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Improving purchasing performance in a new product development context

A case study at a research and development organisation

Master's thesis in Supply Chain Management

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ABSTRACT

Purchasing processes exists in all organisations today, and are seldom connected to one department. Instead, several departments are included in the decisions on what to buy, which can make the process very complex. Dependence relationships occurs between the included departments, and an efficient communication is a prerequisite to achieve high purchasing performance. This thesis is made in collaboration with a purchasing division in a research and development company, which struggles to achieve on time deliveries on their orders. They are to a great extent dependent on information from other departments in the organisation which increases the complexity of their activities. This creates a situation where the buyers have problems to place orders to suppliers on time, which consequently causes late deliveries of the material to the R&D projects.

The purpose of this thesis was to improve the purchasing process at the purchasing division in the organisation to be more efficient and contribute to on time deliveries. To achieve this, the process was mapped and analysed to detect areas of improvement, and dependent input from other departments was defined. To fulfil the purpose, empirical data of the current situation was collected through direct observations, semi-structured interviews, and internal documents. Further, to create an understanding of activities in the purchasing process three specific components with different characteristics were studied and analysed. Several wastes could be identified in the processes, they were categorised in their difficulty to be implemented and their effect on the process time and purchasing performance. Suggestions of improvements regarding the processes was produced to reduce the prioritised waste, and the focus were on how to coordinate the interface between Material & Logistics and the other departments, and how the work processes and input could be standardised.

The suggestions of improvement made it possible to save time in the processes, these savings were explained and visualised in future state maps. This contributed to an understanding of how the current situation at the organisation could be changed to improve the purchasing process. When compressing time the efficiency can be increased and this gives a better opportunity to reach on time deliveries, which continuously increase the purchasing performance.

Keywords; purchasing performance, process based work, dependence relationships, coordination mechanisms, standardisation.

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Lina Frödell and Maja Skovshoved

LIST OF ABBREVATIONS

3PL - Third Party Logistics
BOM – Bill of Materials
ETA - Estimated Time of Arrival
ETD - Estimated Time of Delivery
KPI - Key Performance Indicator
M&L - Material and Logistic
MRD - Material Requirement Date
PO - Purchasing Order
PR - Purchasing Requisition
PSS-owner - The engineer responsible for a specific material.
R&D - Research and Development
VI - Vehicle Integration

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1. Introduction

The following chapter explains the background of the chosen topic to research. A description of the organisation were the study is performed is presented, followed by an explanation of their experienced problems in the purchasing division Material & Logistics. Further, the purpose of the project is presented and explains what the project aims to study. Research questions are defined and finally the limitations of the study are highlighted.

1.1 Background

Regardless of an organisations core business, they need to purchase materials, components and services from the market to be able to follow through their business activities (Werner-Lewandowska & Pawlewski, 2015). Purchasing organisations looks different in different types of organisations and industries, but common for most of them is that the purchasing process is rarely isolated to one department. In contradict, it involves many departments at different levels of the organisation (van Weele, 2014). This creates dependence relationships that puts pressure on vertical integration and communication in the organisation. These dependence relationships are even more constant in new product development organisations, since the information on what to purchase is frequently updated and changed, which further increase the complexity in the process (Glock & Hochrein, 2011).

A work process, like the purchasing process, is by Bergman & Klefsjö (2011) defined as a group of interrelated activities that together transforms input to output. The process aims to produce the desired output, while using as little resources as possible. Defects or bad quality of the output in processes are a result of flawed approaches in the activities that creates the output. These flawed approaches can be inefficient work practices, ineffective business processes and miscommunication that creates errors and rework (Cooke, 2010). In the recent years, time compressions of work processes has proved to be a success factor of the business performance. By reducing the consumption of time in every aspect of the business, companies reduces their cost, improve the quality and stays closer to the customer, whether it is internal or external (Stalk & Hout, 1990a). Waste of time can take different forms in office work with administrative characteristics, such as overproducing, waiting, extra processing and correction (Keyte & Locher, 2004). By identifying waste and take actions to reduce it the time will be compressed, the efficiency increased and the performance improved (Stalk & Hout, 1990a).

This master thesis is performed in collaboration with a purchasing division at a research and development company based in Gothenburg. The R&D are performed in projects that aims to produce different models of the future product. Different functions and versions of materials are tested at the site in Gothenburg. The division in focus of this thesis Material & Logistics, further called M&L, is responsible for the purchasing of direct material to the R&D process. The direct material to the R&D projects is all the material consumed in the tests of different models.

The M&L division consists of six employees; one senior purchasing manager, three buyers and two material planners. They communicate with both engineers, suppliers and third party logistics providers in the purchasing process. In each project 60-200 different material are purchased from 80 different suppliers. The purchases are made frequently, but in small volumes since material to each project is purchased individually. This means that the number of purchasing orders placed to suppliers are high, hence also the orders to track from the suppliers. A number of departments is involved in the decision

of what needs to be purchased and when it needs to arrive to the site in Gothenburg, and M&L are dependent on this information to be able to place the orders to the suppliers.

1.2 Problem description

Today, approximately 20 % of the purchased material to the R&D projects seems to not be delivered on time to the site in Gothenburg. This leads to delays in the building of the models that should be tested. The perception is that the late deliveries are a consequence of that the orders are placed too late to the suppliers, or that already placed orders have to be updated due to new specifications on the materials. The M&L division, who is responsible for placing the orders and tracking the material are finding themselves in a complex situation, where they have to work very hard in the try to coordinate the information from engineers to the suppliers, and get the material delivered on time.

The purchasing process have faced an increased workload since the start, and as explained multiple projects are performed parallel. However the structure of the purchasing process is still designed for one project at a time, as the organisation performed initially. This has led to a confusion in the internal processes, and a need to map the purchasing process and the different responsibilities arises. Further, the dependence relationships that exists between M&L and the other departments involved in the R&D projects are challenging, since M&L can not perform their work without accurate and timely information on what to purchase. The perception from M&L is that the information is not communicated to them as have been agreed on in the organisation, often it is late and not quality assured. This creates a current situation were M&L spend a lot of time on non-value adding activities. A lot of orders needs to be changed or updated after they have been placed, and employees within M&L have to search for the right people that can give the correct input they need to perform the purchases. Further, it seems that the other departments in the purchasing process do not seem to understand what information they need to communicate to M&L, and what the consequences are if they do not.

The problem description implies that M&L has to decrease the amount of time spent on non-value adding activities to be able to place the orders earlier to the suppliers and continuously get the deliveries on time to the site in Gothenburg. To do this they have to communicate what information they need from the dependent departments to facilitate this increase in efficiency, and find an effective way of managing the dependence relationships.

1.3 Purpose

The purpose of the thesis is to present suggestions on how the purchasing process at M&L can be improved to be more efficient and contribute to on time deliveries. The process will be mapped and analysed to detect areas of improvement, and the dependent input from other departments will be defined.

1.4 Research Questions

To be able to understand the current situation at the organisation and the problems the M&L division are facing, it is important to define how their process is structured and what activities they perform. The first question will be answered through mapping and describing the current situation of the process and reads;

1. What activities are included in the purchasing process performed by M&L?

The administrative complexity within purchasing can be very high, and the high number of purchasing orders placed increases the complexity of the process. Therefore, a solid and efficient administrative organisation, like M&L represents, is a prerequisite for a high performance of the purchasing organisation (van Weele, 2004). To help M&L contribute to on time deliveries and continuously improve the purchasing performance it is important to analyse the current situation of the process to find areas where and how the process can be more efficient. Hence, the second research question reads;

2. How can the activities performed by M&L be improved to increase the purchasing performance?

A consequence of the process approach to purchasing is that the quality of the output of the preceding steps determines the quality of the subsequent steps. Continuously, inadequacy in one step will lead to problems in the next (van Weele, 2004). Therefore, it becomes important to identify the input that M&L needs from the dependent departments to be able to perform the purchasing activities, and how the quality on this input affects the performance. This connects the third question with the second one, since it is realised that the input affects the ability to improve the activities. The third research question therefore aims to define the input to M&L and reads;

3. What is the input that M&L need from dependent departments to perform their activities?

1.5 Limitations

For the study to be feasible, the scope needs to be narrowed down and some limitations needs to be made. The thesis is limited to focus on the activities themselves and how they are performed to increase the performance. It will exclude to research the employees skills or the management of the group. This is something that can be considered beneficial to include when improving the performance in a work process, but will due to limitations not be included in this thesis.

The thesis will further exclude all information that regards other purchase than the ones connected to a specific project. There were in the pre-study at the organisation realised that the purchase to the projects was not the only purchasing activities M&L performed. Other materials requested from the engineers was also included in their purchasing activities. These will however not be included in the thesis since this process is designed differently and would have been too time consuming to include in the research. The decision to focus on the purchasing process to the projects was a desire from the organisation since it was there the biggest issues were perceived to exist.

1.6 Outline of the thesis

The thesis is divided in six different chapters and the outline of each chapter is described in the following section.

Chapter 2 - Research Methodology
This chapter explains how the methodology was selected for the thesis in order to answer the research questions and fulfil the purpose. The selected research process summarise how the different methods have been approached to answer each of the research questions. Further, method of the data collection and analysis are presented, followed by a discussion of how the selected method affects the reliability and validity of the thesis.

Chapter 3 - Theoretical Framework
This chapter summarise the findings collected through the literature research. The theoretical chapter aims to support the thesis to answer the defined research questions. The chapter is divided in four different sections; Purchasing management, Process based work, Time management and Lean Administration. The sections aims to clarify the subject and context of the thesis and to present literature regarding improvement possibilities in process based work in the given context of the organisation.

Chapter 4 - Empirical Findings
This chapter presents the findings collected through the empirical data collection at the organisation. The chapter gives an introduction to the organisation and the purchasing division the thesis are made in collaboration with. Further the findings regarding the purchasing activities are presented. Two value stream maps are used as a tool to visualise the information collected from two of the purchasing processes in the division, and finally this information are generalised to the entire purchasing process.

Chapter 5 - Analysis
The analysis are divided in two different parts, which are presented in this chapter. The first part focus on identifying waste in the purchasing process. An analysis of the detected waste are made and they are categorised to understand what waste that should be prioritised. The second part of the analysis explain how the detected waste could be improved to increase the efficiency and contribute to on-time deliveries, with focus on coordination mechanisms and standardisation of work process and input.

Chapter 6 - Discussion
This chapter discuss the results of the thesis and how they contribute to the organisation and specifically the purchasing division M&L. Further, the chapter discuss the validity and generalisability of the results and how the context and selected method during the thesis affects the two areas.

Chapter 7 - Conclusion
The last chapter in the thesis summarise the most important findings and connect the results to each of the research questions the thesis aims to answer.

2. Research Methodology

The following chapter explains the method that are used to reach the purpose of the thesis, and how the work in the study have proceeded. Initially, the research strategy of the project is described and the research process explained. This to understand what method is used to answer each research question. Continuously, a more detailed explanation of the method of the data collection and data analysis are described. Finally, a discussion of how the chosen method affects the quality and validity of the project is presented.

2.1 Research Strategy

There are two common research strategy approaches that could be used in this study, qualitative and quantitative approach. Qualitative research can be defined as a research strategy that emphasise words, from data collection and interviews. While quantitative research emphasise numerical data and mathematical analysis methods (Bryman & Bell, 2007). In this report, to answer the different research questions and fulfil the aim, both of the approaches were used. The qualitative analysis focused on observations of the work within the M&L process but also individual interviews with employees from the M&L division and the departments they interact with. The quantitative analysis included measurements of how the M&L division distribute their time on the different activities.

Since the thesis aims to improve the situation at the specific context of the organisation a case study approach is used. According to Ghauri & Gronhaug (2005), a case study approach is a suitable strategy when many variables and concepts are included and the need for multiple observations is required. It is also appropriate when answering questions related to the qualitative research approach. The case study approach is widely used in business research and focus on giving the researcher in-depth understanding of the specific context (Bryman & Bell, 2007). A case study approach also enables the use of collecting information through different sources and thus avoid having to rely on just one source of information, and is therefore applicable in this thesis research. The research is divided in two blocks, one empirical and one theoretical. Interviews, observations and internal document represents the empirical block while the theoretical block is represented by literature research. This stems from the fact that neither empirical nor theoretical data can be understood or stand-alone (Dubois and Gadde, 2002). Instead by using an iterative process through both blocks a broader view and greater understanding for the empirical and theoretical findings can be reached (Dubois and Gadde, 2002).

2.2 Research Process

The research process of the project is divided into different phases (Figure 1). The project started with a pre-study to understand the problem situation at the organisation. The scope of the thesis was not defined before the project started, therefore the pre-study aimed to clarify the subject and what to be researched. Sjöström (2016) describes the importance of understanding the problem before beginning the research, both to select appropriate research methods and data analysis model, and therefore the pre-study in this research was made thoroughly before setting the scope and defining the research questions. When the purpose were defined, the project continued with data collection, analysing the data and finally presentation of the result.

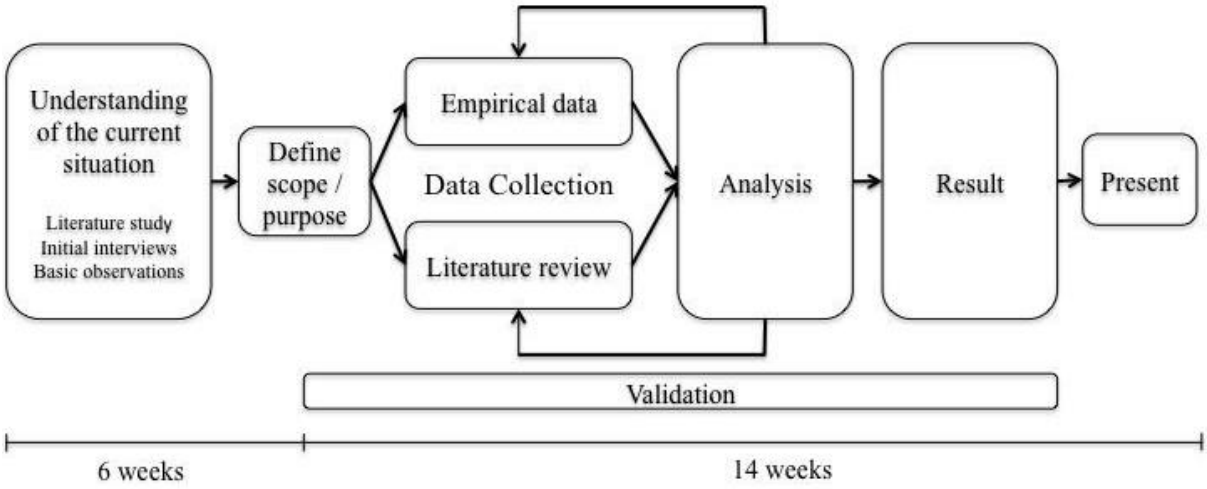

Figure 1. The research process for the thesis

To further understand how the research process were performed for each research question this is summarised in Figure 2. Initially in the report, the research process for question one was prioritised, since this information was a prerequisite to be defined before continuing with research question two and three. The processes for question two and three were later performed in parallel, since the findings and analysis was similar and the result connected to each other.

