19.

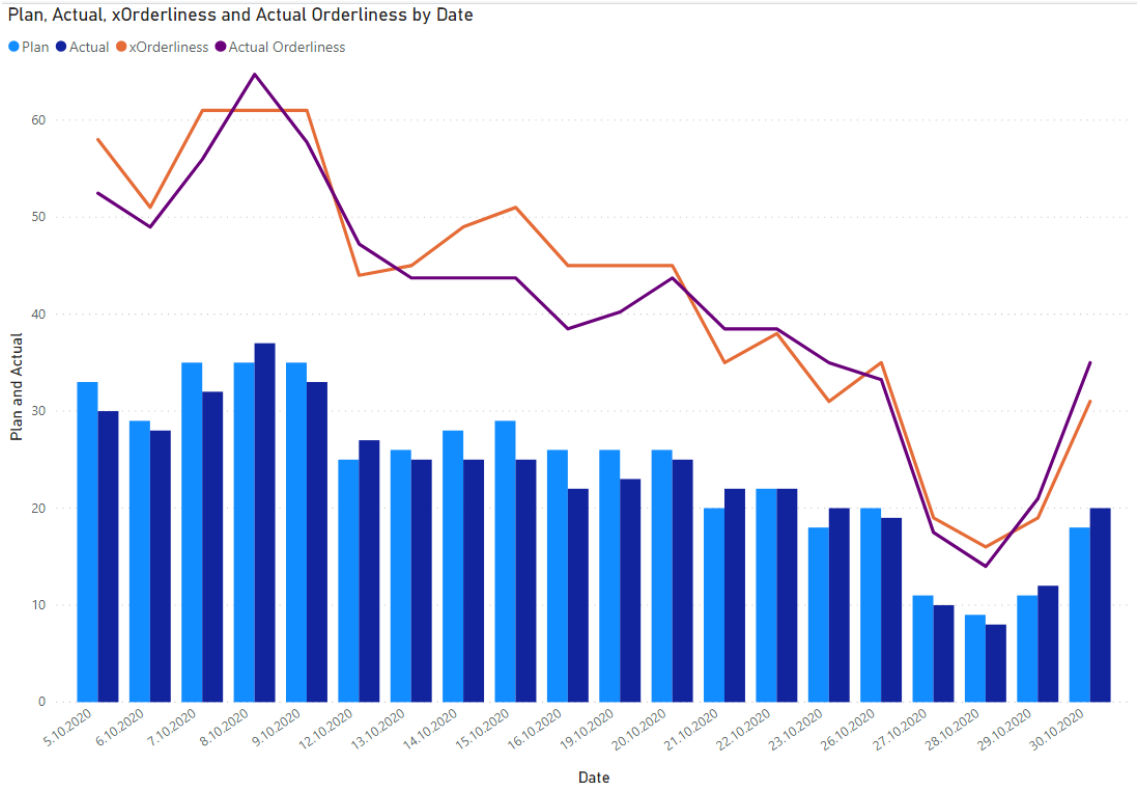

Figure 19. Expected Order lines compared with actual order lines by date.

In figure six we can see that the estimate is following roughly the trend of actual order lines. The deviation between the lines can mostly be explained with difference in manufacturing. When the production line produces less than planed the actual order quantity is less than the estimate and vice versa.

As the method seemed to bring acceptable correlation with production quantities and order lines the study was continued to add variable components in the equation. The production plan is done only on category level and does not consider configurations of the products. The order data was studied to see what share of total order lines variable components have on a daily level. The result is seen in figure 20.

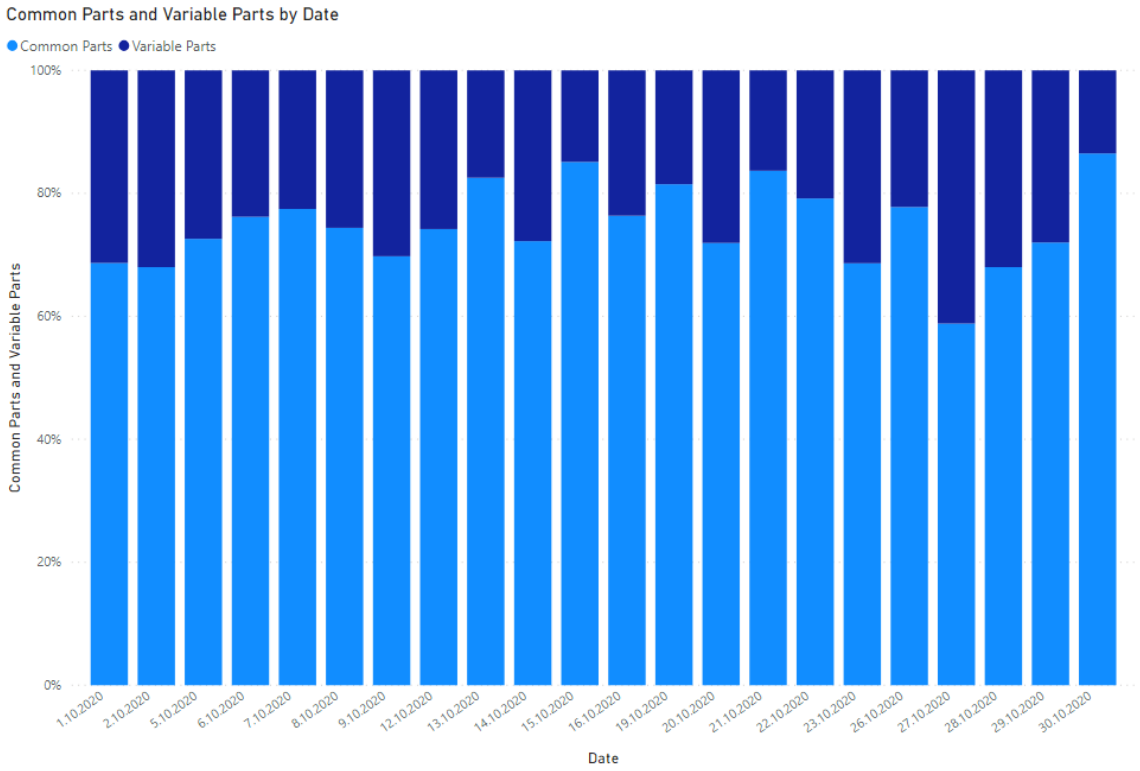

Figure 20. Share of common and variable components on a daily level on one product category

As seen in the figure 7, the share fluctuates significantly on a daily level. It was then determined from historical data the average share of variable parts and used to calculate an estimate to be added into the expected order lines model. Then the factor was fine tuned to align as closely with actual order lines. The result is seen in figure 21.