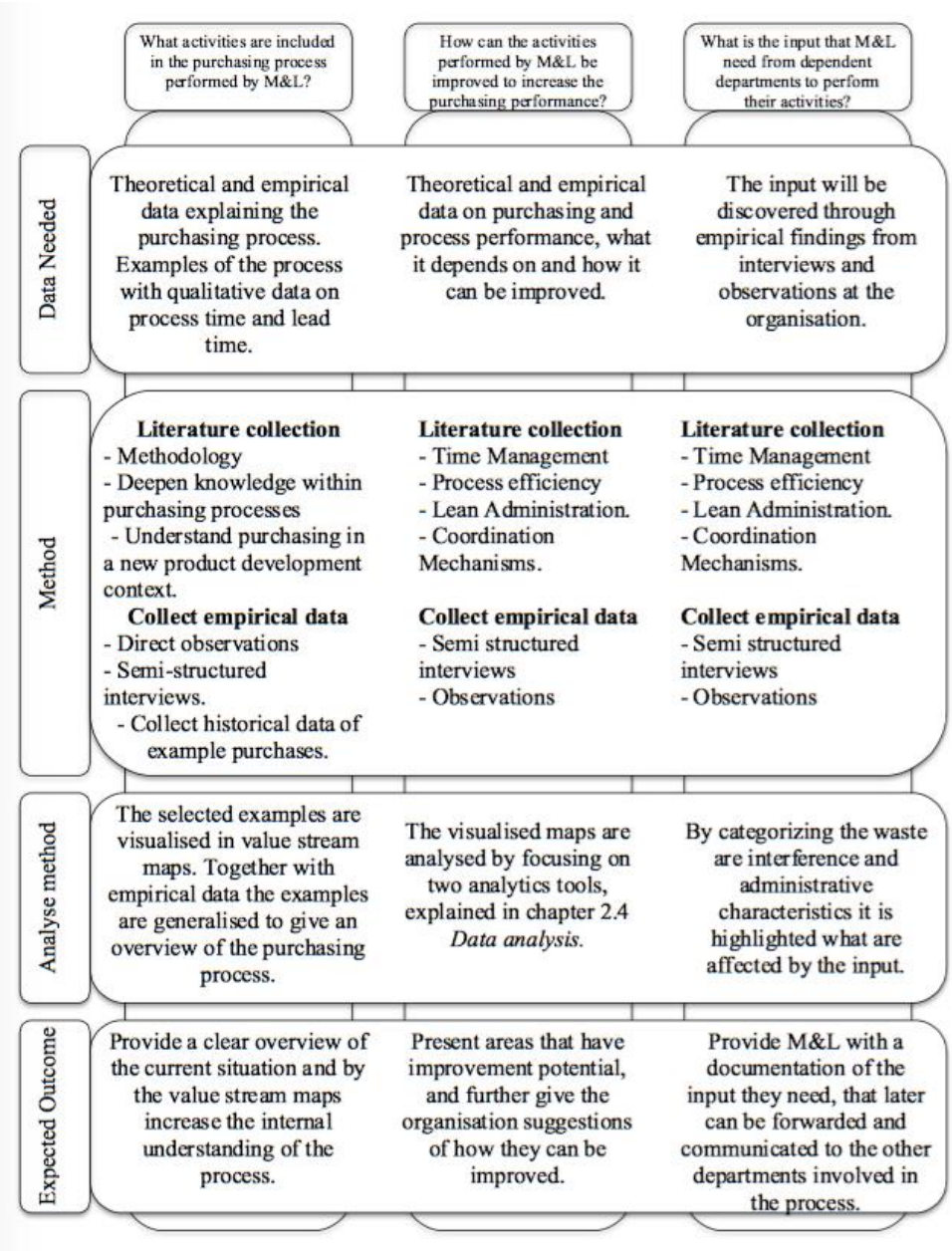

Figure 2. The research process for each research question

2.3 Data Collection

Four different types of data was collected in the process. According to Bryman and Bell (2007), the collected data can be either primary or secondary. Primary data is defined as data collected by the authors and secondary data collected by someone else than the authors. The data collected from interviews and observations are primary data, while the data from the literature review and internal documents from the organisation is considered secondary data.

2.3.1 Literature Review

In order to better understand the selected topic, a literature review within purchasing process performance has been performed. The literature review required research in online databases for articles and books. The databases most frequently used during the project were google scholar and the library at Chalmers University of Technology. Examples of keywords used when searching in online databases

were; Purchasing performance, Purchasing in new product development, Process management, Coordination mechanisms, Time management, Lean administration and Value stream mapping. Besides articles and books reached online, also some physical academic books written by authors that are specialist within the topic were used. These were also provided from the library at Chalmers University of Technology. The findings from the research are summarised in Chapter 3, *Theoretical Framework*, and the review facilitated the aim to answer all research questions.

2.3.2 Interviews

One of two main sources in the collection of empirical data were conducted through qualitative interviews. The interviews were held through a semi-structured technique with some prepared questions within the area of interest. The focus was on the activities the interviewee performed, but the interviewee were also encouraged to speak freely about the discussed areas. This made it possible for the interviewee's to lift subjects they found important and the interviewer could continuously ask unprepared questions to follow up on the interviewee's answer. This technique allows the interviewee to elaborate upon subjects that otherwise may have been excluded (Bryman & Bell, 2007). Initially, broad and unspecified questions were asked to understand the current situation. Continuously, further in the empirical research, more specialised questions in certain areas were asked. Both to secure that the collected information was understood right, and to strengthen the information in the areas it were lacking. This was a natural approach to the interviews and helped to create a successful collection of the empirical data. The interview template that was used can be found in appendix 1 and are based both on the information collected in the pre-study at the company and on the literature research. The majority of the interviews were held with employees at the M&L division, but also interviews with personnel in other departments were performed to understand their connection and contribution to the purchasing process. The approach on the interviews were that one of the authors asked the questions and one documented the answers through extensive notes. A list of all interviews with the interviewee and date can be found in appendix 2.

2.3.3 Direct Observations

The other main source of the empirical data were collected from direct observations. The direct observations were divided in two different parts, one overview and one more specific. Initially, the observations were conducted to understand the current situation at the organisation. The authors observed the employees within M&L in action, participated in meetings with the departments involved in the purchasing process and observed the collection of materials in the warehouse. Further the second part of the observations was performed with the purpose to map the purchasing process, and together with the data collected from the interviews, answer the first research question; What activities are included in the purchasing process performed by M&L?. Three specific materials that are purchased to projects in the organisations were followed and data of activities, ways to communicate, and time were collected and later analysed. Since the lead time of the purchasing process in the division of M&L was longer than the data collection in the project, some adjustments in the collection were made. The observations of the different materials were performed in present, but also historical data of activities performed were collected. How this affected the reliability in the project is discussed under section 2.5 Trustworthiness of the methodology. The three different materials were chosen to represent different situations that occurs in the current situation of the purchasing process, and was selected together with the M&L group. The different purchasing processes differed in complexity, criticality and in the way they were performed and therefore represents different examples of the purchasing process. A further explanation of the different materials and their characteristics is explained in chapter 4, *Empirical*

Findings. The information found in the different observations of the processes is documented in different ways. Process 1 and 2, are summarised in value stream maps where every specific activity, the process time and the lead time are visualised. Here four different time slots was suggested to the employees for each activity, and the they filled in what time slot they considered was most appropriate for each of these activities. The use of time slot made the time for each activity consist of a minimum and maximum time. Process 3 are documented in writing only, this is since the characteristics in the purchasing process differs and a time study was not feasible to perform. Instead, process 3 is focusing on presenting the relationships that occur in the interfaces, and how they are managed.

2.3.4 Internal documents

As mentioned some historical data were collected to be able to create the value stream maps. These documentations were mainly emails and online messages between engineers and buyers, and suppliers and buyers. The internal documents were collected with help from the employees who could access historical emails for the specific purchasing orders that were followed. Also, excel-files that were used to document the information of the purchasing orders to the project was collected.

2.4 Data Analysis

The data analysis process was divided in two different parts. The first part was to identify issues in the current situation and categorise those issues, and the second part was to analyse the implementation possibilities of improvements. The two part analysis are together answering research questions two and three in the project.

To be able to analyse the current situation and highlight problem areas, both the quantitative and qualitative data were analysed. To reach identifications of problem areas in the processes the empirical findings were compared to the gathered literature. When analysing the value stream maps for process 1 and 2, the method by Chen & Cox (2012) was used as guidance. Here the third step, identifying waste, were highly emphasised and performed with the definition of the eight wastes explained by (Keyte & Locher, 2004). This helped to identify where in the processes that waste occurred, and what types of waste that existed in the processes. The waste were then characterised to what type of activity they belonged to, and the division were made between waste that were connected to administrative activities, and waste that were connected to the interfaces in the purchasing process. To create an understanding of how the detected waste could be generalised to the bigger perspective, hence to be considered to occur in every purchasing process, this was analysed. The generalisation of the detected waste created a motivation to what waste and problem areas to focus on in the second part of the analysis.

The second part of the analysis was inspired by the seventh step from Chen & Cox (2012) and aimed to understand the possible improvement areas and how these could be implemented at the organisation. The findings from the first part of the analysis was a basis for the identification of improvement areas. Since it was highlighted that the majority of the problem areas were connected to the interfaces, this part of the analysis emphasised the coordination mechanisms by van de Ven et al. (1976) and Mintzberg (1979). The findings in the theory was compared to the findings from the empirical chapter, and suggestions of improvements could be presented.

2.5 Trustworthiness of the Methodology

In order to maintain a high level of quality and accuracy of the research, the gathered information has been evaluated in its trustworthiness. The validity, reliability, and relevance of the information has been evaluated through the project which is presented in the following sections.

2.5.1 Validity of the Methodology

Both internal and external validity has been considered during the project. Internal validity is according to Bryman & Bell (2007) a measure of how well the study is correlated with the theoretical ideas developed by the authors. To strengthen the internal validity the findings from the literature has been discussed with the supervisor and employees at the organisation, to assure that it is comparable to the current situation at the organisation. Ideas and progresses in the project were continuously discussed with the organisation to secure that the project and its findings were fairly described and analysed.

External validity means how well the methodology could be generalised and used in other contexts (Bryman & Bell, 2007). They further discuss that it can be hard to generalise a case study, since the situation and context of the company is in focus. The context of the organisation has been a big influencer in the way the study has been performed, and therefore the external validity is considered to be moderate. However, there are parts of the methodology that can be used in situations independent on the context. For example to describe current situations by using value stream maps is a common approach, today widely used in performance projects in different business situations. To secure the external validity, the methodology could have been tested on processes in other context. However, this was not feasible due to the limitations in time and scope of the project.

2.5.2 Reliability of the Methodology

The reliability of the methodology is a discussion of how similar the result will be if the project is made again (Bryman & Bell, 2007). To secure the reliability, all steps in the process has been documented and the research methodology and schedule of the process followed. Semi-structured interviews can consider to decrease the reliability, since they can be hard to perform again with the same result. However, the template that were used for the interviews is documented in the report, to provide opportunities to be used again to reach similar results. Further, there exists potential biases of getting the interviews personal opinion on the current situation. This has been avoided by interviewing employees at several levels, and representing different departments in the purchasing process.

The time constraint in the data collection made it unfeasible to follow the purchasing process for one material since the lead time of that process was longer than the data collection. This threatens the reliability in the mapping of the process since an entire process can not be followed in real time, thus some activities could been left out. To strengthen the reliability, communication was held with employees at the organisation while collecting the data. They contributed with experience and information of similar cases in the past to make the data collection as reliable as possible.

3. Theoretical Framework

The purpose of this chapter is to introduce the theory that is used in the research. The chapter is divided in three parts; first purchasing management is introduced with the aim to explain the characteristics of purchasing in the given context, and what parameters that affects purchasing performance. Continuously, an explanation to work processes is presented to explain performance in processes, what dependence relationship that can occur and what coordination mechanisms that can be used to manage the dependencies. Finally the concepts of time management and lean administration is explained, and how this can be used to improve the performance in processes. The key takeaways from the theoretical chapter is summarised in the end of the chapter, to understand how the theory is combined and further used in the analysis.

3.1 Purchasing Management

Purchasing is defined as the activities an organisation has to perform in order to get materials or services delivered from their suppliers. It includes activities as; decide specification on what needs to be bought, select suppliers, contracting, ordering and expediting. What needs to be bought, the selection of suppliers and contracting is often in the responsibility of engineers and sourcing teams. The ordering and expediting is activities with administrative characteristics, and often in the responsibility of purchasing divisions. Many researchers mean that purchasing activities has increased in the past century due to the increased amount of outsourced activities (van Weele, 2014). Regardless of the core business companies purchase materials, components and services to be able to follow through their business activities (Werner-Lewandowska & Pawlewski, 2015). Purchasing organisations in companies can have different structural views dependent on what importance the purchase has on the organisational performance. This can be decided by product characteristics, purchasing volume, product complexity, or all of them combined. Purchasing organisations can according to the context of the purchase be structured by standardisation, specialisation, configuration, involvement and (de-) centralisation (Glock & Hochrein, 2011). No matter what the structural view on purchasing organisations are, researchers stress that purchasing is not an isolated activity, instead it involves different departments in many levels of the organisation (van Weele, 2014; Glock & Hochrein, 2011; Werner-Lewandowska & Pawlewski, 2015). As a consequence, dependence relationships occurs between the different organisations and the ability to manage those relationships have a big impact on the purchasing performance (van Weele, 2014).

3.1.1 Purchasing Performance

Purchasing performance is a measure of how efficient and effective a purchasing organisation performs their work. Efficiency is by Achabal et al. (1984) described as using the resources in the best possible way to meet a given strategy, while effectiveness is how well an organisational goal is being met. The two categories, purchasing efficiency and effectiveness is by van Weele (2014) divided in four different areas of measurement. The first three are related to the effectiveness of the purchase, who he explains is to what extent the organisation are reaching previously set goals, which is supported by Achabal et al (1984). These three measurements of purchasing effectiveness are purchasing cost, product quality and purchasing logistics. The fourth measure is related to the efficiency of the purchase and is according to van Weele (2014) a measure of how well the resources are used in the purchasing organisation, which is comparable to Achabal et al. (1984) explanation. . Further, Murray (2009) explains that the efficiency can be measured by the administrative costs in the purchasing division, which will increase or decrease dependent of how much the resources is spent. Achabal et al. (1984) also stress that by using the

resources efficiently does not imply that they are being used in the most effective manner when reaching the goals. Purchasing performance can thus be reached either effectively or efficiently, but the most desired outcome would be to achieve purchasing performance by a combination and reaching the defined goals with as little resources as possible.

Measuring purchasing performance and adjusting the decision making after that leads to both strategic and operational benefits for organisations. It also gives an insight to the activities performed in the purchasing process and improves the communication between the departments involved in the process (van Weele, 2014). A common way of measuring performance is to use key performance indicators, KPI's. Indicators can be set after what goals the purchasing organisation aims to reach and can for example be cost savings, percentage rejected deliveries, number of on time deliveries and number of rush orders (van Weele, 2014). Even if some measurements are more common than others, there are no right and wrong on what to measure in organisations. Instead Murray (2009) stress the importance of adapting the KPI's to the context of the purchasing organisation. This is supported by Caplice & Sheffi (1995) who stress that the performance measurements needs to be customised after the management strategy, industry, product characteristics and competitive situation they are in. When the KPI's are set, Parmenter (2010) recommends companies to measure their KPI's frequently to keep track of the activities in the organisation. Also, the KPI's should continuously be developed and updated so they always measure what is relevant and not after past goals or strategies.

3.1.2 Purchasing in New Product Development

The increased competition in today's industry has led to that organisations continuously have to renew themselves and their products to compete on the market. The market is moving faster and organisations work and emphasise in new product development have increased, and continuously the pressure on the performance on R&D has grown. This new environment for product development in the industry has changed the view on its integration with other business departments. Van Weele (2014) explains that the product development activities form the future activities in the organisation, for example the logistics. Further, to not lose the competence of the purchasing employees, researchers stress the importance of integrating purchasing early in the product development phase. They usually have developed a relationship with the suppliers, and can therefore contribute with input on whom to source from with price and quality as dependent factors. The required speed in the new product development phase also put pressure on a fast speeding purchasing organisation. The communication between engineers responsible for the R&D and purchasing employees is therefore a prerequisite and a success factor for the new product development and for the purchasing performance (Eriksson & Rönnbäck, 2011). A challenge in the collaboration between the engineers and purchasers are the differences in the functional goals, for example that engineers have limited concern for costs, what can be the purchasers' highest priority (Murphy & Heberling, 1996).

Organisations acts in different contexts, depending on the industry they are in, the products they offer, the customers they serve and the suppliers they cooperate with. The context is of great importance when companies creating their purchasing strategy, and therefore the specific conditions and success factors in that context should be considered (Fisher, 1997). The context of purchasing organisations in new product development organisations hence differs from, for example, manufacturing organisations. Instead it can be related to customised manufacturing. The production is small, sometimes even singular and therefore the materials are bought in small volumes. The purchase is seldom repeated, since different versions of the product is produced and that increases the complexity of the purchasing activities since new information is needed for each specific purchase (Jagdev & Browne, 1998). The

increased complexity and uncertainty in the purchasing activities in a new product development context, makes it even more important to manage the process to achieve a high purchasing performance.

3.2 Process Based Work

Purchasing are in almost all organisations performed as a process based work, a purchasing process. Since it is realised that the purchasing process performed by M&L has an administrative characteristic it is important to wider the scope and not only research literature with a purchasing context. Therefore the following section explains process based work in general. The definition of a process, what it characterises and also what dependence relationships that occurs if the activities in a process is shared within an organisation are explained.

3.2.1 Introduction to Work Processes

A process is by researchers defined as a group of collected and interrelated activities that together produce an input to output (Benner & Tushman, 2003; Bergman & Klefsjö, 2011). The output of the process aims to satisfy the customer needs, while using as little resources as possible. Every step of a process consumes one or more resources; employee time, energy, machines and money. As visualised in Figure 3, the output of one step in the process acts as input to the next, until the process have produced the final output. Defects, bad quality or performance of the output of processes in organisations are a result of inadequate approaches to the activities in the process. These inadequate approaches can be inefficient work practises, ineffective business processes and miscommunication that creates errors and rework (Cooke, 2010).

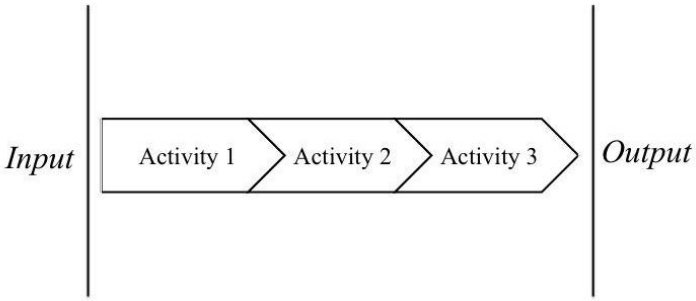

Figure 3. Serial performed activities performs input to output

Process based work are very common in today's industry and business processes are adapted after the strategy and what output that needs to be achieved by a group or organisation. Work processes can be mechanical or more organic and flexible, dependent on the context they act in and what they produce. When defining processes in organisations it is important to understand the activities included in the process, what controls the process, what acts on it, what means it uses to perform its functions and the output it produce (Biazzo, 2002).

3.2.2 Process Efficiency

Efficiency in processes means how well the process is using the resources in the organisation to deliver the expected output. An efficient operation strives to minimise the waste and maximise the resources. Resources can be measured in material, time, money and efforts and therefore efficiency can be quantitatively measured. This explanation is comparable to the previously explained purchasing efficiency mentioned in the section of purchasing performance. Since the purchasing activities also was

described to often be performed as a process this comparison strengthen each of the definitions. Low efficiency in processes is often caused by underutilisation of resources. Underutilisation is defined as a resource have greater capacity to perform an activity than what the organisation is using (Cooke, 2010). Examples of underutilisation is a photocopier that is used only twice a day, an empty office space, or employees who can not progress their work because they waiting on information, materials or management approval. Further, misutilisation of employees can occur in organisations when employees focus their skills on activities that does not add value to the organisations. An example of this is redundant or repeated work, potentially caused by lack of effective communication channels (Cooke, 2010).

3.2.3 Dependence Relationships

Dependence relationships exists between the activities in processes, since the process are dependent on the incoming input, and within the process each step performs an output that becomes the input to the next step (Cooke, 2010). Dependence relationships require internal coordination and collaborations between the involved employees, divisions or departments. Interfunctional coordination is by Min (2001) defined as different functions working together across the organisation to achieve common goals, which can be compared to a work process. These relationships in work processes makes it crucial to have a holistic view of the process when improving the activities. Further, to understand how the work and activities changing in the process, employees have to have an understanding of the work process as a whole (Cooke, 2010).

To understand and analyse dependence relationships in processes Stalk & Hout (1990a) recommends initial questions to ask. These questions are; What players that are involved in the process and how often? What should each player know about the other players work? And, where are decisions made and what do the decision makers need from other players to make better decisions?

3.2.4 Coordination Mechanisms

Dependence relationships prove that activities and resources within organisations are connected, and that the coordination, or lack of coordination of this relationships affect the performance (Mintzberg, 1979). To achieve high performance in processes, like the purchasing process, organisations should put high emphasis on coordinating between the departments and the activities that are involved in the process. Coordination itself means *"integrating or linking together different parts of an organisation to accomplish a different set of tasks"* (van de Ven et al., 1976, p. 322). Different types of organisational dependencies can be solved by using different coordination mechanisms (Mintzberg, 1979). Below, coordination mechanisms from two different authors are presented. Van de Ven et al. (1976) are focusing on what type of communication to use in different activities in the process, while Mintzberg (1979) is including how the activities themselves can be standardised to achieve coordination between the involved parties.

Van de Ven's coordination mechanisms

Van de Ven et al. (1976) explains three different factors that motivates different coordination mechanisms, task uncertainty, interdependence and unit size. Task uncertainty refers to the difficulty and the variability in the task performed by an organisation. Interdependence is to what extent people are dependent on one another to perform their individual jobs. Unit size refers to the number of people in the unit that performs a certain tasks. Dependent on these factors, the coordination mechanisms impersonal coordination, personal coordination and group coordination are used to different extent.

Impersonal coordination is explained to be a type of programed coordination, were the integrating mechanisms are pre-established plans, policies, procedures and standardised information systems. Personal coordination and group coordination are both mutual adjustments based on new information, were in the personal coordination individuals make the mutual adjustment, and in the group coordination groups perform the mutual adjustment in scheduled or non-scheduled meetings. The following summary made by van de Ven et al. (1976) explains when to use which coordination mechanisms, the central motivations are;

If the uncertainty of the task increases
- The use of impersonal coordination decreases
- The use of personal coordination increases
- The use of group coordination increases significantly

If the use of interdependency increases
- The use of impersonal coordination slightly increases
- The use of personal coordination moderately increases
- The use of group coordination increases significantly

If the use of unit size increases
- The use of impersonal coordination increases significantly
- The use of personal coordination increases
- The use of group coordination decreases

Mintzberg's coordination mechanisms

Mintzberg (1979) uses a different method to solve dependence relationships and explains the coordination mechanisms mutual adjustment, direct supervision and four types of standardisation. Mutual adjustment means that people adapt to one another by using informal communication during the work in the process, and is commonly used in both simple and complex situations. In complex situations for example, it is hard to plan beforehand and knowledge has to be developed during the process and the people performing the work has to adapt to each other. This is supported by van de Ven et al. (1976) and defined as personal or group coordination. Direct supervision means that one person gives orders to employees and instruct them on how to perform their activities. This is used in situations where several people coordinates to perform a task. The four types of standardisation are standardisation of work process, outputs, skills and norms (Mintzberg, 1979). Standardisation of work process means that to coordinate activities and workers, a work process with instructions and procedures is needed and followed by everyone. This coordination mechanism is best used in simple and routine tasks with low uncertainty, which can be comparable with the use of impersonal coordination described by van de Ven et al. (1976). Standardisation of output means that the expected result should be set and reached every time a process is performed. The focus here is on the interface between the activities and stress the importance of a standardised output to achieve a standardised input for the next activity. The mechanism is best used in more complex situations. Standardisation of skills means that the workers are standardised in their skill to perform the work. This achieves a situation where workers know what they can expect from each other and by that they coordinate. Standardisation of norms means that when the employees have common values and norms they also share the same goal and coordinate automatically (Mintzberg, 1979).

3.3 Time Management

Time management can be described as the control of time as a limited resource, to use it effectively and provide the most value for the least amount of time (Stalk & Hout, 1990a). In the previous chapter the aim of a process was defined as producing the expected output to satisfy the customer, while using as little resources as possible. Since time is defined as a resource it becomes important to manage time in order to create an efficient process. Further, time management has also been described as the prioritisation of activities in terms of importance in a process, after the determination of expected goals and outcomes. To spend the right amount of time on the right activity and prioritise which activities that needs to be done before others. This is performed by the usage of effective planning, setting goals, deadlines and delegations of responsibilities and this management of time can increase the process performance in organisations (Macan, 1994). Using time as a measure of performance is a common way in today's industry and expressions as lead time, on-time delivery and response time are often used to describe an organisation's ability to serve their customers (Stalk & Hout, 1990b). Further, using time as a measure of performance has been motivated to be a more important measure than money in some contexts, since it is more objective and not only shaped by accounting activities. Using time makes it possible to quantify and measure a flow of activities directly in order to see if they are adding value or not (Stalk and Hout, 1990a).

When working with time management it is important to define the activities in a process and sequence them in order to understand the relationship between them. Further, it is important to understand how the activities will be carried out and who is responsible for each of them, e.g. define what resources, in terms of people and equipment that is needed. Continuously, the duration of activities needs to be defined, in order to understand if the right activity is done at the right time (Managementstudyguide.com, 2017). For many companies, time has become an overarching measurement of performance. By reducing the usage of time throughout the business, a company can be able to restructure their activities and thus reduce costs and improve quality (Stalk, 1988).

Time compression

A common expression when using the concept of time management is time compression. This is a way to improve and streamline the activities in a process. Time compression refers to redesigning the organisation for time and performance is achieved by structure and managing the organisation effectively. Stalk and Hout (1990a) explains two concepts of structuring the work for time compression. The first is to organise around the main sequence, which means that the direct value adding activities should be isolated from the supportive activities. The second is continuous flow of work, which means that the main sequence should be organised in a clear and consistent sequence. These concepts can, regardless of the size and nature of the organisation, drive faster cycles in a process (Stalk & Hout, 1990a)

When streamlining the process one have to analyse what type of improvements that can be made in the current situation. What capabilities that are needed by what steps, what can be collocated and were, how performance should be measured and rewarded, and who should report to whom needs to be defined to start improving the process. By focusing on time and continuously compress time in the processes, organisations can gain benefits over those who do not use time as a measure of performance (Stalk & Hout, 1990a). It is important that the whole organisation is aware of the importance of time and recognise it as a scarce resource. To compress time, the organisation needs to have an environment that facilitate change and innovation, and use technology that can provide people with the most current

tools to perform their work. If this can be managed and implemented properly, speed can result in several benefits where the substantial benefit is the reduction in cycle time (Youssef, 1992).

3.4 Lean Administration

Lean management is a philosophy of a manufacturing process improvement through the elimination of waste. To produce as much as possible with as little resources as possible. This can be compared to van Weele's (2014) definition of purchasing efficiency. Both methodologies strive to use as little resources as possible while producing the expected outcome and therefore Lean management can be used as a tool to increase the efficiency in purchasing processes. Lean was initially developed in the automotive industry and derived from The Toyota Production System. Using Lean to improve work processes has historically been frequently used in manufacturing environments by reducing the waste and improving the process in production lines. Lean management in non-manufacturing environments has in the recent years been seen in improvement projects in hospitals and other administrative contexts (Larsson, 2008). Researchers in Lean administration stress that the same type of benefits can be created in administrative processes, for example economy, purchasing and customer service, as in manufacturing processes. Further, they motivate the implementation of Lean in all processes in the organisation, including the administrative, to not decrease the benefits it brings (Larsson, 2008; Ari, 2010). One of the key phases in Lean is to identify and remove non-value adding activities to streamline the process, and this can also be performed in an administrative context to improve the process and reduce the lead time (Larsson, 2008).

The difference between an administrative process and a traditional manufacturing process can be considered large. When implementing Lean in administrative processes and information flows a challenge is to see the physical flow, and what is hard to see gets hard to improve. To visualise the flow of the process has therefore a high value in the improvement of the process (Larsson, 2008).

3.4.1 Value Stream Mapping

Visualising the flow of the process can be performed either by process mapping or value stream mapping, two very similar methods that are commonly used in today's businesses. The difference between the methods is that process mapping is on a higher and broader level, while value stream mapping goes very detailed into a process. Process mapping is defined as a construction of a model that shows the relationship between the activities, people, data and objectives that are involved in a process. The process mapping aims to define the input and output of the process and what happens in between (Biazzo, 2002). Value stream mapping refers to putting together a timeline of activities that explains what happens every hour or every day in an order or a project (Keyte & Locher, 2004). Value stream mapping are widely used as a tool to understand and improve processes, in different levels of an organisation. It can be made to improve handoffs of paperwork, changing the information system, redefining roles and responsibilities, and improving coordination (Keyte & Locher, 2004). A general approach to value stream mapping includes five steps (Rich, 1997);

1. Study of the flow process
2. Identification of waste
3. A consideration if the process could be changed in a more efficient sequence
4. A consideration of a better flow pattern
5. A consideration of whether everything that is being done at each stage is really necessary and what would happen if non-value adding activities were removed

The first step in value stream mapping, study of the flow process is very important to be able to perform the following steps. After the first step is finalised the map of the current situation must explain clearly; what the system does, what controls it, what acts on it, what means it uses to perform its functions and what it produces (Biazzo, 2002).

Template for value stream mapping

Templates for value stream mapping differs dependent on the type of process that aims to be mapped. In processes that are not repeated, hence are not performed the same way from time to time, Rother & Shook (2001) suggest to study type projects. The best result is then reached if the projects are in the final phase, or already finalised. Rother & Shook (1998) propose a couple of predefined symbols and special notations before mapping the current state of the process. These figures are used in the map to explain the different players involved, type of activities, communication and movement of the process. The symbols used in the mapping performed in this study are visualised in Figure 11 and can be found in the empirical chapter. Before mapping the process it is important to define the input, output, customer and supplier of the process (Rother & Shook, 2001). All activities that are performed inside the division is documented in as boxes in a row, activities outside the division are placed as boxes above. Also, it is suitable to have several figures represents the customer or supplier, if the contact and communication with them occurs frequently during the process. What each box presents is decided after the context of the project and what is planned to analyse. Commonly however, is to present the activity, involved employee, the lead time of the activity and what tools or supportive systems that are used to perform the activity (Keyte & Locher, 2004).

Analysing the value stream map

When the current state of a process is visualised in a value stream map the map should be analysed, to see what it can tell about the process, its current performance and the potential of reducing waste (King & King, 2015). When analysing the value stream map Chen & Cox (2012) suggest to ask and answer the following questions;

1. What/When does the customer need?
2. How often will we check our performance to customer needs?
3. Which steps creates value and which are wastes?
4. How can we flow work with fewer interruptions?
5. How do we control work between interruptions?
6. Is there an opportunity to balance the workload and/or different activities?
7. What process improvements will be necessary?

After the analysis, the suggestions of improvement can be visualised in a future state map. This presents the result of the new design and lead time of the process, if the wastes were to be removed and the process streamlined (Rother & Shook, 1998).

3.4.2 Waste

Waste is every action in a process that does not add direct value to the product (Womack & Jones, 2003). Identifying waste and create an understanding of why they occur is an important step in the improvement process initiated by a value stream map (Hines & Rich, 1997; Chen & Cox, 2012). Highlighting the waste is a motivator that change is needed and proves that a process can be performed in a more efficient way, therefore waste can be considered to be a measure of performance in an organisation. Efficiency was in previously defined as a measure of how well the resources are used in

the purchasing organisation (van Weele, 2014). The waste explained below can therefore be connected to efficiency, and continuously the performance of an organisation.

Within a process there can be three types of operations; non-value adding, necessary but non-value adding, and value-adding (Hines & Rich, 1997). The first one is pure waste and involves non-value adding actions that should be eliminated, the second one are actions that may be considered as waste but are at the same time necessary for the current operating activities. The last type of operation are value adding activities in the process. Toyota first defined the seven wastes in production flows, this was later developed to eight wastes (Hicks, 2007). These wastes are first and foremost designed after a manufacturing context. However, as mentioned researchers have stressed that the eight wastes also can be applied on office and administrative work. Below Keyte & Locher (2004) describes examples of how the eight wastes can take form in an office context (table 1). This strengthen the motivation from researchers that the concept of Lean as an improvement process can be applied and useful in other context than manufacturing ones (Larsson, 2008; Ari, 2010). When the wastes are identified Larsson (2008) stress the importance of finding the underlying reasons for them to be able to improve or remove them in the long run.

Table 1. Example of waste within an office context (Keyte & Locher, 2004).

Type of Waste	**Office Example**
1. Overproducing	Purchasing items, printing papers and processing paperwork before they are needed.
2. Inventory	Filled in-boxes, office supplies, batch processing transactions and reports.
3. Waiting	System downtime, system response time, approvals from others or information from customers.
4. Extra Processing	Re-entering data, unnecessary reports, transactions, accounting, expediting, labour reporting.
5. Correction	Order entry errors, design errors and engineering change orders, invoice orders.
6. Excess Motion (Movement of people)	Walking to and from a copier, a fax machine or other offices.
7. Transportation (Movement of paperwork)	Excessive email attachments, multiple hand-offs, multiple approvals.
8. Underutilised People	Limited employee authority, and responsibility for basic tasks, management command and control, inadequate business tools available.

3.4.3 Principles for Lean Administration

When improving an administrative process after the Lean concept Larsson (2008), explains several concepts to base the implementation on. There are different principles for Lean administration that is adapted after an administrative context, and therefore differs from the concepts used in Lean production.

However, the fundamental strategy is the same, to design a process that gives opportunity for high performance. Larsson (2008) explains several principles that can be used both when implementing, managing, forming the groups of employees, and changing the activities themselves in the organisation. The explained principles below focus on the activities, and how they should be designed and performed. The principles regarding people, management and implementation of change is left out since this is a limitation and not included in the improvement process.

The first principle of interest is; standardise and stabilise, which highlights the importance of standardising the administrative tasks and the input of information needed to be able to fulfil the takt time. Further, Larsson (2008) stress that the administrative process should be stabilised to eliminate deviations in input and output. This can be compared and is strengthened from Mintzberg's (1979) theory of standardising the output, explained in section 3.2.4, Coordination mechanisms. Both researchers explains the importance of knowing what to expect from the department producing the output, that continuously is your input in the process.

The second principle of interest is; balance the administrative production. To produce exactly when the customer needs the product can create stress and high workload at times. It is recommended to have a dialog with the customer about delivery times and content. With this input from the customer the administrative process is easier to plan and give the opportunity for a balanced production (Larsson, 2008).