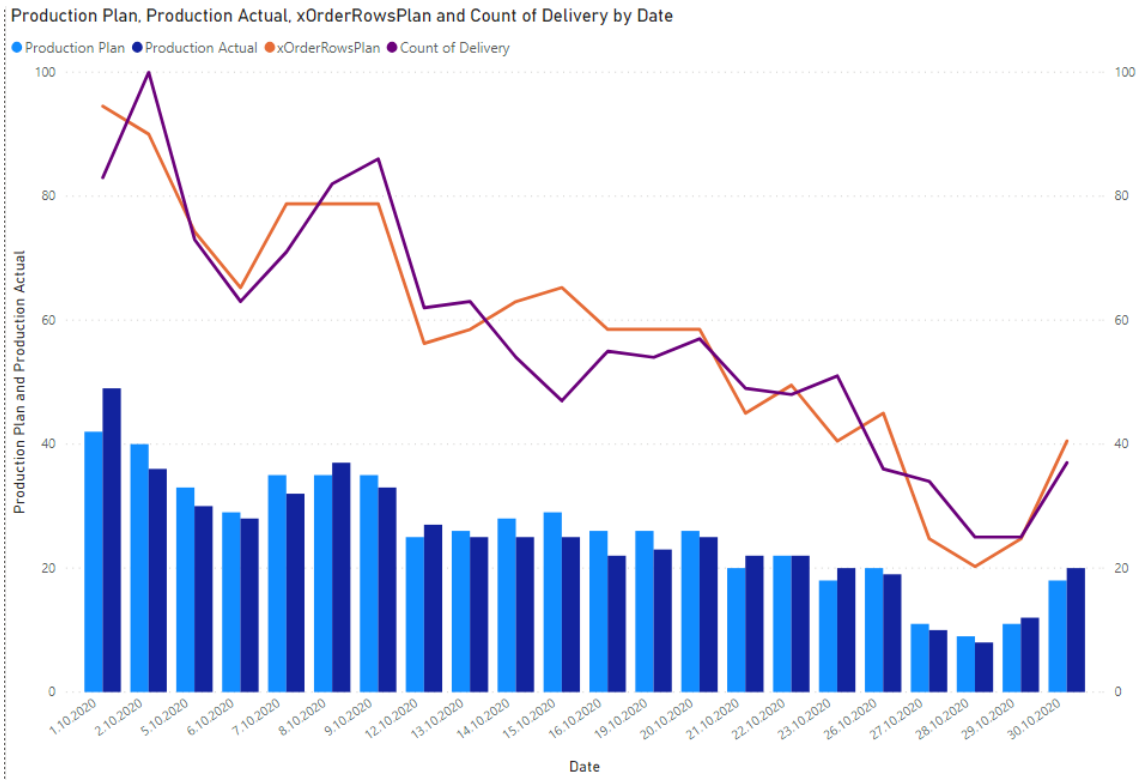

Figure 21. Comparison of expected order lines and actual order lines with variable components considered

As seen in figure 8 the correlation with order lines is still present but, on some days, it seems to decouple. For example, on 9th of October the actual order quantity is higher although the production quantity was lower than planned. These findings were discussed with the customer and factory inhouse logistics representatives.

Few key explanations were suggested to days when the correlation cannot be found. First one is that the model does not know what the opening stock balance was from the point the calculation starts. So, it is possible that several nearly empty boxes of low consumption materials were ordered on those dates after a long idle time. The other one is based on experience with order behaviour. As the assemblers are tasked to order a refill after a box is consumed there might be difference with actual order time and planned order time. This means that if the order is placed after a shift change the order will be calculated in the next shift rather than in the shift it was consumed. The other issue is that assemblers might order before the actual order point by emptying the last contents of a box into the next one in the FIFO-storage for various reasons.

In the last phase the difference of ordered rows against the expected rows were calculated and a +-5 percentage limit were set to an acceptable deviation. The result of the three product categories manufactured on the pilot production line is seen in figure 22.

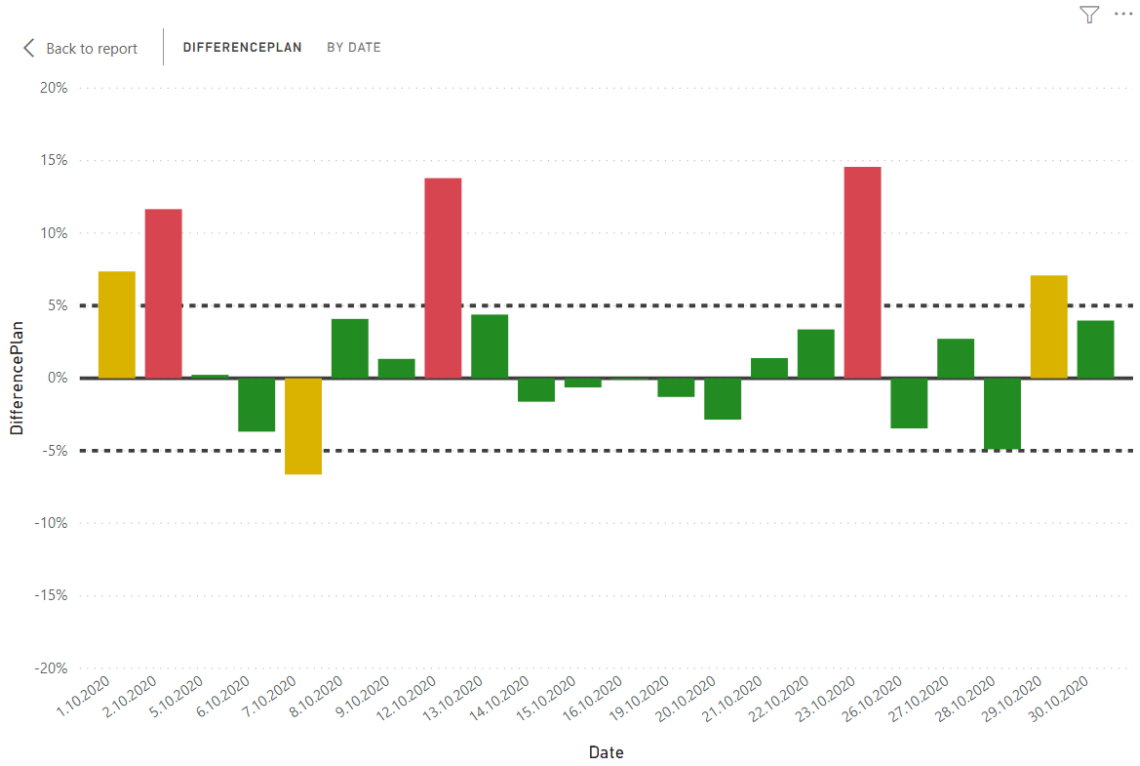

Figure 22. Difference between expected and actual order lines by date

In conclusion it the estimate is in the acceptable range on 72,7 percent of the days in the study month. With time and more study on variables it is believed that the accuracy can be improved.

After the study, a decision was made to continue with building an automated model on customer end to predict order line volumes. In the essence a database service will query on a regular interval from the customers ERP-system changes in the production queue. The database service will combine the plan data from different production lines to one table. This table will be then queried by Power BI -service.

The Power BI -service will clean and transform the data to needed format and add the definition table that links products with appropriate handling units. The definition table is updated periodically by the factory inhouse team that are responsible for changes in logistics procedures.

The Power BI report then displays the predicted volumes and updates it on regular interval which will be decided later. A feedback loop for correcting the forecast is inserted in the model after enough data is collected. If the prediction is continually over or under the actual, the report will use a factor to compensate until a change in the model is done.

Advance Order Forecasting

The short lead time factory production has a solution developed in tandem with the customer. However, the long lead time factory production has not presented yet a similar model. There are some caveats in using the solution described earlier to this because of the nature of the production. The production is more project-minded and producing one unit might take anything from weeks to months. Also, the products are highly configured and component needs are hard to predict as when and how much varies considerably.

A short study on order behaviour was done in the fall of 2018. The goal was to determine if there is any basis in the ‘gut-feeling’ the department supervisor used in capacity planning. The premise was that 2-3 days before the delivery date the level of capacity requirements could be seen from orders that have arrived on a particular workday.

The study used a small sample set and was not further tested but yielded some interesting observations. The data was setup in Excel from a 19-day period in history. Order lines were calculated by creation date in the system. Categories were same day, -1 workday, -2 workdays, -3 workdays, -4 workdays, and earlier. The resulting quantity per category was then compared against the total number of order lines realized on the date. The distribution is seen in table 18 below.