The last principle of interest is; create a continuous flow of the administrative process. This aims to make the process as simple and uncomplicated as possible, and remove the activities that do not contribute to the customer needs. Further, one should try to reach a situation where employees can solve as much as possible individually, to reduce handovers in the process (Larsson, 2008).

3.5 Summary of the Theoretical Framework

When summarising the theoretical framework, it is understood that the four different sections, Purchasing management, Process based work, Time management, and Lean administration, are strongly related to each other.

When focusing on purchasing performance, it is affected by different areas. Purchasing performance itself are defined by the purchasing efficiency and effectiveness. Further this is connected to the context of the purchasing process, which in the studied research is new product development. The new product development context was realised to be create a complex purchasing process, which affects the performance. Continuously, purchasing are explained to be performed as process based work. This means that the performance in the process, the interaction between the activities and the performance when producing input to output affects the purchasing performance. This explanation implies that purchasing performance in this study are connected to the efficiency and effectiveness in the division, the new product development context and the process performance, which is visualised in Figure 4.

This connection further leads to the three different improvement methods explained; Coordination mechanisms, Time management and Lean Administration. Coordination mechanisms strives from the explained dependence relationships that exists in processes were different coordination mechanisms are explained to improve the performance of the process. Time management and Lean administration are both related to the efficiency of the process, where time is used as a measure of performance and the

utilisation of time in the process is highlighted. Both Time management and Lean administration suggests value stream maps as a good analytic tool. By visualise the process through the use of value stream maps and further compare it to definitions of waste in administrative context, improvement areas can be detected.

The three different improvement methods suggest principles of how the activities in the purchasing process can be evaluated and improved to increase the purchasing performance, these are coordination mechanisms and Lean principles. The coordination mechanisms emphasise impersonal-, personal-, and group coordination and standardisation of work processes and input. Lean principles emphasize how to standardise and stabilise to create a continuous flow of the process. The Lean principles, together with the different coordination mechanisms provides opportunities to reduce waste, which increase the efficiency and continuously can increase the purchasing performance.

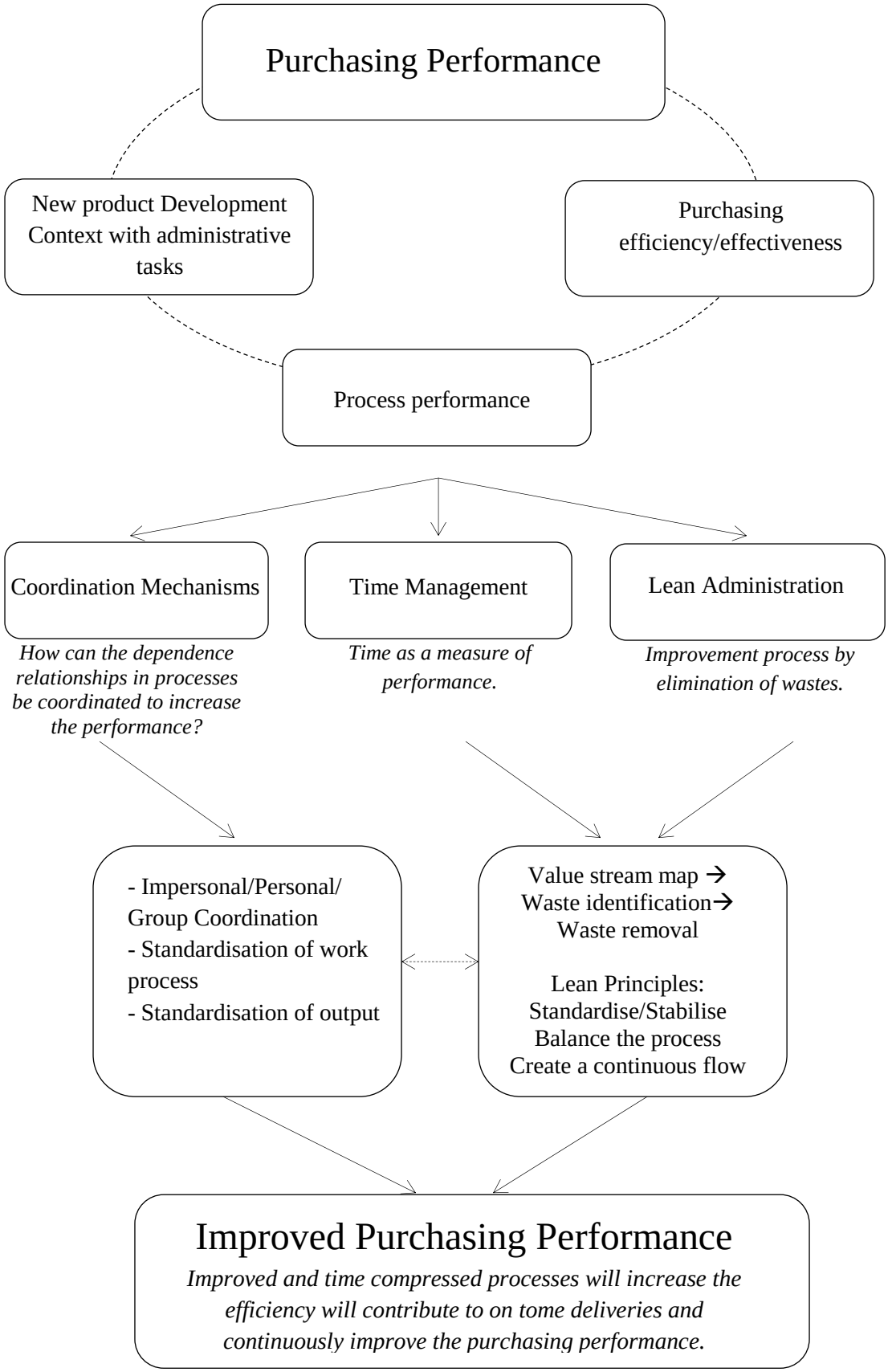

Figure 4. Connecting the areas of research

4. Empirical Findings

The following chapter presents the empirical findings that have been collected through interviews, observations and internal documents. The chapter is divided in two different parts, the first part explain the organisation, the purchasing division in focus and their activities in general. The second part focus on the purchasing process of three different materials, were the processes are visualised and explained in more detail. The information found in the examples are generalised in the aim to summarise and give an overview of the purchasing process overall. The empirical findings in the chapter explain the current situation of the purchasing process and therefore answer the first research question the thesis aims to answer; What activities are included in the purchasing process performed by M&L?

4.1 Description of the Context and Process at the Organisation

This section describe the background of the studied organisation and gives an introduction to the purchasing division M&L. To understand the purchasing activities of the materials, the R&D projects are introduced and continuously the purchasing activities explained. This section focus on giving an overview of the purchasing activities and how they are connected to the business.

4.1.1 Background of the Organisation

The studied R&D company is a located in Gothenburg. The company is young, founded a few years ago and has since the start faced a tremendous growth. The internal processes were designed after the context the organisation faced in the beginning, and has not changed since. One challenge is therefore to align the internal processes with the increased workload they now experience. The organisation is currently working to restructure the ongoing processes to be more adjusted to the amount of R&D projects.

4.1.2 The Purchasing Division M&L

The department responsible for indirect purchasing is divided in three different divisions; M&L, Consultant Purchasing and Indirect Purchasing, each responsible for one purchasing segment (Figure 5). M&L is responsible for the purchase of the direct material, which is material needed in the different R&D projects the organisation is running. The material are different component parts that are tested in the R&D projects, further in the report the component parts purchased are referred to as “material”. The M&L group consists of six employees. One purchasing manager, responsible for managing the group and controlling the activities. Also, the purchasing manager leads meetings with the group, and is representing the group in meetings with other departments. There are one buyer and two buyer assistants in the group. They are responsible for collecting the orders from the engineers and placing the orders to the suppliers. Finally, there are two material planners, responsible of tracking and tracing the orders from the suppliers and 3PL’s. Until recently the M&L division only consisted of the purchasing manager and the buyers. The material planners was not a part of the group and the work of track and trace the material was a part of the buyer's responsibility.

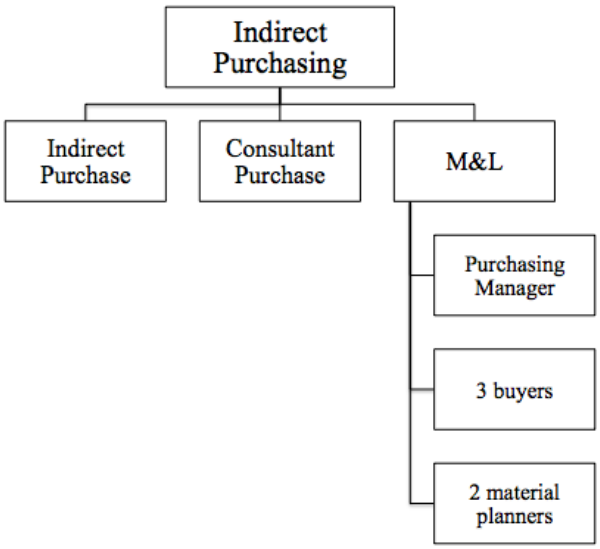

Figure 5. The organisational structure of Indirect Purchasing

4.1.3 The R&D Projects

The organisation perform and produce their R&D in projects. For one new modular architecture, projects are performed in four different maturity levels. The process starts with a prototype model were basic functions are tested. Continuously, the model is developed to different levels until the final version is determined. In each maturity level of the project, advanced testing is performed where different components and electrical functions in the model are evaluated. The different maturity levels of one model do also have different stages were different status of the materials are tested, explained as an example in Figure 6 below as A1, 2 and 3. The purchasing process is therefore made in projects where one project is made for each stage in each level, for example XXX A3, were XXX is the name of the project and A3 explain the maturity level and at what stage the model is in. The R&D projects can look different and the stages in each maturity level can vary. The models are tested until the final version with the desired standard, technical specifications and design is reached. Further, the purchase of material for different projects with different maturity level varies. There are more material bought for projects with low maturity level than with high, for example project XXX A1 will contain more material than XXX A3. This because within the first maturity level and stage all material needs to be tested and as the levels and stages updates only the updated parts needs to be tested again. Also the purchase for material in projects with higher maturity level do not include as many activities since more information about this materials is known, such as supplier and price, which facilitate communication both internally within the organisation and externally with the supplier.

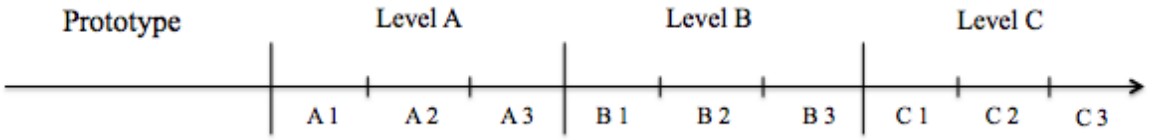

Figure 6. Explanation of the R&D project process

4.1.4 The Purchasing Process of Direct Material

Figure 7 below illustrates how the purchasing process of direct material is a part of the R&D project. The purchasing of the direct material is in the responsibility of M&L. However, the different activities

in the purchasing process is not performed solely by M&L. The first step in the process, create product request, is performed by engineers in the R&D department. The product request includes what material from their division that needs to be bought and tested. The second step in the purchasing process is to create a bill of material, a BOM-list, from the different product requests. This is performed by Vehicle Integration, VI, who summarise the different product requests to one BOM-list and forward it to the buyers within M&L. VI is the owner of the models that are built and tested, and are responsible of communicating the decisions between engineers, the purchasing division and the build and test team. The third step in the process is an approval of the purchasing request and is handled by the finance department. The purchasing request is an approval of the entire project, for example XXX A3, and is forwarded to M&L. The approval of the purchasing request means that the buyers can start ordering the material. The fourth step, placing the purchasing order is handled by the buyers in M&L. They create a purchasing order from the information in the BOM-list and send it to the supplier. The sourcing team that negotiates and contracts the suppliers are located at the organisation in China, and is not performed by the purchasing department in Gothenburg. The engineers who specifies what material to buy often suggest a supplier that is sourced, and this is not made by the M&L division. When the order is placed, the material planners in the M&L division continues with the fifth step in the process, tracking and tracing the orders. They communicate with the suppliers and 3PL's about delivery dates and forwards it to the organisation. The sixth and last step in the purchasing process, collect the material is handled by employees in the warehouse, where they collect the material and forwards it to the test area. In different situations, they can need approval from the material planners at M&L who knows what is expected to arrive. This step is therefore also included in M&L's purchasing process and examples of these situations are explained in section 4.1.5 The Purchasing Activities performed by M&L.

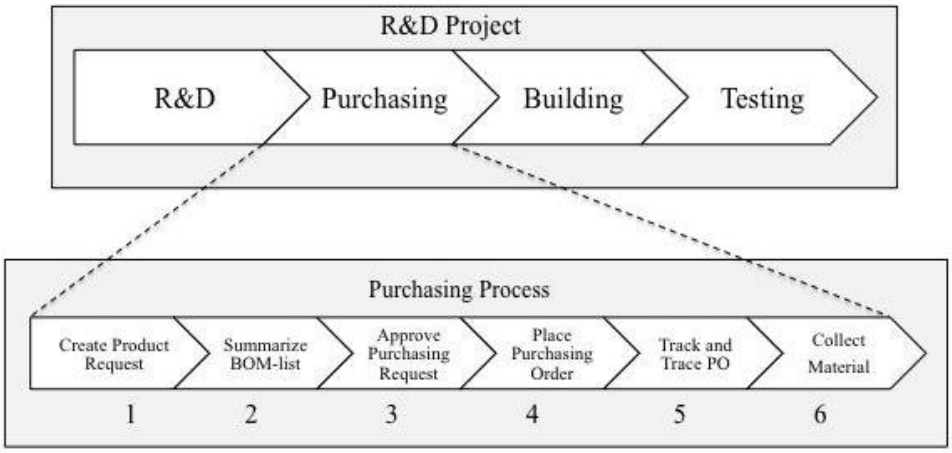

Figure 7. The purchasing process of direct material

Today, no guidelines or specific procedures exists of how to perform the purchasing process. This strives from the fact that when the organisation started, the R&D projects were performed separately, one at a time. Activities were performed the way the employees thought was best then and there, and the processes have never been changed since. No performance measurements are implemented in the process and continuously no KPI's are used to control the work. VI, the owner of the models, keeps track of the amount of material delivered on time to each project, which is considered to be the only way the performance are measured in the current situation of the purchasing process.

4.1.5 The Purchasing Activities Performed by M&L

As mentioned in the section above the M&L division is responsible for the purchasing of the material to the models in the R&D projects. They collect information from the organisation, place the orders to the suppliers and track and trace the orders until they arrive at the site in Gothenburg. This section describes a general explanation of the activities included in their process; collect information, place order to supplier, handle deviation, material meeting, track and trace, and collect material, which is visualised in Figure 8. All the activities except handle deviation are performed in all purchasing processes for the projects. However, handle deviation is present in almost all of the purchasing processes. It is considered one of the activities that the employees consume a lot of time on and is therefore included in the description of the purchasing process in general.

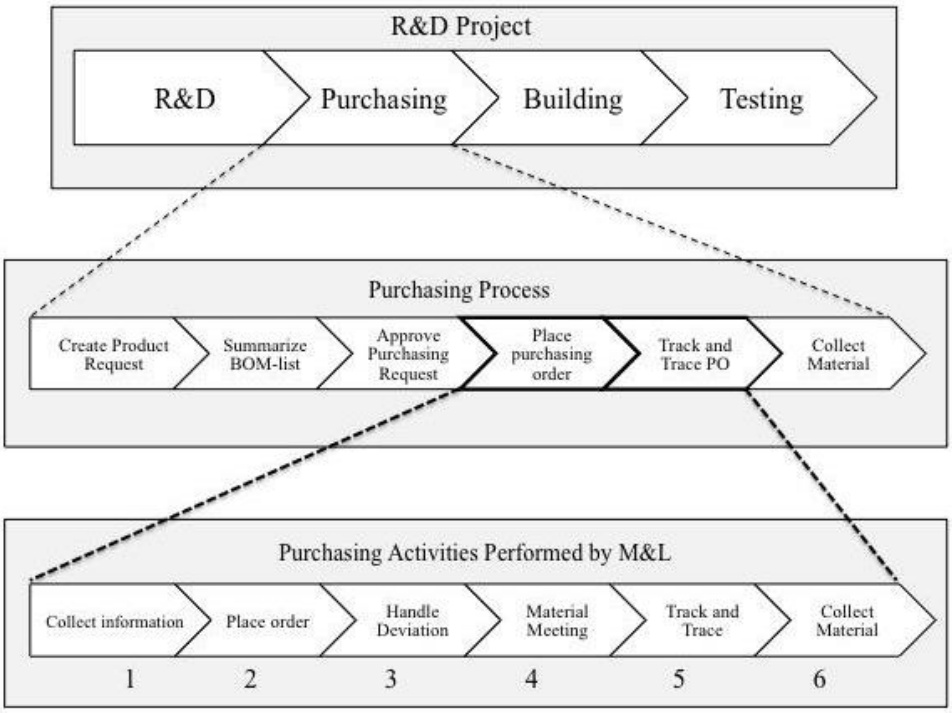

Figure 8. The purchasing process of direct material with the activities performed by M&L

Collect information

The collection of information is the first step in the process performed by M&L. They receive an approval of the purchasing request from the finance department, and a BOM-list of what to purchase for one specific project from VI. The BOM-list is an excel file stored at the company's intranet and contains information about the material and what quantity of each material that needs to be purchased. The organisation have decided that the BOM-list should be delivered to M&L 20 weeks before the building of the model starts. Before the BOM-list is delivered to M&L it should be quality assured by the engineers to ensure that the right material are inserted in the file. However, sometimes the engineers can not approve the BOM-list because they do not have enough information about the requirements. For example, some knows first a couple of weeks before the build start what they will include in the model, therefore they can not approve the BOM-list at the desired time and writes old or non-existing part numbers in the requests. The BOM-list is therefore only partially quality assured when VI send it to M&L.