Date	Delivery date	-1	-2	-3	-4	Earlier
30.10.2018	9,9 %	21,4 %	66,9 %	1,2 %	0,0 %	0,5 %
31.10.2018	7,2 %	18,7 %	70,0 %	4,1 %	0,0 %	0,0 %
1.11.2018	15,6 %	13,1 %	69,0 %	2,3 %	0,0 %	0,0 %
2.11.2018	5,5 %	25,0 %	61,0 %	8,5 %	0,0 %	0,0 %
5.11.2018	17,8 %	20,1 %	48,2 %	11,6 %	1,8 %	0,3 %
6.11.2018	13,5 %	45,7 %	33,6 %	7,1 %	0,0 %	0,1 %
7.11.2018	16,2 %	36,1 %	47,0 %	0,0 %	0,0 %	0,7 %
8.11.2018	14,9 %	47,9 %	37,1 %	0,0 %	0,0 %	0,1 %
9.11.2018	10,8 %	29,2 %	28,3 %	31,7 %	0,0 %	0,1 %
12.11.2018	11,6 %	44,9 %	43,0 %	0,0 %	0,0 %	0,5 %
13.11.2018	17,3 %	18,1 %	42,2 %	22,3 %	0,0 %	0,1 %
14.11.2018	15,6 %	24,1 %	37,4 %	22,6 %	0,0 %	0,4 %
15.11.2018	11,7 %	19,8 %	54,4 %	14,0 %	0,1 %	0,0 %
16.11.2018	9,4 %	34,5 %	39,6 %	16,4 %	0,1 %	0,1 %
19.11.2018	10,2 %	27,0 %	52,0 %	4,8 %	6,0 %	0,0 %
20.11.2018	8,1 %	18,4 %	50,2 %	23,3 %	0,0 %	0,0 %
21.11.2018	13,8 %	4,8 %	69,7 %	3,2 %	8,5 %	0,0 %
22.11.2018	9,5 %	19,0 %	54,7 %	8,1 %	8,0 %	0,5 %
Average	12,1 %	26,0 %	50,2 %	10,1 %	1,4 %	0,2 %

Table 18. Distribution of order line creation time by delivery date

The conclusion is of a mixed sort. It can be determined that on average only 12 percent of the orders are placed on the same day as the delivery date. Also, on average most of the orders are placed two workdays prior to delivery but there is considerable deviation between 28 to 70 percent. Nonetheless, it can be determined that between 82 and 92 percent of the order lines are known before the delivery date.

Second part of the study was to see how a fixed distribution would have predicted the outcome of the actual realized volume. An approximation was tested from the averages presented on the table x and can be seen in table 19.

Period	Share
Same Day	12,00 %
-1 workday	25,00 %
-2 workdays	50,00 %
-3 workdays	12,00 %
-4 workdays	0,99 %
Earlier	0,01 %

Table 19. Share of volume by time category.

The volume was then set up to accumulate from earliest category to the delivery date and an approximation of total order lines per category was calculated. E.g., if there are 1000 order lines realised two days before the delivery date and at that point about 63 percent of the order lines are known, the prediction is around 1587 order lines. The result was compared with the actual totals and the deviance is presented in table 20.

Date	Delivery date	-1	-2	-3	-4	Earlier
30.10.2018	100,00 %	102,38 %	108,98 %	13,51 %	50,74 %	5074,16 %
31.10.2018	100,00 %	105,47 %	117,63 %	31,47 %	3,29 %	329,49 %
1.11.2018	100,00 %	95,98 %	113,19 %	17,92 %	0,00 %	0,00 %
2.11.2018	100,00 %	107,36 %	110,30 %	65,42 %	0,00 %	0,00 %
5.11.2018	100,00 %	93,34 %	98,46 %	106,22 %	217,08 %	3376,75 %
6.11.2018	100,00 %	98,32 %	64,73 %	55,48 %	8,01 %	800,64 %
7.11.2018	100,00 %	95,19 %	75,63 %	5,45 %	70,56 %	7055,81 %
8.11.2018	100,00 %	96,73 %	59,02 %	0,48 %	6,05 %	605,33 %
9.11.2018	100,00 %	101,44 %	95,37 %	244,55 %	6,52 %	652,32 %
12.11.2018	100,00 %	100,44 %	69,02 %	4,00 %	52,04 %	5204,16 %
13.11.2018	100,00 %	93,92 %	102,45 %	171,93 %	6,20 %	620,35 %
14.11.2018	100,00 %	95,94 %	95,80 %	176,92 %	37,75 %	3775,37 %
15.11.2018	100,00 %	100,40 %	108,79 %	109,09 %	14,81 %	0,00 %
16.11.2018	100,00 %	102,95 %	89,10 %	127,14 %	11,12 %	556,17 %
19.11.2018	100,00 %	102,05 %	99,73 %	83,24 %	601,07 %	335,80 %
20.11.2018	100,00 %	104,37 %	116,66 %	179,56 %	3,70 %	370,23 %
21.11.2018	100,00 %	97,97 %	129,23 %	90,01 %	845,77 %	0,00 %
22.11.2018	100,00 %	102,78 %	113,37 %	128,37 %	854,75 %	5243,84 %

Table 20. Deviation between the forecast model and actual order line quantity

Conclusion of the deviation is that the accuracy is acceptable mostly on the previous day with all the values being inside a +- 5 percent margin. Two days before only seven values of 18 are in in the margin with 13 values inside a +-20 percent margin. Earlier dates give highly varied results and thus over two days in advance predictions are not possible.

In conclusion, the ‘gut-feel’ capacity planning done in the operations seems to have some basis in the actual order behaviour. And because the operational planning scope is at this point around two days in advance, there are positives to be found in the study.

Firstly, the study should be carried on and build an automated report that uses the basic logic of advance order forecasting. Secondly, with a larger data set the used model could be smoothed against fluctuation. The results could be calculated with other models such as the additive model or develop a regression model.

Secondly, the project-based production can be further divided to three or more parts, it is possible that some parts of the operation are more predictable that the others. Lastly, with a more advanced automated forecast model that provides some analytical insight, the warehouse operations can use the forecast to support capacity planning. Also, this insight could be taken to the customer and start negotiating acceptable and clear rules on order placing.

Make-to-Stock Forecasting

Make-to-Stock materials are sub-assemblies and kits that are sold directly to the customer as accessories or service parts. Furthermore, some sub-assemblies are used in the factory production which assembly is outsourced to the warehouse. The supervisors that oversee these operations are confident that the visibility of capacity requirements is adequate.

The capacity requirements are agreed with the customer and the operations produces these products in stock on a regular rate. This part of the warehouse operations is thus seen as base demand in the capacity planning section and no forecasting method is suggested.

Make-to-Order Forecasting

Make-to-Order materials are sub-assemblies and kits that are produced directly to customer orders as accessories or service parts. The customer offers an acceptable sales forecast on the products and the visibility of open orders are up to two weeks.

Like Make-to-Stock products, Make-To-Order products are also periodically discussed with the customer and a base capacity has been agreed on. Thus, these products are also deemed as base demand in capacity planning section and no forecasting method is suggested.

Conclusions

When the different sub-parts of the picking operations have been identified, data sources determined and forecast model chosen, a system needs to be set in place to combine the values to an understandable format. A simple data architecture is described in figure 23 below.

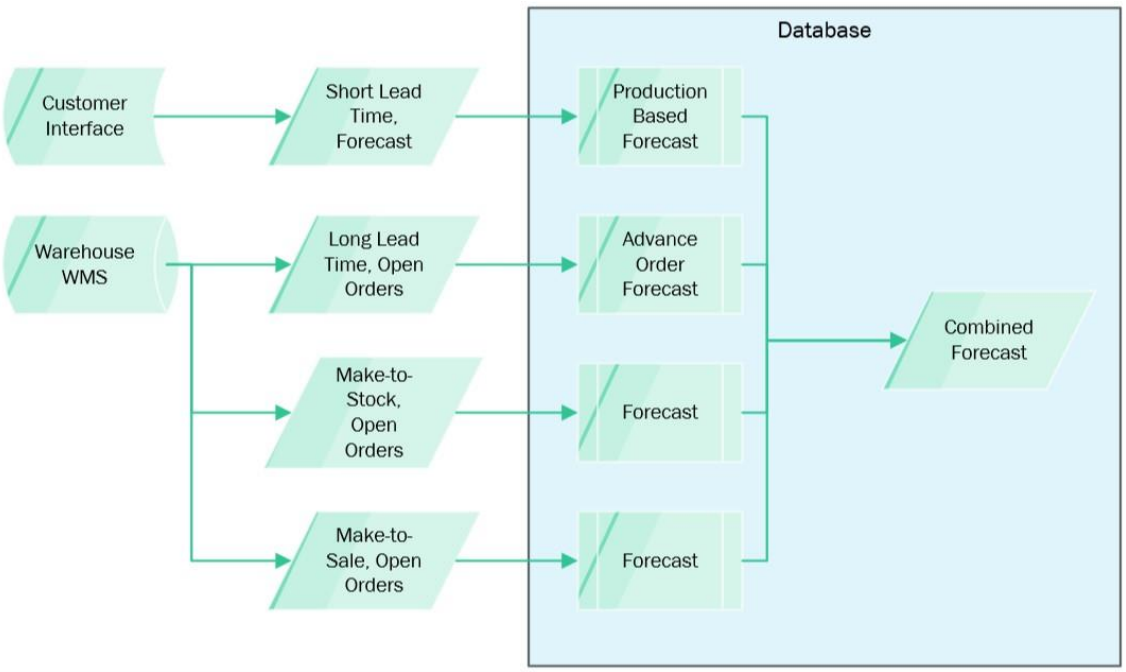

Figure 23. Data architecture of the forecasting system

In the figure it can be seen that there are two distinct data sources. Customer interface and the warehouse management system. The four different raw data types are fed into a database where the model logic is applied. The output is a combined forecast.

The combined forecast should be accessed with a simple reporting tool such as Power BI and open to all of management. In the report intelligent filters and tools that provide insight of the forecast can be accessed. The forecast would be updated on important times of the day such as before the daily performance meeting. Of course, the forecast

needs to be translated into a capacity demand. The general method is discussed in the next subsection.

5.4.2 Capacity Planning

When the forecast is processed and available, capacity demand must be calculated. The forecast would offer the predicted order lines per department. The calculation would utilise a running average productivity rate per department that includes a rough activity mix. This means that if a certain department receives 1000 order lines, a half of it could need a high-level order picker, one third a reach truck and the rest a low-level picker. The exact mix would need a material level forecast that would not be practical to set up at this time.

In figure 24 it is presented a hypothetical capacity demand forecast. The predicted order lines are translated into needed hours by a rough productivity rate that varies by order type. In example make-to-stock orders are the lowest in volume but also the lowest productivity rate due to value added services in the process.

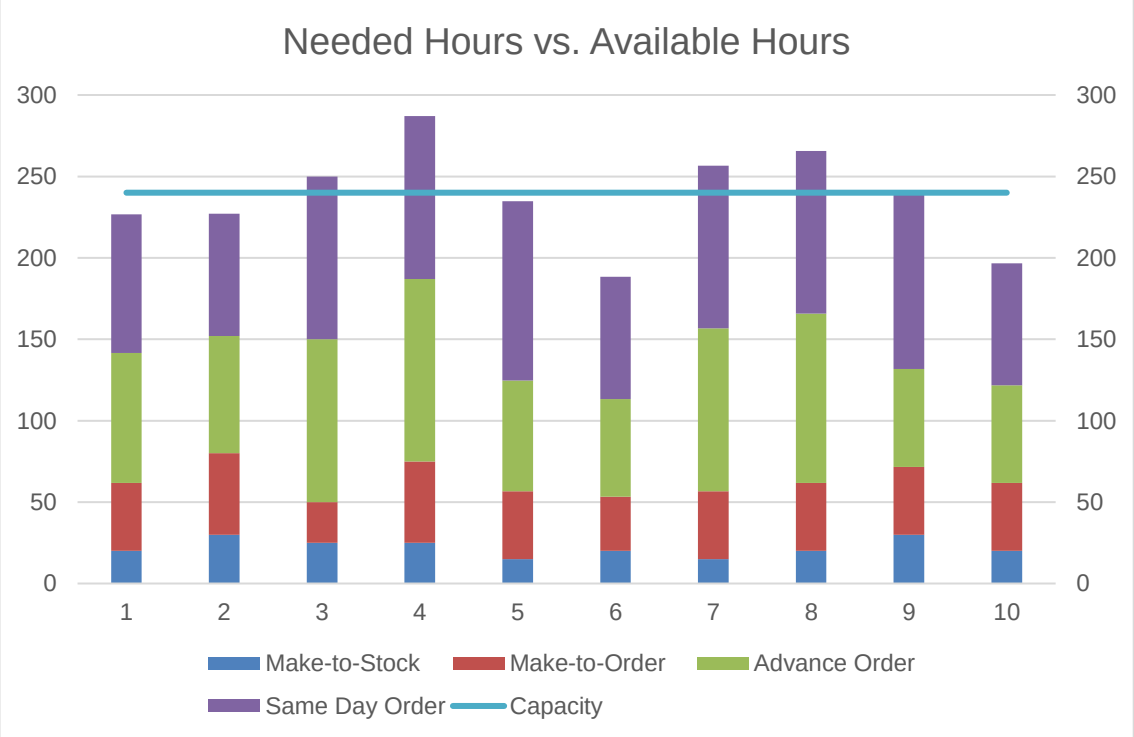

Figure 24. Hypothetical capacity demand on a ten-day period.

As in real life the order picking activities uses most of the hours in the operations, but the demand fluctuation is high. There are many days when the demand is over or under the capacity with the order picking activities as the most influential component.

The hypothesis is that advance orders are visible 1-3 days before the delivery date and make-to-stock orders are done with a few days lead time. The simplest solution thus is to delay make-to-stock orders and pick earlier part of the advance orders. After the new capacity allocations, the situation would look better as seen in figure 25.

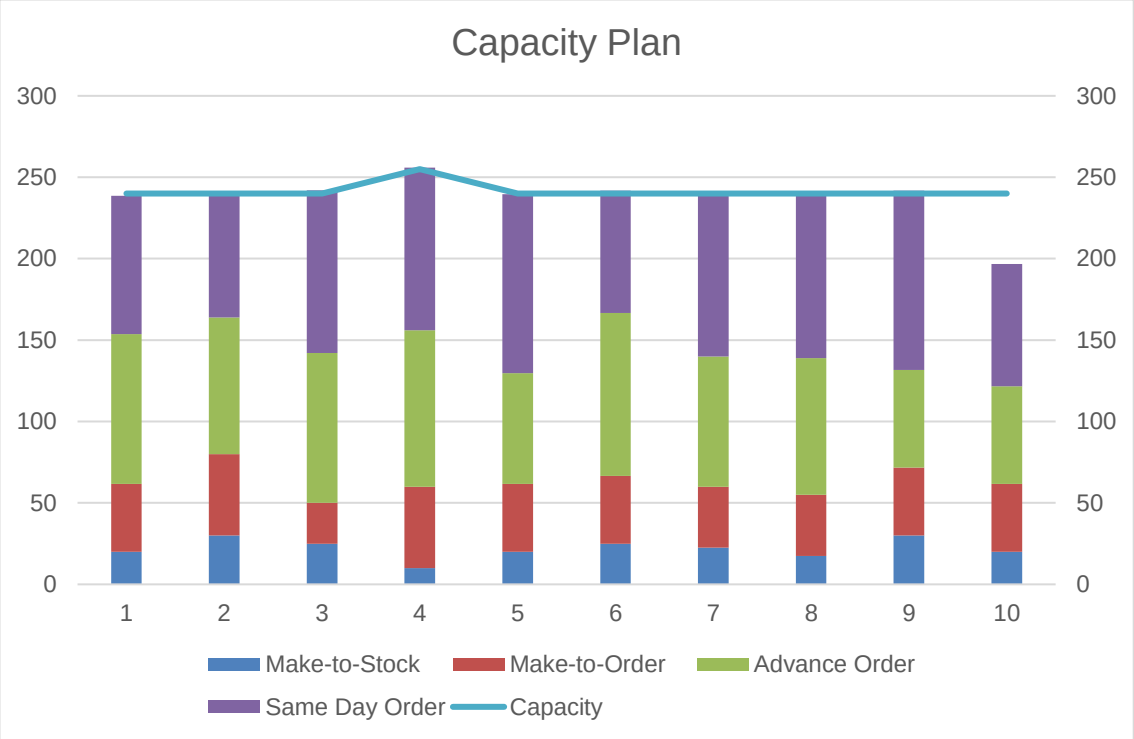

Figure 25. A plan to smooth out variation in the capacity demand.