The material that are purchased are divided in six different cost centers, which can be defined as material groups where each cost center represents one type of material. The buyers at M&L have responsibility of purchasing the materials in two cost centers each. The BOM-list that is received is one for all the material in one project, and the buyers sort the information in the BOM-list that regards their cost centers.

The sourcing of suppliers and negotiating of material prices are performed in China. This is since the production of the products the R&D results in is placed there, and the contracts with the suppliers includes both materials to R&D and to the final production. If a material has been purchased before and no updates about price is needed the buyer can use information of price and supplier from a previous purchase. If updates of suppliers and prices is needed for a material this information is collected from the sourcing employees in China.

Place order to supplier

When the buyer creates an order, the information system SAP is used. The material with part number, quantity and price is inserted and what supplier that the material is purchased from. The buyer insert a desired delivery date that usually is set to one week prior to the built start. The buyer sends the order to the supplier by email with a copy to the material planner. Continuously, the buyer update the BOM-list with purchasing order number, and the date the order was sent to the supplier. When the supplier confirms the order, the material planner updates the BOM-list with estimated delivery date, which is when the order is sent from the supplier, and estimated arrival date, when the material arrives on site.

Handle deviation

A deviation is made when there are changes in the orders that will be or already has been purchased. Deviations can take different forms in the purchasing process, and be made of different reasons. Often deviations occurs when the engineers' updates the status they want on a specific material after the BOM-list is sent to the buyers. New status of a material can be updates in the design or changes in the software. It can also be smaller changes as updates in the label or table of content. In this situations the deviations are detected internally in the organisation, and forwarded to the buyers. Deviations can also be detected by the supplier, and they inform the buyer that they can not deliver the desired order. This can be either that the part number is new, i.e. the supplier cannot deliver the new status, or that the part number is old, i.e. the supplier do not deliver that status any longer. In this situation the information is collected from the supplier and the order is either updated or cancelled. The deviation requires extended contact for the buyers, both internal with engineers and external with the supplier, to communicate on a purchase that is agreed of all parties.

When a deviation is detected a separate template is used to handle the deviation process. In this template the existing part number that needs to be changed is showed together with information about the required change. Purchasing in Sweden, purchasing in China and an R&D representative needs to confirm the deviation before it officially gets approved. After the approval a new or updated order can be sent to the supplier. New deviations are collected by VI that sends out deviation-lists to purchasing for confirmation twice a week. All buyers must enter each list to see if any of the deviations affect them, if so they need to check with the supplier to confirm if the new updates can be delivered. When they receive an answer they forward this information to the purchasing manager which in turn needs to confirm the deviation and send it back to VI for final approval. All issues that could become deviations are discussed during the material meeting to clarify the changes between the involved departments, and all approved deviations for one project are then gathered in one list called master deviation-list. This

list can be reached by all involved departments at the intranet and it is from this list that the updated material should be purchased.

Material meeting

Material meetings are held twice a week to discuss problems arising in the projects. All buyers, both material planners and the purchasing manager are present during the meeting together with representatives from VI, a material manager, and a workshop mechanic. One representative from each cost centre joins the meeting during a specific timeslot to discuss the problems within their cost centre. The meetings are held in order to get an overview of the projects and to inform each other of updates and changes for the material. To get this overview and easily see what issues there is for different projects a list called issue tracker is used as a checklist during the meetings.

The issue tracker is a summary of all the placed orders for one specific project. The number of placed orders are stated and divided on cost centre, to clarify which buyer and representatives that are responsible for the issue. When delivery and arrival confirmation is received it will be updated in the list. If there are any issues with any of the material the purchasing order number will be added in the issue tracker together with the part number and the issue. If something is added to the issue tracker it will be discussed during the meeting until it has been solved and removed from the list. It is the material planner's responsibility to update the issue tracker, but everyone involved can access the list through the intranet.

Track and trace

The material planners are responsible for tracking and tracing the orders from when the buyer send an order to the supplier until it arrives at the warehouse. It means that the material planner keep the contact with the supplier after the order is sent. In some situations the supplier confirm the order right away, but when they not confirm the material planner need to request confirmation. For most of the material it is enough to send an email and request order confirmation but in other situations the material planner need to request a confirmation multiple times both by email and phone to receive a confirmation. When the build of the model is approaching the material planner contact the supplier again to ensure the agreed delivery date. Once the supplier provide new information about the material the material planners update both the BOM-list and their own list, which is called ongoing purchasing order-list, with that information. The ongoing purchasing order-list is an excel file with information regarding all the ongoing purchasing orders that the material planners track and trace. The material planners have one each and share them with each other. If the update from the supplier contain information about late delivery the material planner also update the issue tracker with that information together with the new estimated delivery date. If the goods have a tracking number the material planner will request notifications from the 3PL company providing the transportation in order to get a message when the goods will arrive at the site. Usually, the tracking number is provided by the supplier but sometimes there is no tracking number. In these situations the material planner either have to wait for the employees in the warehouse to collect the material and update a storage-list so they can read the information from the list, or they have to go down to the warehouse and search for the material them self.

Collect material

The final step in the process is the collection of the material and is primarily performed by the employees in the warehouse who sign of receiving the material when it arrives at the site, and update the storage-list with information about the received goods. The storage-list is a public excel file placed at the company's intranet where the employees in the warehouse insert information about goods arrival and the received quantity. If the material planners have received a tracking number they will get a

notification when the goods have been signed off, but if they do not have a tracking number they need to check the storage-list continuously to see if the goods have arrived or go to the warehouse and search for the material them self. Sometimes there are problems with the arriving goods, such as wrong part number, wrong quantity or the goods lacks a purchasing order number. Problems regarding the part number are not solved by M&L but if the goods do not have a purchasing order number, which means that it is unknown what project it belongs to, the material planner needs to go down to the warehouse and try to solve it. The purchasing process that M&L is responsible for is finalised only after the material has arrived and the delivery is confirmed. Therefore, the material planners are involved in the collection of material.

4.2 Empirical Examples of the Purchasing Process

In the previous section an overview of the different activities in the purchasing process are explained. To collect quantitative data on the time spend for the different activities three examples have been selected and studied in more detail. The following section is initially visualising two of the purchasing processes by value stream maps, were the different activities and the time they consume are explained. Continuously, the third process is described to present a better understanding of the coordination mechanisms that are used in the purchasing process, and how it differs or are similar to the mechanisms in the other two processes.

The two materials that are visualised in value stream maps were selected to present different situations that can occur in the way the purchasing process is performed. Figure 9 presents that the two materials is similarly critical to the project start, were both materials are of high importance in order to start the building of the model. However, they differ in complexity were process 1 is less complex than process 2, both in specification and communication, which means that the material in process 2 is more uncertain and difficult to handle than the material in process 1. The material purchased in process 1 is a material that is repeatedly purchased, and therefore the supplier and price is known. The lead time for the supplier, hence the time they have from the order is placed to the material are deliver, is agreed on five weeks between the parties. The material purchased in process 2 is also a repeated purchase were the supplier is known. However, the price changes in every new project, and this information is collected from the sourcing team in China. The supplier in process 2 has a lead time of eight weeks. Process 3 differs from the other two processes in both criticality and complexity. The specification do not change for this material for different projects and is therefore seen as less complex to purchase since all information is known, and not critical for the project since if it would be delivered late the same material used in a previous project can be used.

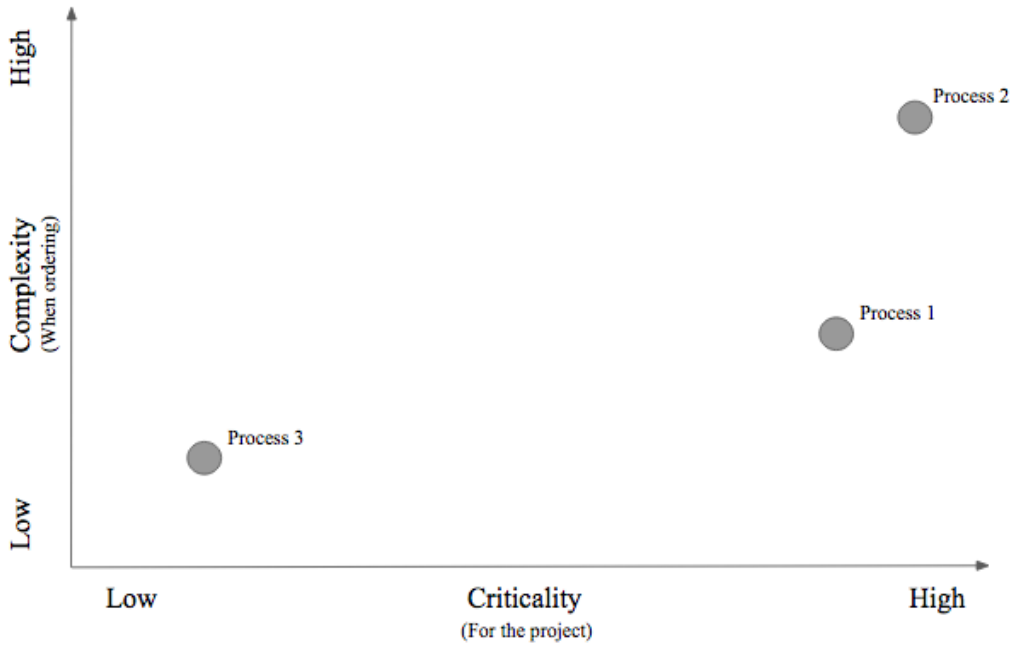

Figure 9. Comparison between the processes regarding their complexity and criticality

The material that is described in process 3 was chosen not only because of the difference in complexity and criticality, but since the way to coordinate with the supplier differs from the other two. The reason to study the material was to understand how this affects the purchasing process. In the theoretical chapter three different coordination mechanisms were described by van de Ven et al. (1979), impersonal, personal and group coordination. Figure 10 explains how the three chosen materials differ in terms of complexity and the described coordination mechanism.

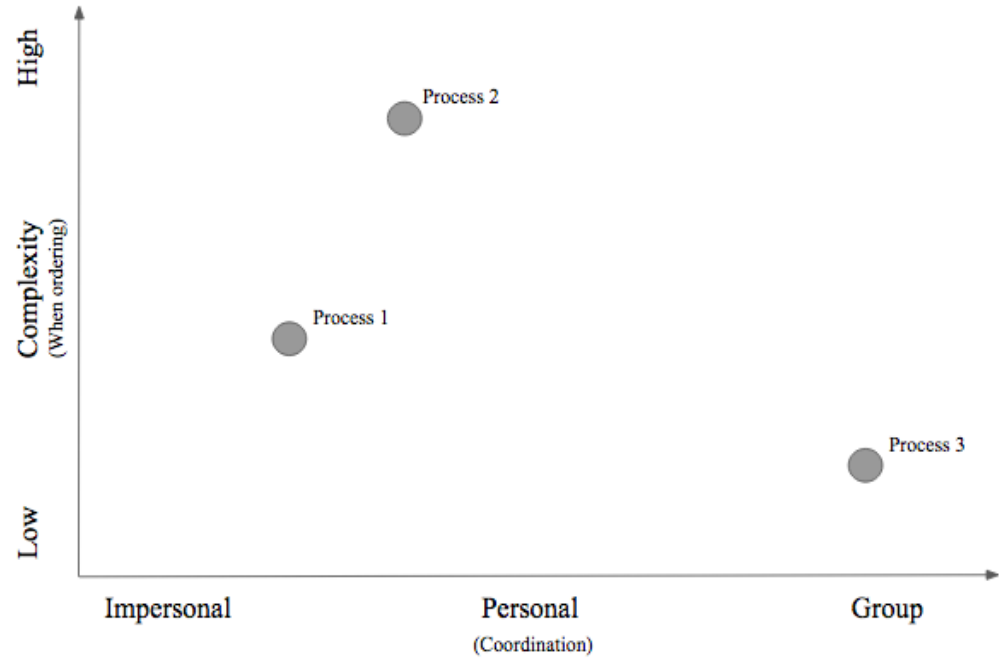

Figure 10. Comparison between the processes regarding their complexity and what coordination mechanisms mostly used within the process

This is only three examples from around 70 different material purchased from 13 different suppliers to the specific project. To increase the possibility of generalising the characteristics of the processes to the

entire project this were discussed with the buyers at M&L. It turned out that the different levels of complexity that were present in the three processes could be generalised to the other material purchased in the project. Therefore, it is also realised that similar types of issues can occur in the processes with the same type of characteristic. This conclusion further creates the possibility to connect the future suggestions of improvements to the entire purchasing process. In figure 11 below all the materials purchased to the project are divided in three different groups, with different levels of complexity and were the three processes each represents one group. The figure explains that 33 % of the material has similar characteristics in their purchasing process as the material studied in process 1, the process that were mediate in its complexity to purchase. 62 % of the material has similar characteristics as process 2, a high complexity and further 51 % is bought from the same supplier and therefore face similar issues. Finally, 5 % of the material has the same characteristics as the material in process 3, a low complexity in the purchasing process. Even though it is realised that the processes are not entirely equal it was from interviews with the buyer's confirmed that they were enough similar to be comparable with the purchasing process of the studied material. This categorisation to the three different levels of complexity are visualised in Figure 11.

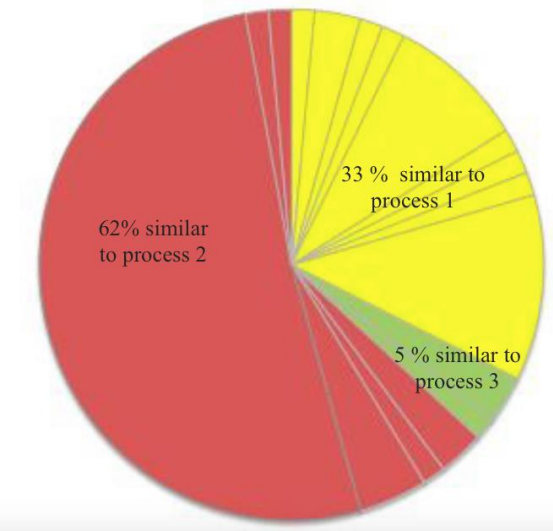

Figure 11. A summary of all purchased materials in three categories of complexity

4.2.1 Introduction to the Value Stream Mapping

To create a better understanding of the current situation in the purchasing process, three specific materials were selected and studied. The information in two of the processes is visualised in two value stream maps, explaining the purchasing process in these specific situations. The purchasing process is mostly describing a flow of information, were the information on what needs to be purchased is transferred internally in the organisation and externally to suppliers. The value stream map shows that the way to communicate differs between the processes, but included in the way to communicate are emails, online message-conversations, phone-calls, meetings and electronical information. The maps are created and designed after the value stream mapping template explained in the theoretical chapter. In the maps different symbols are used to describe the processes and these are presented in Figure 12. Further, the process time for the different activities shown in the maps are an average time calculated from a time interval for each activity. The intervals were discussed and developed together with the responsible employees and can be found in appendix 3.