It is worth to note that on day four the capacity has increased. In this hypothesis the capacity could not be smoothed as much as needed, so an agency order of few workers should be placed on that day. In this scenario the day ten has a high over capacity. The solution could be found when time moves forward, and more orders appear after day ten. Other solutions could be transferring people to other activities such as inventory counting required by the customer or facility maintenance.

A future consideration could be that the forecasting, capacity planning, and T&A systems would be integrated on a higher level. The capacity plan could offer directly what activities should be done on what day to accommodate, for example, a two-day buffer on orders.

5.5 Third Element of Proposal – Roles and Responsibilities

Previously the resourcing activities did not have a clear owner. Resourcing decisions ranging from transfers between departments and shifts to overtime allocations. Even agency orders were sometimes agreed with workers directly by supervisors. The extreme example being that a person arrived at work, but no preparatory work had been done.

In this section suggestions for roles and responsibilities are discussed. In the first subsection some considerations for the organisation are given. The second sub-section offers a RACI-matrix for resourcing activities on different time frames. The last section gives suggestions on process management.

5.5.1 Organisation

This thesis does not suggest any changes in the organisation's layout. The organisation is defined by the OMS directives in hand with the needs of the customer and local work culture.

The general hierarchy at every site is that a site manager sits on top of the site. Under the site manager there are operations managers that oversees the specific part of the operations. Under the operations managers there are supervisors that oversee a certain function of the operations. Beneath the supervisor there are shift coordinators that manages the daily work. It is seen by the OMS directives that this level is needed to manage a site with hundreds of workers and ensures a coordinator does not have over 20 subordinates.

However, this thesis suggests that boundaries between the vertical layers of the organisation should be made more flexible. In the current state analysis, there was found to be inflexibility with cooperation between functions. These inflexibilities can be mitigated with

performance meetings described in the technical designs, co-planning on every time period, and increasing the cross-functional influence of the resourcing team.

5.5.2 Resource Planning

In principle the company management program OMS gives directives on resourcing roles. The directives in essence assign shift-level decision making to the shift coordinators and decisions regarding the future to the supervisors. These directives are included on the proposed RACI-matrix in table 15. These roles are complemented with assignment of responsibilities to other roles in the organisation.

The RACI-matrix has four timeframes: Same Day, 1-3 Days, Tactical and Strategical. Same day decisions are mostly ad hoc in nature and has impact on the current workday. In the second timeframe decisions have an impact on the next one to three days. In the tactical timeframe decisions impact mostly a two-week period. The period is defined by the collective agreement requiring workers to receive their shift schedule two weeks in advance. So, in essence the tactical decision making gives a rudimentary capacity plan for the future, and operational level adjusts the capacity with the set boundaries. Strategical level considers more long-term decisions with influences from budget, financial goals, customer forecasting, and seasonal variations.

The matrix uses four different roles and responsibilities to the different job titles. The responsibilities are described in table 21 below.

Key	Name	Description
R	Responsible	The person is responsible for decision making.
A	Accountable	The person is accountable for the decision making. The person is required to monitor the decision making and ensure that decisions are made.
C	Consulted	The person is consulted on decision making but does not make decisions.
I	Informed	The person is informed of the decisions and might be required to carry out activities based on the decisions.

Table 21. Description of the roles and responsibilities in the RACI-matrix

Whit these guidelines each role has been assigned a responsibility. The guidelines state that only one person can be responsible for decision making. However, in the following table includes roles that are assigned to multiple persons. In example, there are several

shift coordinators that are all responsible for decision making in same day operations. However, they are responsible only for the resourcing of their own subordinates. The same logic is applied to supervisors and operations managers. The proposed responsibilities are presented in table 22 below.

Role/Timespan	Operational		Tactical	Strategical
	Same Day	1-3 Days		
Coordinator	R	C	I	I
Supervisor	A	R	C	I
Operations Manager	I	A	R	R/A
Site Manager	-	I	A	R
Resource Manager*	I	C	C	C
Process Coordinator**	-	I	I	I

* Process Owner

** Process coordinator is a suggested role that is not in use at this point.

Table 22. Roles and responsibilities regarding capacity planning

Decision making on the level of same day are restricted to assignment of tasks to the warehouse workers, movement of labour between departments, and overtime. The main responsible is the shift coordinator with the support of the department supervisor. Other stakeholders are informed on decisions that deviate from the plan. E.g., the use of overtime.

The next one to three days of planning is decided by the department supervisor that gathers information from the coordinators and resourcing team. At this level decisions include task assignment, movement between departments or even sites, overtime work (especially overtime requested by the customer), and requests for extra labour from the agency worker pool.

Tactical meetings are held every two weeks and considers the shift plan that is required by the collective agreement. At this level decisions are made by the operations manager with information gathered from the subordinates and resourcing team. The decisions consider more long-term capacity requirements. These can include shift changes, department changes, recruitment of new agency workers, training of workers to new skills to improve capacity, and so on. These decisions have more apparent financial impact and thus the site manager oversees the decisions.

Strategical planning is done periodically by the management. It utilises guidelines from the company strategy and relies on knowledge gathered from performance meetings, worker skill levels, customer long-term trend messages, and so on. The planning level aligns the personnel level to the strategical profit goals and outlines the costs that are acceptable for instance in the summer period.

5.5.3 Process Management

This thesis suggests in line with the principles of process reengineering that the company employs a process owner and a process specialist. The process owner should be the resourcing manager. The process owner's main tasks are to oversee the process functionality and effectiveness and reports the results periodically to the management. The process owner establishes a continuous improvement methodology regarding the process, tools, and procedures.

The process specialist was at the start of this thesis project the production planner but currently the position is not held. This thesis suggests that a person from the resourcing team will be designated as the process specialist. The specialist's role is to work as a cross-functional resource that has visibility of all relevant information and communicates directly with internal and external stakeholders via various tools. Internal stakeholders are other support worker such as IT superusers that manages rights and profiles in different systems. External stakeholders can be the agencies and other sites.

Considering that forecasting has a deep influence on the effectiveness of resource planning, responsibilities regarding its management must be allocated. The forecast systems should be built by the development team and any technical maintenance resides with them. The tool itself is available to use by the supervisors for the 1–3-day planning scope.

However, regarding the tactical planning, the main users of the tools are the resource manager and the operations managers. As the forecasting horizon is somewhat limited, the forecast used on long-term decision making must be enriched. This should be the process owner's activity with the support of the process specialist. The process specialist would be tasked with monitoring the accuracy of the forecasted demand against the actual demand and report findings to the process owners and the development team.

5.6 Proposal Draft

When an organisation has proper understanding of what affects its capacity needs, it can build procedures and tools to make most of the resources at hand. The proposal building stage has presented suggestions for forecasting, capacity planning, roles & responsibilities, skill management, and tools to manage various aspects of resourcing.

Some of the solutions are technical and some are social. It is imperative to understand the separation of these proposals. Technical applications can be built, procedures set up, and forecasting methods developed in high detail. But without understanding the human aspect of development, the results can be ineffective. Thus, cross-functional thinking, process management, training individuals, and applying roles accordingly is a crucial step in change. These different solutions with their technical or social aspect highlighted are gathered in figure 26 below.

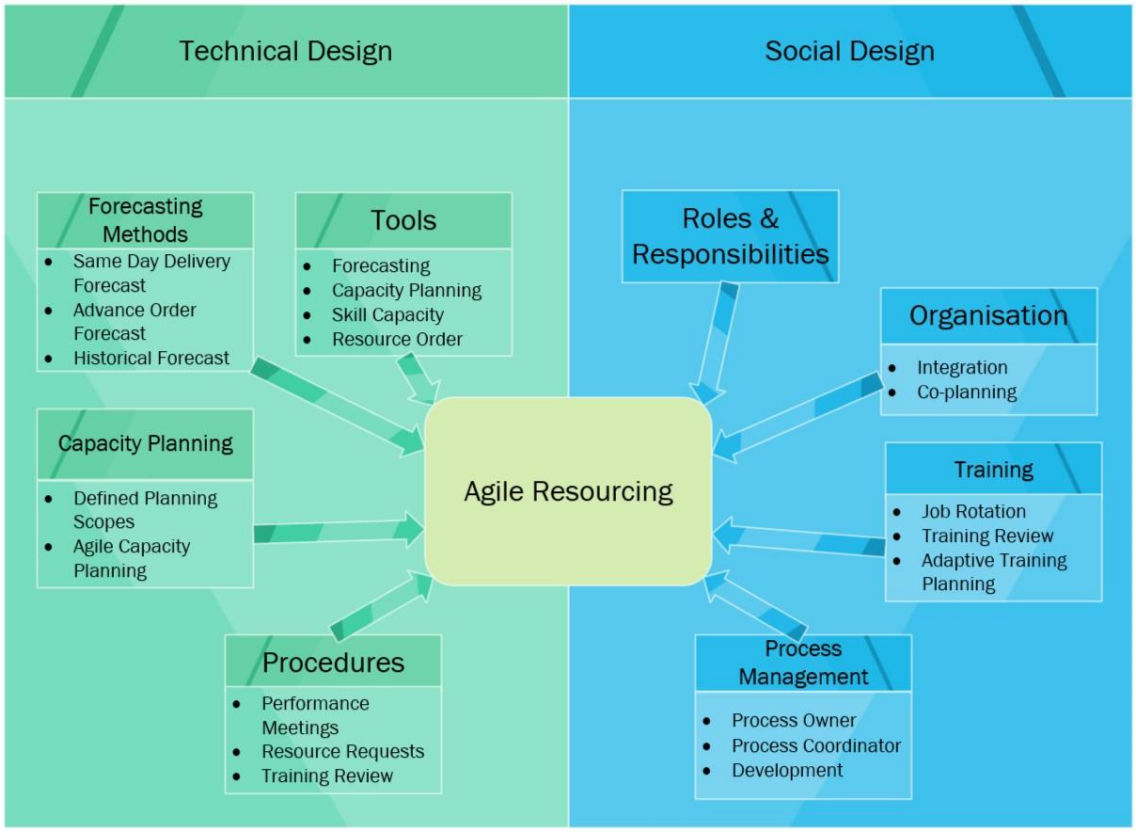

Figure 26. Proposal elements by design type

The first consideration is to change the organisations thinking from isolation to integration with increased co-operation between departments. This will be complemented with appropriate roles & responsibilities to simplify decision making on different planning levels and reduce confusion.

To ensure process functionality and continuity a process owner will be appointed. Process owner employs a continuous improvement process to monitor and develop different elements to increase operational capability. A process coordinator will be appointed to executing daily tasks regarding resourcing decisions such as communication with agencies, maintaining skill records, and monitoring forecasting and capacity plan accuracy.

When a proper skill record system is set up, skill management is more efficient. The operation is aware of what training it needs, who to train, and how to manage job rotations. With right level of skilled workforce is available, the capacity at hand is also more agile.

The technical design offers procedures, methods, and tools to guide the decision making. A more accurate forecast gives the supervisors more concrete foundation for capacity decisions. Capacity planning tool will give insight on the available capacity against possible demand. Supervisors can thus make adjustments to capacity to smooth out variation by postponing some orders and advance others.

Performance meetings are enablers and forums for co-planning and decision making on short and long-term resourcing. In these meetings tools mentioned provide a clear and transparent overview of the operation. Thus, the management can concentrate on problem solving instead of validating the situation.

Resource orders are done via a predefined approval process to give the resource manager a possibility to view the big picture before giving a solution. This will reduce lead times and confusion as the workflow will guide the decision makers through the process.

In the next section of the thesis the proposal draft and detailed descriptions of the different elements are presented to the organisations key stakeholders. The goal is to validate the solutions presented in this section and receive feedback to building the final proposal.

6 Validation of the Proposal

In this section results of the validation stage are reported. The initial proposal in section 5 was presented to key stakeholders and feedback was recorded. The feedback was then considered when drafting the final proposal.

6.1 Overview of the Validation Stage

The initial proposal was built on the base of finding of the current state analysis and subsequent workshop discussions on the issues and possible solutions. The conceptual framework created a theoretical background for the suggested solutions and offered tools to piece together different procedures, tools, and methods. Finally, the proposal was presented to the key stakeholders of the organisation.

Validation of the proposal was done with a presentation to key stakeholders. The presentation started with a brief recollection of the findings of the current state analysis and with a discussion on what is the status of the issues now. This was followed with a brief presentation of key theoretical concepts presented in the conceptual framework and how they are present in the final proposal. The proposal was then presented, and feedback was collected at the same time. Possible implementation was discussed also. After the presentation, the used material was sent to all invited stakeholders to have additional time to reflect it.

6.2 Findings of Data Collection 3

The feedback for the proposal was altogether positive. The only key change suggested regarded roles and responsibilities. Mostly the discussion revolved around handing off the proposal to implementation and how to achieve cohesion with other development projects working on similar questions presented in this thesis. Key comments are presented in the table 23 below.

Respondent	Comments
Site Manager	“Good work! This covers about everything discussed during the past two years. This could function as a guide for the new resourcing manager. Still, the advance order forecasting might need to be validated again. The lead times have shortened after year 2018. The roles and responsibilities would need a slight update. The resourcing manager should make the decisions, but the operation manager should have a veto-power.”
Resourcing Manager	“The proposal includes several discussed development needs. If the proposed framework for the tactical meeting with the envisioned tools can be implemented, it would be a substantial improvement.”
Site Development Manager	“Great work! However, regarding implementation it is imperative that especially the tools for training management utilises same data sources as OMS performance management requires and the overall tool is aligned with the OMS requirements. In that way, several issues could be resolved simultaneously.”
HR Manager	“This work covers many subjects that are in focus for the HR Department. Especially the tracking of skill usage and improving work circulation. These should be developed further and implement as soon as possible!”

Table 23. Stakeholder feedback

As seen in table 23, the suggested tools, procedures, and responsibilities where acceptable. The technical aspects of the suggestions were met with enthusiasm, but it was recognized that building, testing, and implementing them would take serious amount of work.

The concrete change suggested related to the roles and responsibilities. The first two levels, the daily and next few days, of planning is valid from the point of view how the operations want them and also how the OMS handbook outlines it. However, the site manager requests that the resourcing manager has a more active and decisive role in resourcing. This means that the tactical planning and resource requests are resolved and decided by the resourcing manager. However, as the operations manager is responsible for the overall performance, they would have the last word on any decisions that have significant financial or functional impact.

Regarding the advance order forecasting, the site manager made a remark that the data should be validated at some point. The notion is that the lead times would have shortened from the 2018 study. However, a data study at this point was not requested. The issue will be discussed in section 6.5.

The final notion was made by the development manager in charge of OMS related matters. He pointed out that if these suggestions are implemented in practice, there are several tools and procedures that should be integrated to OMS related developments. Thus, not a development request regarding this thesis but an important point when implementing suggestions presented in this work in the future. The issue will be discussed in section 6.5.

6.3 Developments to the Proposal Based on Findings of Data Collection 3

The requested change in the feedback concerned the suggested roles and responsibilities. The initial proposal defined the resource manager as consulted or a contributor to decision making. This would, however, leave the resourcing manager without any decision-making responsibilities regarding resource and capacity planning.

The plan for the site is to employ a dedicated resource manager and give them a stronger role in planning. From the RACI-matrix point of view, this would mean that the resourcing manager is given the R-label in tactical and strategical planning. The revised matrix is seen in table 24 below.

Role/Timespan	Operational		Tactical	Strategical
	Same Day	1-3 Days		
Coordinator	R	C	I	I
Supervisor	A	R	C	I
Operations Manager	I	A	V	V
Site Manager	-	I	A	A
Resource Manager*	I	C	R	R
Process Coordinator**	-	I	I	I

Table 24. Revised RACI-matrix

As seen in table 24 the resource manager is now the dedicated decision maker on tactical and strategical levels. However, the operations managers are responsible for the performance of their dedicated parts of the operation and in need of a new label. It was suggested by the site manager that a veto-label (V) is introduced.