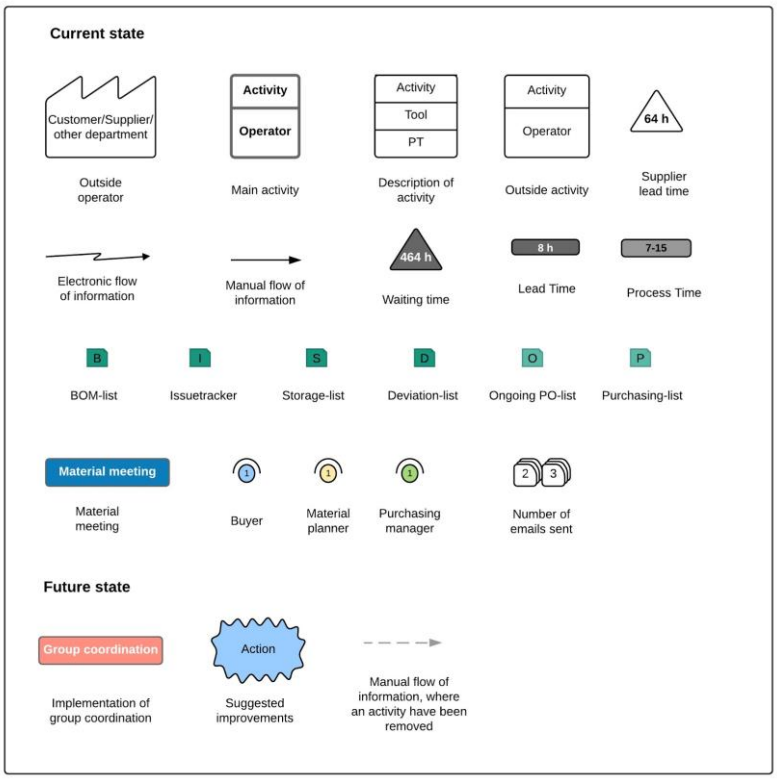

Figure 12. Symbols used in the value stream map

4.2.2 Current State of Process 1

The value stream map made for process 1 are visualised in Figure 13. The first step in the process was to collect information which in this process was divided in two different activities, receive the purchasing request and the BOM-list. The buyer first received information from the finance department with an approved purchasing request and about two weeks later an email with the BOM-list from VI. When both the purchasing request and BOM-list had arrived the buyer could create the order in SAP. The buyer did not need to insert new information about price or supplier in the program since the purchase of this product is repeated and historical information about the product was stored in SAP. The required delivery date was inserted in the order and set to one week before the build of the model. Quantity was collected from the BOM-list and inserted in the order. When the order was made and saved, the buyer contacted the PSS-owner to confirm that the part number was correct. When it was confirmed the order was sent to the supplier with a copy to the material planner, who from then on got involved in the process to track and trace the order. The buyer inserted order number, the date the order was sent, ordered quantity and supplier in the BOM-list and once the supplier confirmed the order the material planner inserted the expected delivery date in the BOM-list. The time that follows after this activity was lead time for the supplier and is represented by white triangles in the map.

When the built start approached, the material planner contacted the supplier to confirm the agreed delivery date, which was approved by the supplier. At almost the same time the buyer received a deviation-list from VI with updated information about the material, hence the order needed to be updated. This deviation was a change in requisition letter, which means a change in the label or table of content. From the company's side, changes in requisition letters are okay as long as the part number is the same. The buyer contacted the supplier directly to ask whether or not they could deliver this update and the supplier replied that they already knew about this change and approved the delivery. The buyer confirmed the deviation and forwarded it to the purchasing manager for approval, which in turn

approved it and sent it back to VI for final approval. As already mentioned the new order should not be placed until VI have made the final approval, but since the lead time for handle deviation was 88 hours (Figure 14), the buyer used the same order as before instead of placing a new one, and confirmed changes with the supplier over email in order to get the material to the site on time. After the supplier had confirmed the update and delivery date to the buyer a conversation started between the supplier and PSS-owner where they again discussed the delivery date. This conversation was not directed to either the buyer or the material planner but both of them were receiving copies of the emails and were expected to read them, take part of the conversation and note useful information. The buyer was asked to confirm the built start, which the PSS-owner forwarded to the supplier who informed that they could not deliver on time but one week late. The material planner documented the new expected delivery date and inserted the PO-number in the issue tracker since it was a late delivery, so it could be followed up on during the material meetings. From the time the purchasing order was inserted in the issue tracker it was discussed during every material meeting to keep track of the order. After the discussion between the supplier and PSS-owner the buyer called the supplier to confirm the update and the expected delivery date one more time.

When the material was sent from the supplier, the buyer received a delivery confirmation and forwarded it to the material planner, since it is the material planner who should track and trace the material. Further, the material planner collected the tracking number for the order and inserted it in the BOM-list and issue tracker. The material planner traced the order and requested notifications about it from the 3PL. When the order arrived a notification was delivered to the material planner who updated the BOM-list with arrival date and removed the order from the issue tracker. The final step in the process was the goods approval, which was done by the warehouse. Once the goods was approved the warehouse inserted all information in the storage-list. The material planner collected this information and updated received quantity in the BOM-list. When the quantity was updated in the BOM-list the process was completed. The total lead time for this process was 712 hours and the generated process time was 63-231 minutes which gives an average process time of 147 minutes, around 2.45 hours (Figure 14). The calculation of the minimum and maximum value, and the total process time can be found in Appendix 4, where the process time for each activity is calculated and summarised. Of a total lead time of 712 hours for the entire process the process time of 2.5 hours represents a small share. However, 496 hours (464 plus 32), of the total lead time is the supplier lead time and are represented by white triangles in the map (Figure 14). The supplier lead time is a necessary waiting time in the process and can not be affected by the organisation, hence this 496 hours can be removed from the 712 hour lead time that the process is lasting. The lead time for the internal purchasing process is therefore 216 hours.

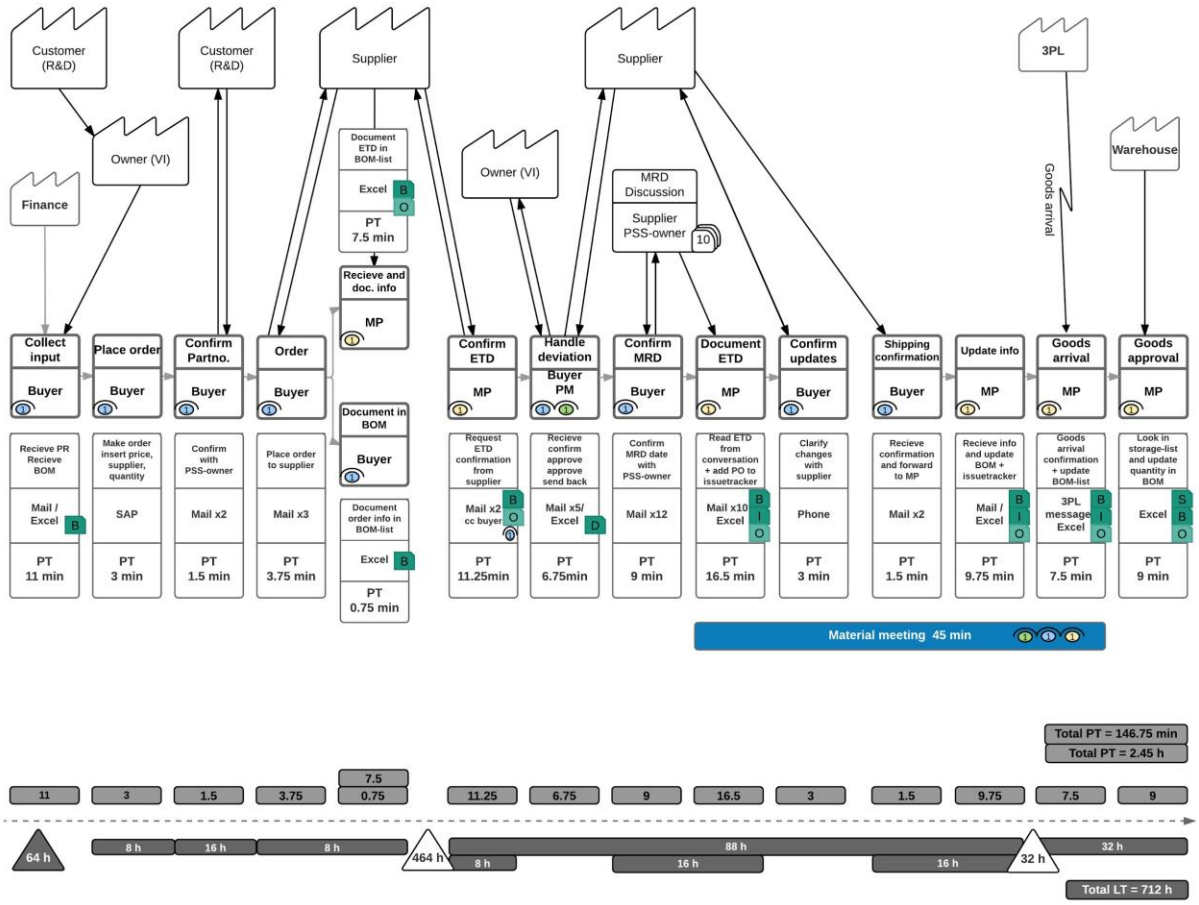

Figure 13. Value stream map of process 1

4.2.3 Current State of Process 2

The value stream map made for process 2 are visualised in two figures. Figure 14 explains the total purchasing process, and Figure 15 presents a closer examination of two specific steps in a sub-process.

The first step in process 2 was the same as in process 1, collection of information. It contains and the same activities; collect the BOM-list and purchasing request but also additional activities had to be performed. When the BOM-list was received the buyer sorted on cost centre and transferred all information from the BOM-list to an own list called the purchasing-list. The purchasing-list is a personal excel file that includes the same information as the BOM-list but only the material that the buyer alone will order. For the example material in process 2 the price is constantly changing, due to part number updates, and therefore the buyer need to collect a new price for each order. The buyer requested a price from the engineer, supplier and finally sourcing responsible in China before the price was received. A few days before the order was placed the buyer called the supplier to inform that an order would arrive soon. When the price was known and both the BOM-list and PR had been received the buyer could place the order in SAP, including quantity, supplier, price, and expected delivery date. It was further specified in the order that the new material must have the latest status and the order was sent to the supplier with a copy to the material planner. Since the supplier did not confirm directly, the buyer sent a new email and requested order confirmation, which the supplier confirmed but informed that they did not have enough information of the latest status to start producing the new status. The information about the latest status should have been provided to the supplier from engineers at the organisation, who is responsible for the R&D and thus the updates in the specifications of the material. The buyer however

updated the purchasing-list with the supplier confirmation on the order and the material planner updated the BOM-list and ongoing purchasing list with the same information. Later, the buyer received another email from the supplier who said that they could not deliver the requested status, and after a while the supplier sent a request again to the buyer and asked if they wanted to cancel or update the order. These two activities, receive status info and cancel or update order, are shown in Figure 14 as a sub-process since they include many separate activities, which are described on a more detailed level below.

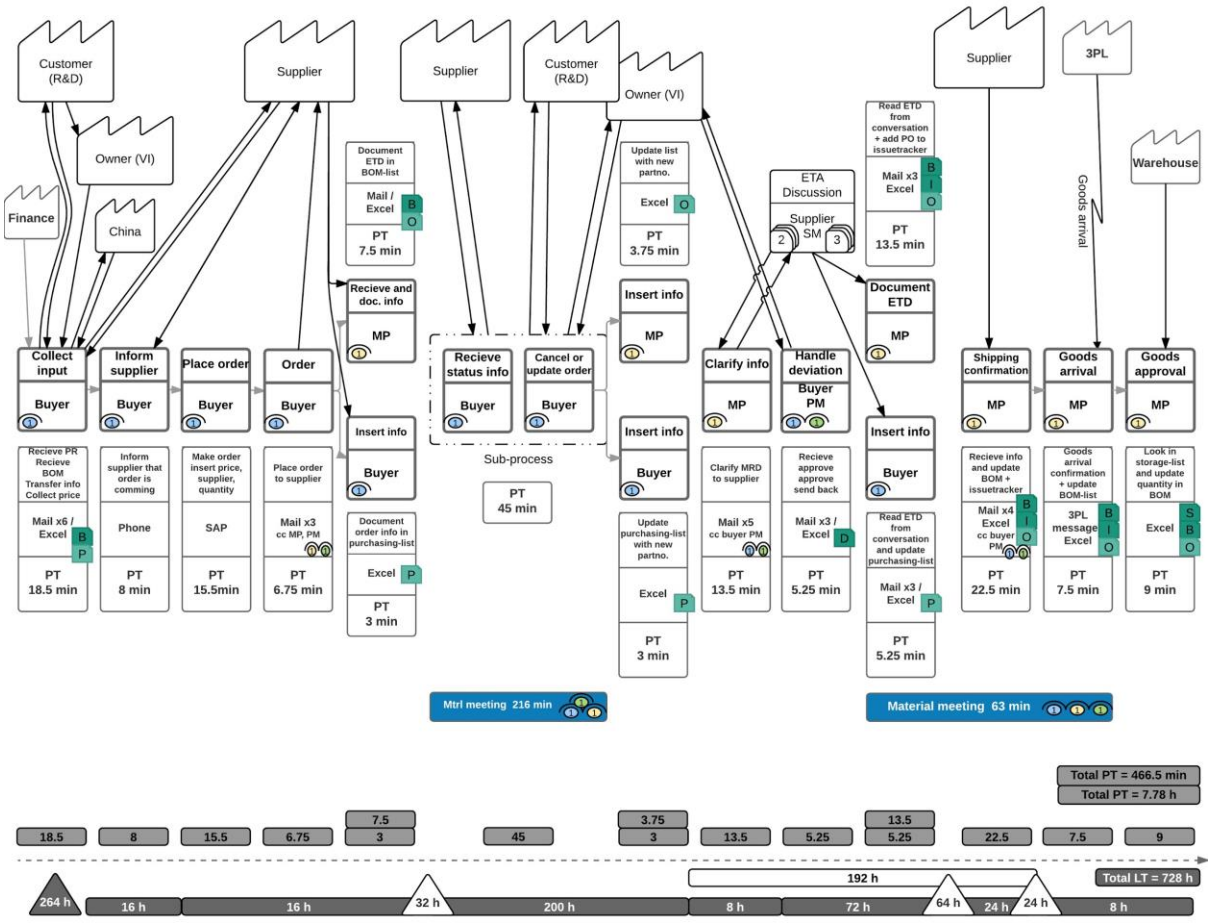

Figure 14. Value stream map of process 2

In the first activity in the sub-process, visualised in Figure 15, the buyer received information from the supplier who for the second time stressed that they could not deliver the requested status. The buyer communicated back to the supplier that it would be discussed in the organisation during the day. The buyer also turned to the PSS-owner for help on how to proceed with the purchasing order, with the aim to reach information from different directions. The PSS-owner returned with the information that the engineer would provide the supplier with updates about the new status. The buyer forwarded that information and communicated to the supplier that changes for the new status would be delivered within two weeks. Almost a month later the supplier contacted the buyer again and informed that the order was cancelled and wondered if the buyer wanted to update or discard the order. The buyer forwarded the information and asked the PSS-owner how to proceed, who turned to the engineer for information. No answer was received so the buyer reached out to both the PSS-owner and the engineer and asked for an update, and the PSS-owner requested an answer from the engineer again. At the same time the buyer asked the PSS-owner to do a deviation when the change was confirmed. There was still no answer and a couple of days later the supplier, for the fourth time, informed the buyer that the order was cancelled and wondered if they wanted to update or discard the order. Now the buyer turned to the PSS-owner,

the engineer and the R&D representative and asked if one of them could respond with an answer. The engineer answered with a new part number that should be ordered instead of the old one. The buyer directly sent the information about the new part number to the supplier but did not change the purchasing order. The new part number was forwarded to the supplier almost six weeks after the supplier initially informed about the missing information. At the same time the R&D representative informed VI that a deviation was needed for this part. The supplier confirmed the new part number and informed that that they could deliver one week after the expected delivery date. The explained steps presents the sub-process, which have a total lead time of 200 hours and generates a process time of 31-59 minutes, hence an average of 45 minutes (Figure 15). These calculations can be found in appendix 4.