In practice this would mean that the resourcing manager has the autonomy to plan and make decisions regarding any resourcing issues on tactical and strategical levels. The operations managers are given veto power to overturn the decisions and to return them back to planning. Furthermore, the site manager would be accountable for the decision-making process on these planning levels.

It was believed that setting up the responsibilities in such a way, the decision making could be further streamlined. In example, the preliminary proposal suggested a two-stage approval process for resource requests. First the resource manager would devise a solution and then the operations manager would approve it. The updated proposal cuts the operations manager approval stage. The operations manager would still be given information on the solution and can use the veto power if necessary.

6.4 Final Proposal

The objective of this thesis was to study the resourcing model in use and to develop an operating model that enables the company to achieve appropriate capacity at any given time. The proposal includes a framework for resourcing with procedures and tools that support decision making.

The essential tool to achieve agile resourcing is to build a forecasting system. The forecasting model enhances understanding of real capacity needs, increases transparency in the operation, eases cross-functional planning, and strengthens customer co-planning. When the needed capacity can be calculated, resourcing decisions become easier.

Decision-making needs appropriate forums and clear responsibilities. The proposal outlines a framework for two key meetings, the daily performance meeting, and the biweekly tactical meeting. These meetings utilise the forecast and performance related data for the management to achieve understanding of capacity needs and furthermore if any resource related decisions must be done. The goal of these procedures is to have an iterative, transparent, and stable decision-making process that uses the same information every time.

Recommendations are also given to further enhance the agility of the decision making and capability of the operations. These include appropriate defined roles and responsibilities, process ownership, and cross-functional cooperation. The key proposition is that

the resourcing manager takes ownership of the process and also is the key decision maker regarding tactical and strategical planning. The line organisation will still be accountable of the decisions and have veto power.

To further enhance the operational capability a tool for tracking employee skills is suggested. The goal of the tool is to identify skill usage on at individual level but also to define what is the operational skill capacity. The tool would thus help the operations to make decisions on what kind of training is needed for individuals, strengthen job rotation, and identify picking activities that are in risk with absenteeism.

6.5 Recommendations

Two comments that did not result in development of the proposal was made during the presentation. The first considered the validity of the proposed advanced order forecasting method. The second considered implementation of the IT solutions and how they will integrate to other IT developments at the company.

Regarding the advance order forecast, it was not requested that a validation to the data is made at this point. The notion was that the lead times have shortened but the reason is unclear. The original data was collected in the fall of 2018, a relatively stable time. At this time, it would not be possible to distinguish accurately if the change in order behaviour is influenced by changes in the customer's operations or are they the result of the ongoing pandemic.

Therefore, this thesis will suggest that the model will be validated later with the customer. There have been promising results with customer cooperation in developing a forecasting method for the same day deliveries. Thus, a validation of the advance order data with the customer could lead to several options. Firstly, if the results are acceptable, the model can be implemented. Secondly, if the results are promising but not consistent, a discussion of improving order behaviour could be conducted. If the model is not working or the order behaviour cannot be influenced, the improved cooperation could result in development of a new model akin to the same day order forecasting.

The second comment was directed at building and implementing the IT-solutions presented in the proposal. The OMS requires the company to manage multiple data sources and construct reports for identifying process discrepancies. Parts of the IT-solutions are

overlapping with the OMS needs and thus, cooperation with the OMS development should conducted.

The solution could be to start a cross-functional project that brings together the company's local IT specialists, development managers, and data end users. The objective would be to identify all data sources and build a comprehensive data architecture. On top of the data architecture the different reports would be built. Thus, different end users would not need to manage the data individually as the data would be ready made for report building. Also, the solution would ensure that the underlying data used is identical.

7 Conclusions

In this section a summary of the thesis and recommendations for implementation is presented. Furthermore, the thesis is evaluated based on the objective versus the outcome.

7.1 Executive Summary

The objective of this thesis was to find ways to improve the resourcing process of an outsourced warehouse feeding a customer with several factories and other related businesses. The key challenge was the diversity of the work offered to the customer, low forecast visibility and barriers between different parts of the operations. The challenges have led to inflexible resourcing that mostly is seen with over-resourcing or with untimely allocation of these resources.

This thesis employs a design research approach. The general method is to find issues in the company's context and find solutions to them. Any generalisation is thus avoided. The study is divided into four parts. The first part is the current state analysis that used current knowledge gathered from interviews and data sources to understand the key shortcomings. In the second part literature was reviewed to find ideas for solution building. The third part used the findings of the current state analysis and literature to graft in cooperation with the stakeholders a proposal for the improvements. In the last part the proposal was validated with key stakeholders and minor tweaks to the proposal was done.

The research started with a current state analysis. It was noticed that the operation did not employ a comprehensive resourcing process or any relevant tools for supporting decision making. Mostly decision was made ad hoc with subjective experience-based analysis of the situation. To delve deeper into the perceived issues and weaknesses the de facto resourcing activities were first described and presented to the key stake holders on all management levels. The issues raised from different levels of management were mostly in common agreement. The lack of a process made decision making inconsistent and ineffective. The unclear roles and responsibilities caused duplicate work or neglect in some tasks. The low level of forecasting made capacity planning difficult. Lastly the different parts of the operations had developed barriers that meant that workforce mobility was low. This meant in practice that some parts of the operations could be understaffed and other overstaffed resulting in financial loss and negative impact on service

promises. To tackle these issues literature was searched for ideas on forecasting and capacity planning, role and responsibility assignment, and a concept for constructing an agile organisation.

The first element of the proposal focused on building the process and the organisation. It was found that the resourcing process is multi-dimensional, so a few frameworks were suggested to understand better the interconnectivity of the decision making. The first framework presents the process on the perspective of time. This meant that any strategical planning must directly influence tactical planning and tactical planning must influence operational planning all the way to the daily decision making on the shop floor. The key takeaway is that decision making on different time spans must be connected to the actual work done on the shop floor. The second framework ties the resourcing to customer demand. It describes what elements influence or enables the capacity needed by the customer. Influencers are strategical initiatives and goals set up by the upper management and contractual obligations. Enablers are tools, procedures, and methods to increase the effectiveness of the resources at hand to determine the actual capacity the warehouse is providing.

To ensure these frameworks are followed and the information feeds as envisioned, decision-making procedures are suggested. Key procedures are the daily performance management and a meeting for tactical planning. These meetings existed before this thesis but improvements for conduct is suggested for these.

The second part of the proposal explored forecasting and capacity planning. As the operations was roughly divided to demand with only a few hours of lead time and to demand with up to a week of a lead time, two different models were suggested. A cooperation with the customer was setup to build a forecasting method for the short lead time operations. The idea was to utilise the customers production planning data with the logistics process to determine how many order lines any given product would generate. For the longer lead time demand advance order data forecasting was explored. The idea of the concept is that based on historical data it could be determined how much of the orders are known in advance for a particular day. For example, in the study roughly 50 % of the order lines were known two days in advance and 80 % were known the day before. This distribution could then be to calculate an expected volume for any day in the future when orders start to appear in the system.

The capacity planning part of the proposal describes a simple logic for flattening demand. The same day orders with short lead times are work that has to be done on the day. On top of that the daily volume consists of long lead time picking, make-to-stock and make-to-sale work. The idea of the proposal is to do cross-functional planning to see the total capacity need versus the available capacity for any day. If there is a shortage of resources in the future, some of the work should be done in advance. If it is seen that there is spare capacity in the future, this should be pre-planned and directed to other activities such as the make-to-stock work, required inventory counting or other activities that are not directly related to picking activities but ensure smooth operations in the future.

Third part of the proposal redistributes roles and the responsibilities on different time frames. The key takeaways are that the coordinators are responsible for daily decision making with their supervisors accountable. The operational planning is done by the supervisors with their operation mangers accountable. Tactical and strategical planning is the responsibility of the resource manager to ensure agile decision making. The site manager is accountable as on these levels the financial impacts are evident. The operation managers are granted a veto right to intervene if they see an issue with resourcing decisions impacting their operations negatively. Other stakeholders are consulted or informed when appropriate.