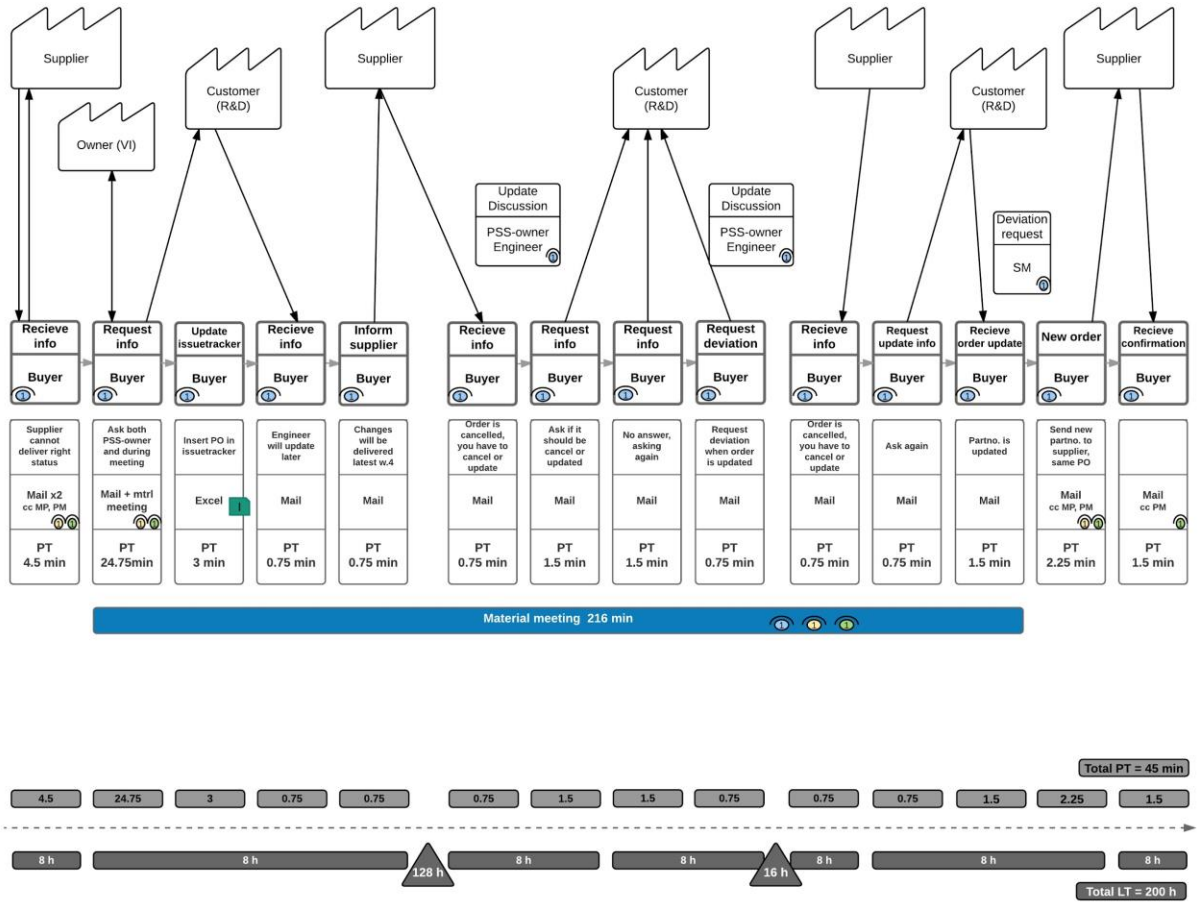

Figure 15. Value stream map for the sub-process in process 2

When the two steps explained in the sub-process were performed the purchasing process in Figure 14 continued. When the supplier confirmed the updated part number and informed about the new estimated delivery date, explained as the last step in the sub process, the buyer updated the purchasing-list with the new part number and the material planner updated the same information in the ongoing purchasing order-list. Since it is a very critical product for the project, which is described earlier under 4.2 Empirical Examples of the Purchasing Process, and shown in Figure 9, the organisation puts a high value on on-time deliveries. Therefore the R&D representative started a conversation with the supplier and asked if they could deliver earlier. This conversation was not appointed to either the buyer or material planner but they were expected to collect the information through copies sent to them. In the conversation the material planner clarified the information about wanted delivery date to the supplier. After this the buyer received a deviation-list and confirmed it directly since the change already was confirmed by the engineer, and forwarded it to the purchasing manager who approved it and sent it back to VI. The R&D

representative once again requested updates on delivery date from the supplier who responded with information on the delivery date. The material planner read the expected delivery date from the conversation and inserted the order to the issue tracker and updated both the BOM-list and the ongoing PO-list. The buyer also collected the expected delivery date from the conversation and updated the purchasing-list. When the expected delivery date approached the material planner contacted the supplier about updates and received confirmation on the delivery date. The material planner requested a tracking number and when the goods had been picked up the material planner received the tracking number from the supplier and further requested notifications from the 3PL. When the order arrived the material planner got a notification and could update the arrival date in the BOM-list and removed the order from the issue tracker. When the storage-list was updated the material planner collected the final information of the order and updated the received quantity in the BOM-list.

The total lead time for this process is 728 hours and the generated process time is 287-646 minutes, an average of 466.5 minutes and around 7.78 hours (Figure 14). These calculations can be found in Appendix 4. 7.8 hours process time is significantly more than the process time generated in process 1, but it still represents a small share of the total lead time of 728 hours. However, 120 hours can be removed as external lead time, were M&L is waiting for the supplier to produce and deliver. These 120 hours are calculated from the white triangles in the map (Figure 14). M&L does not perform any activities during this time and can not affect it since it is necessary for the external parties. Therefore 120 hours can be removed from the 728 hours total lead time for the process and the lead time for the internal purchasing process are calculated to 608 hours. In this process the supplier received the right order information late which affected the supplier lead time, therefore the actual lead time for the supplier was 192 hours, visualised in Figure 14 from when the right information is provided after the sub-process until the goods arrival. If comparing this to the 320 hours, 8 weeks, that the supplier lead time should be, it can be identified that the order was placed late to the supplier.

4.2.4 Current state for Process 3

The third process in this thesis is not described in a value stream map. The purchase of this material was chosen to describe a different characteristics of the purchasing process than the ones previously described, who is quite similar. This process differs in the way to communicate, both internally and with the supplier. It was visualised in Figure 10 that group coordination is most commonly used within this process when communicating with the supplier. The use of group coordination between the buyer and supplier creates another type of process for the activities it affects and is shown in Figure 16.

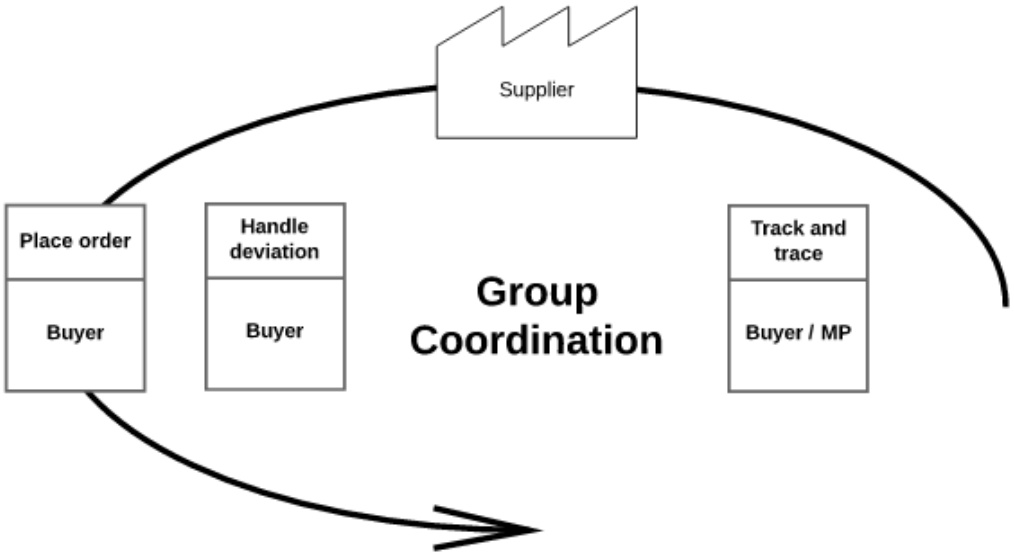

Figure 16. Group coordination within process 3

To contact and communicate with the supplier weekly meetings are held with their representatives, which is presented as the group coordination. The order is placed in SAP similarly to the other processes but all the communication with the supplier around the purchase are performed during the meetings. This differs from the other two processes were the majority of the contact with supplier was performed via email and phone calls. Further, a part of the track and tracing of the material are performed during the meetings. New information about the delivery of the material is shared during the meetings, which differs from the other processes, where the material planner need to request that information. Continuously, the following activities in the process are performed in the same ways as for the other two processes studied. The material planner receive a tracking number and further a notification when the material arrive at the site.

The material studied, does not change in specifications as the models are updated to the next project. This means that the material can be "carried over", and used in other projects than what it was purchased for initially. The buyer responsible for this material is dependent on the information on what quantity to purchase for each project, similar to the other processes studied. However, since the material purchased to old projects can be used, the material is not as critical to the project start as the other two described. Continuously, the buyer takes a lot of own decisions in the purchasing process, since no new specifications are needed from engineers. This also differs from the other two processes were the buyers can not take any own decisions and constantly has to request information from the organisation. Therefore the internal communication is not as frequent in the purchasing process for this material. In this specific purchasing process the buyer ordered a larger quantity than what was needed to the project because the supplier had a minimum order quantity which exceeded the desired quantity for the project. Hence the material not used for this process were put in storage to be used in future projects, and continuously it is the buyer's responsibility to keep track on what quantity of the materials that exists in storage. What differs in this purchasing process is also the supplier lead time, hence the time it takes for the supplier to deliver the material from when it is ordered. The supplier in this process has a lead time of 12 weeks, which is longer than the lead time the supplier needs from order to delivery in the other two processes.

4.2.5 Generalisation of the Purchasing Process

It was previously explained and visualised in Figure 11 that the characteristics in the chosen processes can be transferred to the other materials purchased to the project. Therefore, when studying the value stream maps and the explanation of the current situation of the example processes a generalisation of the purchasing process can be made. It is visualised that a lot of the activities in the purchasing process is to exchange some kind of information, both internally and with suppliers. The employees collect and transfer information multiple times during the processes and the interaction are performed in different ways. The other type of activities that are performed are to create the orders, document them and other information in different lists. The activities performed by the employees at M&L can therefore be divided in two different categories;

1. Activities to interact/communicate and share information with other parties, both internally and externally.
2. Activities of administrative characteristic, insert orders and document information.

The information exchange are almost constant performed manually, were conversations are made over phone, email, and meetings. Making and documenting information of the orders, is also performed manually, where information are collected and inserted in SAP and in the excel files. What further can be highlighted from the examples is that the employees within M&L are not involved in the purchasing decisions and do not participate in the development on what to purchase. Further, they are dependent on the information on what to purchase and in many of the processes they can not take any own decisions if questions arises during the process. This was visualised in the maps for both process 1 and 2 and is contributing to a situation where everything has to be confirmed by R&D or VI if any questions regarding the purchase arises after the order is placed.

As a final remark when considering the selected status of the project were the example materials are studied, it has a high maturity level. As explained, the purchasing process for project that has a high maturity level, are considered easier to purchase. This is since the supplier is known, and not all materials needs updates. Since the project the studied material are purchased for has a high maturity level, the findings in the examples from this project might differ from findings from purchasing processes for projects in earlier projects. However, since the studied project is explained to be more “easy” than other projects, the findings and problem areas can be generalised to be found in the other projects as well, to an even broader extent.

5. Analysis

This chapter presents the analysis that is made of the empirical findings in comparison to the theoretical framework. The chapter answers the second and third research question in the thesis, hence how the activities performed by M&L can be improved to increase the performance in the purchasing process and what input from other departments they are dependent on. Initially, it is discussed how the different areas studied, both at the organisation and in the literature, can be connected to purchasing performance. Further, the chapter are divided in two different parts, one to identify problem areas and one to give suggestions how to solve them. Section 5.2 and 5.3 represents the first part where waste in the processes are identified, analysed and categorised. The second part consist of section 5.4, 5.5 and 5.6 were suggestions of how to improve the process are presented using lean principles and coordination mechanisms as improvement tools. Further, it is visualised and explained how the suggestions of improvements affect the efficiency, on time deliveries and the purchasing performance in the processes.

5.1 How to Increase the Purchasing Performance

In the theoretical chapter purchasing performance was defined as a measure of how efficient and effective the purchasing organisation perform their work. Further, effectiveness was defined as to what extend the organisational goals are reached and efficiency defined as how well the resources are used (van Weele, 2014; Achabal et al., 1984). The aim of this thesis is to improve the purchasing process to be more efficient and contribute to on-time deliveries. Therefore, the focus on the analysis will be on increasing the purchasing performance through the efficient use of resources. However, if a more efficient purchasing process can contribute to the goal of on-time deliveries the process can also be considered to be more effective, and both of these parameters will increase the performance.

In the empirical chapter it was described that the only way performance are measured today are through the number of on-time deliveries. Since time is defined as a resource (Stalk and Hout, 1990a; Cooke, 2010) which can be quantitatively measured, the focus on improving the efficiency is connected to the usage of time. By measure and analysing time through value stream mapping, waste can be identified and by removing those waste the process time can be compressed, which potentially increases the efficiency and thus the performance. This is supported by Cooke's (2010) definition of efficient operations where the goal is to minimise waste and maximise the resources. Further, the presented dependent relationships between the M&L division and the other departments involved in the purchasing process is highlighted in the aim to improve the processes. This is motivated by Van Weele (2014), who stress that dependent relationships and the ability to manage those have a big impact on the purchasing performance. By analysing the current state and the waste identification in combination with the presented coordination mechanisms and standardisation processes, suggestions of how waste can be removed and time reduced can be presented. As mentioned above, this will contribute to a possible increase in efficiency, contribute to on-time deliveries and continuously increase the performance of the purchasing process.

5.2 Identification of Waste

The theoretical chapter explained in both the concept of Time management and Lean administration the importance of identifying and removing waste when improving a work process (Chen & Cox, 2012; Hines & Rich 1997; Stalk & Hout, 1990a). Eight waste that could occur in administrative context was

explained and has been used when analysing the value stream maps made for process 1 and 2. Early in the study it was realised that waste did occur in the purchasing process, and that improvement areas existed. The waste that have been detected in the two processes are described below, and this identification is further used as a motivation and tool to streamline and improve the process with the aim to increase the effectiveness. As explained in the method and empirical chapter material with different characteristics and complexity were chosen, this to describe different examples of the processes. The value stream maps in the empirical chapter pictured that the processes differed in the activities, lead time and process time. The further analysis and waste identification show that the amount and characteristics of the waste at some point also differs between the processes, but that they also can be similar. The similarities in the waste gives an opportunity to generalise them to different purchasing process than the ones studied, which contribute to a better understanding of the purchasing process as a whole.

The two following sections will initially present the process time and lead time in the two processes studied. Further, the identified waste are presented and connected to different types of waste; Extra Processing, Correction, Transportation, Underutilised People and Waiting. These categorisation strives from the eight different types of waste explained by Keyte & Locher (2004), were these five were present in the two processes presented.

5.2.1 Identified Waste in Process 1

When comparing the current state with the explained waste from the theoretical chapter it was found that several waste could be detected. The identified wastes in process 1 are described below.

Extra processing
The first group of waste that was identified are extra processing and are defined as re-entering data and unnecessary reports or transactions (Keyte & Locher, 2004). In waste one explained in Table 3, the buyer contact the PSS-owner to confirm information already given in the BOM-list. When the information is already known this activity can be seen as extra processing since the activity is not necessary for the buyer to proceed the order, instead only performed as an act of caution to secure the given information. The second waste involves the activities of updating different list with the same information, which is considered re-entering data and hence extra processing. The third waste contains activities where information is shared with more employees than it was intendent for. This can be considered extra processing since it is unnecessary for everyone receiving and processing this information without purpose. The fourth and last waste within this category is when the buyer contact the supplier to clarify already confirmed updates, which can be seen as extra processing since they already was confirmed by the supplier.

Correction
The waste correction is defined as order entry errors, design errors and engineering change orders (Keyte & Locher, 2004). The fifth waste are identified as correction and includes the deviation process, which occur due to a change in an already placed order. The three following activities would not be needed if there was no deviation and can therefore also be considered corrections due to the deviation.

Transportation
Transportation are defined as excessive email attachments, multiple hand-offs and multiple approvals (Keyte & Locher, 2004). In the process the buyer needs to forward the shipping confirmation from the supplier to the material planner since it is the material planner’s responsibility to track and trace the

order. Waste six are therefore considered as transportation since the buyer, who is not responsible, needs to forward this information.

Underutilized people

Within the deviation process the buyer confirm the change with the supplier, but do not have the authority to approve the change in the deviation list. Therefore the buyer have to forward the information from the supplier to the purchasing manager who can approve the deviation. The limited employee authority creates extra processing, hence the seventh waste is seen as underutilised people which is defined as limited employee authority and responsibility for basic tasks, management command and control or inadequate business tools available (Keyte & Locher, 2004).

Waiting

The eighth and ninth waste are defined as waiting time. Waiting is by Keyte & Locher (2004) defined as system downtime, system response time, approvals from others or information from customers. Waste eight occur because the buyer are dependent on input from two different departments before an order can be placed, which was received at different dates and therefore the time between are considered to be waste. Further, waste nine involves activities throughout the whole process and are shorter waiting times when the buyer or material planner needs to request information outside their division and has to wait for confirmations or answers about the material or delivery date.

The material studied in process 1 was delivered on time to the built start, with a few days margin. Therefore it is in the organisations perspective considered a successful purchase. However, the presence of the wastes proves that there are improvement areas in the process. A summary of the identified wastes in process 1 are presented in Table 2 below.