The proposal was validated with the key stakeholders in the management. The feedback was positive and intrigued. Few changes were suggested. The original responsibility matrix did not utilise the veto role. The draft used the resource manager as a point of consultancy and executer of the decisions. It was decided that the resource manager should be given more power to make the decisions faster and more agile. It was also suggested that the findings used in the advance order forecasting study did not represent the situation today and a new study is needed.

The suggestions in this thesis implemented, the warehouse operations could work as coherent unit. Roles and responsibilities would be clear, barriers between parts of the operations would vanish and right sized and right timed resourcing could be achieved. The procedures and tools proposed would set a standard way of conduct, support decision making and provide transparency of actual capacity needs. In the future with a standardised methodology the company would not be subject to disruptions if customers change, as the template for resourcing is already existing. This would ease transitions, improve quality, and cut costs in the long run.

7.2 Next Steps and Recommendations Toward Implementation

During the validation discussion described in the previous chapters, implementation was touched upon. The general consensus was that the incoming new resource manager would be presented with a summary of this thesis findings and suggestions. The resource manager would take the responsibility of implementing the solutions with future development.

It is worth noting that most of the technical solutions presented in this work are mostly on a framework level and lack details on how they should be constructed. In reality to implement these solutions, a company level project would be needed to change fundamentality how data is gathered, stored, managed, and used. Although, all of the suggestions in this work would not be implemented as presented, the basis for any advanced resourcing tools in the future would need the basis of a comprehensive data architecture that complies with any regional data privacy regulations. Furthermore, the project should be done on company level (in Finland) to ensure proper management support and to get benefits of standardisation across all the company's sites and warehouses.

Regarding the suggestions for the procedures, roles, and responsibilities. This work suggests that the warehouse management along with head office management reviews in detail the suggestions. As the suggestions are mostly organisational and role tweaks, to implement such measures would need a strong managerial commitment to ensure that any organically grown procedures and hierarchies are dismantled and the people in the organisation aligns with the new desired state. With these two cornerstones, the data management and the functional organisation, the resource manager can begin to build their desired tools on.

7.3 Thesis Evaluation

To determining the quality of a research, several evaluation perspectives need to be applied. This thesis is evaluated by relevance, consistency, reliability, validity, and transferability.

The first step is to evaluate if the objective of the research is relevant for the company. Then consistency is considered. Is the outcome and the research process consistent with the desired objective. Validity measures the quality and coverage of the research

data. Reliability discusses if the results can be reproduced. Finally, transferability considers if the results can be transferred to other sites in the company, as the objective defined.

7.3.1 Relevance and Consistency

Evaluation of a research of this type must be start at the beginning. The first question is whether the business challenge is relevant to the company? This can be ensured by validating the business challenge with the case company's management. With a relevant business challenge, a relevant objective for the research must set. This means that the objective must attempt to solve the issues presented in the business challenge. The third part is to determine an outcome for the research. What is the desired improvement, model, or development the research is striving to produce? Thus, it is important that there is consistency between these three elements. Is the outcome of the research actually a solution to the business challenge presented in the beginning of the research?

In this thesis the business challenge was perceived to be low predictability of the picking operations and thus the operation had difficulties to achieve right-sized capacity planning. Objective of the thesis therefore was to study the current process, issues with it, and workload variations to produce an operating model that would mitigate the perceived problems. The desired outcome was an operating model that could be copied to similar context inside the case company's other operations.

The objective was addressed in the current state analysis. Due to the magnitude of different issues raised during the interviews, narrowing of the scope to few key issues that are relevant to the objective was chosen. However, some of these issues, such as the definition of true capacity requirements were discarded during the proposal stage due to not being directly relevant to the resourcing process. Instead, a practical tool for managing training was introduced at this stage.

Due to the fact that this thesis was written partly in 2019 and 2021 with a year of hiatus in between, there are some consistency issues present. The resourcing procedures and capacity planning has seen some improvements based on the suggestions presented in the proposal building workshop. This meant that when certain issues such as operational integration and centralised management of resourcing activities were achieved, new improvement needs were identified.

This means that all of the solutions presented in the final proposal is not directly influenced by findings in the current state analysis or suggested in the original proposal building workshop. However, in the end the original business challenge is still valid. Most of the solution proposed by this thesis is still relevant and it can be argued that the outcome is consistent with the objective set at the start of this thesis process.

7.3.2 Validity and Reliability

In essence, validity means if the research is researching the right things and reliability measures the consistency of the results if the research would be replicated (Kananen 2017: 189). As qualitative research is highly empirical, the validity of the work is harder to quantify than quantitative research (Kananen 2017:189). To mitigate this issue, researcher could utilise as much data as possible from different perspectives to filter out individual opinions.

In this thesis the validity was ensured by interviewing several different people in the operation that were directly linked with the business challenge. A voice was given to every level of management. Coordinators that manage the shopfloor, supervisors that are responsible for capacity planning, operation managers that have to ensure continuity of the operation, and the site manager that is responsible for the contractual obligations and the financial goals of the company strategy. Furthermore, HR manager was interviewed to understand what the company's expectations for the operations resourcing are.

These interviews could then be used to find issues that intersected between them. The results were further enhanced with quantitative data studies to validate claims of some of the claims. These results were compiled and presented back to the management and consensus on the issues were found. Thus, the validity of the research is acceptable and reflecting the issues perceived at that moment.

Reliability considers the possibility to reproduce the results. As the thesis process has taken two years to complete it is not possible to determine at this time the consistency of the results. For example, the quantitative data used in the current state analysis was extracted at the time of writing the stage, and it is possible that the severity of the issue has changed.

Furthermore, while it is credible to believe that the key issues are still present at the company, most of the underlying issues have changed. It is possible that conducting the interviews now, resourcing process and capacity planning is still believed to need improvements, but some of the perceived issues have probably changed due to organic development of the operation.

In conclusion the validity of this research is on an acceptable level as several people with different perspectives were interviewed and quantitative data was analysed to back the claims. Reliability is weaker as the nature of the operations develop overtime due to organic learning and changes in customer needs. However, the outcome of this thesis is still believed to contain universal solutions to set up a resourcing and capacity management inside the company.

7.3.3 Transferability

Although, generalisation is not a goal in qualitative research, it is discussed. The term transferability means that the research results could be consistent in similar cases. To achieve this, the research must have accurate description of the research. (Kananen 217: 191-192)

In this thesis one of the attributes defined in the outcome for this thesis considered transferability inside the case company. The management requested an operation model that could be copied to the similar contexts. The outcome is relatively transferable.

The thesis outcome offered different procedures and tools as solutions to the business challenge. Other sites might not have the same issue with low predictability of the operations, but standardised tools and procedures could bring benefits.

Some considerations for transferability have to be taken. For example, planning time frames must be tailored to the site needs. Forecasting can use the data architecture logic, but of course different customer requires their own forecasting methods. However, the use of advance order forecasting is probably quite suited to most of the sites.

7.4 Closing Words

The operations were earlier fragmented into several customers with their own needs. As a service provider the warehouse cannot be as specialised as in the past. Customer needs changes when their business evolves and in the service business it is always likely that customer leave and new will enter the warehouse. The contractual cycle is still short, measured in years. That is still short, even in the fast-paced world of today. Thus, the operations run the risk of having challenges in implementation of new customers if processes are designed to specially to that customer. On the other hand, there is a loss cohesion when a customer leaves and the existing knowledge, methods and processes are discarded for something new.

A warehouse that employs a comprehensive set of decision-making frameworks, backed up with appropriate tools and methods can deliver value to any customer. It can become the company's key selling statement. As a customer outsourcing its warehouse operations, it is actually seeking an operator that can do the work more efficiently, with better quality and a competitive cost than the customer could do if they decided to maintain the warehousing themselves. With standardised methods of managing capacity and resourcing the providing company can improve its financial goals and simplify its bidding process for new contracts.

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