Table 2. Identified wastes within process 1

Definition	**Shortenings of the identified wastes**
Extra processing	1. In the second activity the buyer contact the PSS-owner to confirm the part number received in the BOM-list, this is considered extra processing. 2a. In several steps during the process the material planner updates three different lists with the same information. Independent of the activity "handle deviation" 2b. One time the material planner update the same information in three different lists, dependent on the activity "handle deviation". 3a. When the buyer or material planner receives copies of emails that is not directly intended for them but they are still expected to take part of the information. Regardless of the deviation handling. 3b. When the buyer, material planner or purchasing manager receives copies of emails that is not directly intended for them but they are still expected to take part of the information. Within the deviation handling. 4. Buyer contact supplier to clarify already confirmed updates.
Corrections	5. The entire activity "handle deviation" is a correction of an order and could therefore be considered a waste. Continuously the three following activities are corrections connected to the deviation.

Transportation	6. In the activity "shipping confirmation" the buyer need to forward information to the material planner. This is considered extra transportation since an employee not responsible has to perform an activity.
Underutilised people	7. Limited employee authority creates extra processing within "handle deviation", since the buyer responsible can not approve the deviation.
Waiting	8. When collecting input, the buyer has to wait 64 hours between collecting the PR-approval and the BOM since they are input from different departments. 9. There are smaller waiting times during the process when the buyer and material planner is waiting for answers and confirms according to the material or delivery date. The information has to be collected from other departments in the organisation.

5.2.2 Identified Waste in Process 2

When comparing the current state with the explained waste from the theoretical chapter it was found that several waste could be detected in the process. The identified wastes in process 2 are described below.

Extra processing
Similar to process 1, the first group of waste that is identified are extra processing and defined as re-entering data and unnecessary reports or transactions (Keyte & Locher, 2004). The first waste within this category, waste 10, regards the use of multiple lists. Since all information are given in one list it can be considered re-entering data when transferring the same information to another list. In the eleventh waste the buyer has to request information about the price several times from different sources. This can be seen as extra processing since the request should only have to be sent once. The twelfth waste are considered a waste since the buyer only inform that an order is coming without sending the order and needs to contact the supplier again to deliver the order. This can be defined as an unnecessary report and continuously as waste since it do not add direct value to the process. Waste 13 involves the activities of updating the same information in different lists. It is also considered re-entering data and continuously extra processing. The last waste within this group is waste 14 and contains activities where information is shared with more employees than it is intended for. This is therefore considered as unnecessary and extra processing for everyone that needs to process information not intended for them.

Correction
The fifteenth waste is identified as correction which was order entry errors, design errors and engineering change orders (Keyte & Locher, 2004). The entire sub process, which is a part of the deviation process and occurs due to a change of part number is therefore considered as correction. The sub process together with the following four activities would not be needed if there was no deviation, therefore are these activities is also seen as corrections due to the deviation.

Transportation
Transportation is by Keyte & Locher (2004) defined as excessive email attachments, multiple hand-offs or multiple approvals. Waste 16 concern the multiple hand-offs that is created within the sub process when the buyer need approvals from other departments in order to confirm the deviations. The buyer need to request answers several times before it is delivered and that creates extra transportation of information.

Underutilised people

Underutilised people are defined as limited employee authority and responsibility for basic tasks, management command and control or inadequate business tools available (Keyte & Locher, 2004). Waste 17 occurs due to the way deviations are handled today. It is the buyer who collect information about the approval of the deviation but have no authority to approve it. Therefore the buyer have to forward information to the purchasing manager who can approve it. It is the limited employee authority that creates this extra activity and therefore this waste can be considered underutilized people.

Waiting

The last waste, 18 and 19, are defined as waiting time which are system downtime, system response time, approvals from others or information from customers (Keyte & Locher. 2004). Waste 18 arises because the buyer is dependent on information from three different departments, the first two are the same as in the first process and was delivered on two different dates. Therefore the time in between are considered waiting time. For this process the buyer is also depend on input of the price before the order can be placed, which also was considered as extra processing and defined as waste 11. However, the time it takes to receive the prices is considered as waiting time and increases the total waiting time in the collection of information. Further, waste 19 involves the activities throughout the whole process that creates waiting time when the buyer or material planner needs to request information from other departments and has to wait for answers or approvals. An example is the sub process where the buyer has to wait almost 200 hours before receiving a confirmation.

In this process the material was delivered one day after the required date and is therefore considered a late delivery. Hence this is an example of a process that is contributing to the 20% late deliveries explained in the problem description. The identified waste within the process indicates that there are room for improvements, particularly regarding extra processing. The explained waste identified in process 2 are summarised in table 3 below.

Table 3. Identified wastes within process 2

Definition	**Shortenings of the identified wastes**
Extra processing	10. Within the first activity the buyer transfer information from the BOM-list to the purchasing-list. 11. During the first activity, the buyer has to request information of the price several times from different sources. 12. When the buyer contact the supplier to inform that an order will be sent soon. 13a.The times the material planner and the buyer update different list with same information and the material planner also update the same information in three different lists. Regardless of the sub process. 13b: Two times the material planner and the buyer update different list with same information. Within the sub-process. 14a. Several times in the process the buyer, material planner and purchasing manager receives copies of emails that is not directly intended for them but they are expected to read them and take part of the information. Outside the sub process. 14b. When the buyer, material planner and purchasing manager receives copies of emails not intended for them. Within the sub process and deviation handling.
Correction	15. The entire sub-process, together with the following four activities, are corrections of an already placed order due to the deviation.

Transportation	16. Throughout the sub-process there are multiple hand-offs and different approvals needed from external departments which require a lot of transportation of the information.
Underutilised people	17. Limited employee authority creates extra processing within “handle deviation”, since the buyer responsible can not approve the deviation.
Waiting	18. In the first activity the buyer has to wait 64 hours between collecting the purchasing request and the BOM-list, and further 200 hours for information of the new price. 19. There are also waiting time through the process when the buyer and material planner waits for information or approvals regarding the material or delivery dates. For example during the sub-process the buyer spent almost 200 hours waiting on approval from the engineers.

5.3 Waste Analysis

To understand how the identified waste contribute to the process performance a waste analysis is made. This section is initiated by comparing the waste detected in each process, followed by a generalisation of the wastes and finally, end with a waste categorisation that defines the waste in terms of their difficulty to be improved and their effect on the purchasing performance.

5.3.1 Comparison between Process 1 and 2

When comparing the different processes it is realised that the number of detected wastes in each process do not differ that much, 9 identified wastes in process 1 and 10 identified wastes in process 2. There are also a lot of similar wastes detected in the two processes, which motivates that general improvement areas exists in the purchasing process. However, the analysis of the value stream maps and the continuous waste identification also indicates that the two different processes are handled differently. The conclusion is made that there are no standardised way of handling the problems that exists. In the current situation each buyer perform their work in the way they believe fits best, and the communication with departments and suppliers differ.

Even though the number of wastes is similar, it is detected that the process time the waste generates is bigger in process 2 than in process 1, which is described in table 4. In the comparison, the different waiting times are not included in the summarised process time that could be saved. The process time includes the activities that are performed by the employees, and waiting is therefore not considered process time. However, the waiting time exists due to many of the other wastes, and is therefore considered to be improved when the other wastes are removed. This relationship between the different wastes and how they affect each other are described in the following sections in the analysis. Furthermore, in table 4 below, two wastes in each process, waste 5 and 15 have other waste included in them. Waste 5 and 15 represents the deviations in the two processes and are defined as corrections of the orders that are placed to the supplier. The deviation process itself includes activities which also are defined as waste, for example waste 13b, 14b, 16, and 17 are included in waste 15, the deviation process in process 2. A division between these wastes are made since it is understood that although the entire deviation process can not be removed, the activities included in the deviation process can be improved.

Table 4. The process time each waste generates within process 1 and 2

Process 1		**Process 2**	
Waste 1:	1,5 min	Waste 10:	3 min
Waste 2a:	18,8 min	Waste 11:	4,5 min
Waste 3a:	1.5 min	Waste 12:	8 min
Waste 5:	35,3 min	Waste 13a:	8,8 min
Waste 2b:	*6 min*	Waste 14a:	8,3 min
Waste 3b:	*15.8 min*	Waste 15:	89,3 min
Waste 4:	*3 min*	*Waste 13b:*	*15 min*
Waste 7:	*3 min*	*Waste 14b:*	*24 min*
Waste 6:	1,5 min	*Waste 16:*	*45 min*
Waste 8:	3840 min (64h waiting)	*Waste 17:*	*3 min*
Waste 9:	N/A (waiting)	Waste 18:	15840 min (264h waiting)
		Waste 19:	N/A (waiting)
Total time wasted:	**58,6 min**	**Total process time wasted: 131,9 min**	

The table presents the amount of time that could be saved if the waste were removed. The waste in process 1 generates a process time of 59 minutes and the wastes in process 2 generates a process time of 132 minutes. The comparison highlights that employees responsible for process 2 spend more time on non-value adding activities than in process 1. This can be connected to the high complexity of that purchase and the new updates in price and status of the material. Further, it is understood that the activities seldom are performed in the same time. The calculated time in the table is an average value of a minimum time and a maximum time of the activities. Therefore the total time saved could differ between 28 and 89 minutes for process 1 and between 74.5 and 189 minutes for process 2 (Appendix 4 and 5). The use of an average time might potentially affect the result of the waste identification. If the actual time were defined to be closer to the maximum time in the two processes, the improvement potential is increased, since more time can be saved.

5.3.2 Generalisation of waste

The analysis of the two value stream maps generated in several waste identifications in the processes (table 3 and 4). Until now the waste have been connected to the processes they were identified in, to compare the two processes studied. In order to further understand how the wastes affect the project as a whole a more general analysis is necessary. Therefore, a categorisation between which waste within the processes that are similar and which are different is used. Waste will be categorised as similar and grouped together if they are;

- The same type of activity, independent of where in the process they occur
- Not the same activities, but similar type of waste

The logic behind the first category is that it is realised that the same type of activities often are performed in similar ways. For example documenting new information is performed similarly each time, independent on when it is performed. The second category strives from the different groups of waste explained by Keyte & Locher (2004). In the following section waste are grouped together with this categorisation. Since the waste in each group are putted together due to their similarity, it is considered that the waste in the same group can be improved by the same type of tools, and an entire group can

therefore be connected to the same improvement possibility in the processes. This finding is of great importance when suggesting improvement possibilities, since it makes the suggestions more generalised to the entire purchasing process and not only to the studied process 1 and 2 specifically. A summary of how the wastes are grouped can be found in Appendix 6.

The same type of activities

When studying the identified waste, it is realised that four wastes occurs in both processes without any difference, hence each of this activities can be grouped as one general waste. The waste; Equal information update in different lists occurs in both processes since this way of documenting the information is used in all purchasing processes. This is represented as waste 2 and 13, and are together grouped as waste A. The waste were employees are expected to take part of information not directed to them, occurs in both processes. This way of communicating is a general approach that are used and can therefore be connected to the entire purchasing process. This is represented as waste 3 and 14, and are together grouped as waste B. The waste; Extra processing within "handle deviation" since the buyer responsible can not approve the deviation, occurs identical in both processes. This is since all the deviations are managed equally in the current situation, and therefore this waste can be generalised to always occur in the deviation handling. This is represented as waste 7 and 17, and are together grouped as waste C. Waste of waiting occurs similarly in the two processes. At some process steps the waiting occurs identically and at some they differ. However, the waste can be categorised as waiting on information from other departments and can be generalised to exist in all processes, even if the time will differ. The waste of waiting is therefore categorised as group D.

Similar types of waste

Continuously, there are two wastes that occurs in both processes but within different activities, and can be considered similar and grouped according to Keyte & Locher's (2004) eight different types of waste groups. The waste; Confirmation from PSS-owner in process 1, and the waste; Request information about price in process 2, are two different activities but can be connected to the same waste, extra processing. They are also performed in the collection information and could therefore be removed if this activity is improved. Extra processing when collecting information is represented as waste 1 and 11 in the processes, and grouped as waste E.

The waste; Clarify updates with supplier in process 1, and the waste; Inform the supplier that an order is coming in process 2 is both extra processing with the supplier. Even though it is realised that the specific activities do not occur in every purchasing process, this type of extra processing with the supplier is considered to often exist and can be grouped together. This is represented as waste 4 and 12 in the processes and are grouped as waste F.

The waste that regards the deviation handling, waste 5 and 15, occurs in both processes but the included activities differ. The deviation in process 1 was a change in requisition letter, which according to the organisation is a "small" deviation and was approved by the buyer directly after confirmation from the supplier. The deviation from process 2 was a change in part number which was discovered by the supplier who contacted the buyer for confirmation, and the deviation was requested first after the buyer could confirm it. During the empirical study it was understood that deviations is something that often occurs not only within this project but in almost every project. Since the characteristic of the deviations was proved to differ from time to it is not considered suitable to standardise the handling of deviation. Instead, it could be favourable to standardise procedures for the different types of deviation. This is further be discussed under chapter 5.5.1 Standardisation of work processes. Therefore, the waste are not grouped together, instead they are continuously separated as G and H.

Waste 10; Transfer information from one list to another do only occur in process 2. However, this waste occurs since there are several lists were the information of the orders are documented, hence out of the same reason as waste 2 and 13. Therefor waste 10 can be a part of group A. Waste 16; Multiple hand-offs and approvals needed from other departments, do only occur in process 2, due to the complex deviation handling in that process and the waste can therefore be connected to waste 15. However, it is realised that even if the deviation process, waste 15 can not be removed, waste 16 can be improved and the two can not be grouped together. Further, it is confirmed that waste 16 can be generalised to all purchasing processes with process 2 characteristics. Waste 16 is continuously named as I.

Finally, waste 6; Forward shipping confirmation occurs only in process 1. This occurs due to a mistake from the suppliers' side and is a very small waste in process time. Further, the waste is considered to be a coincidence and can therefore not be generalised to exist in all purchasing processes. Waste 6 will therefore further not be analysed in the report.

5.3.3 Waste Categorisation

In the following section the waste groups are categorised to understand how they should be prioritised in the implementation of improvement. The general analysis of the wastes and their occurrence in the different processes showed that some wastes can be found in both processes, but also that the total time wasted in the processes differ. In the empirical chapter it is explained that the activities performed by the employees at M&L can be divided in two different categories;

1. Activities to interact, communicate and share information with other parties, both internally and externally
2. Activities of administrative characteristic, insert orders and document information

Table 5 explains what wastes that can be connected to each of the category. This categorisation aims to understand in what type of situations waste is more common, in administrative work or when communicating with other parties. Further, this type of understanding helps to clarify what the waste are affected by, which by Larsson (2008) is important to remove the waste in the long run.

Table 5. Categorisation of wastes

Activities of administrative characteristics, insert orders and document information.	Activities that interacts/communicate and share information with external parties.
A. Equal information-update in different lists. C. Extra processing within "handle deviation", since the buyer responsible can not approve the deviation.	B. When it is expected to take part of information not intended for the employees within M&L. D. Waiting time. E. Extra processing when collect information. F. Extra processing with the supplier. G. Deviation handling within process 1. H. Deviation handling within process 2. I. Multiple hand-offs and approvals needed from other departments.

The categorisation shows that the amount of wastes identified in the two categories differ, were a lot more wastes is connected to the activities were the employees interact with others. This is not surprising

since the empirical chapter explained that the majority of the activities performed belongs in this category. Further, this finding can lead to the hypothesis that more wastes occur when there are more employees involved in an activity, which is comparable to Cookes (2010) explanation that lack of efficient communication channels is one of the most common problem that leads to bad process performance. This finding further stress the importance of including coordination mechanisms as an improvement tool in the aim to remove the waste detected. However, even if this type of categorisation compare the waste to the different type of activities, it does not seem to be the only parameter in the decision on what waste reductions that are essential and continuously what waste to focus on. To understand this a different type of categorisation can be made between the waste groups, and this is explained below.

The waste in both categories proves that there is a potential to improve the purchasing process in general. To analyse this potential of improvement it is further important to analyse the impact of the improvements of the different wastes, and their difficulty to be improved. The difficulty to improve the wastes are based on three aspects;

- if the waste can be improved by M&L alone,
- number of employees involved in the change, and
- if the reducing of waste requires new structure or tools in the process.

The first two parameters are connected to the employees involved in the change. This aspects were discussed with the purchasing manager at M&L were it was confirmed that a change that would involve a higher number of employees, and employees outside M&L would be hard to implement. The last parameter was added by the authors since it was realised that some waste groups required implementation of new tools or a new structure of the activities, which was considered to be both more time consuming and costly for the organisation. If the change can be implemented by M&L alone, have few employees involved, and does not require new structures or tools the implementation difficulty is considered low. If the number of people involved increase, the change is including other departments, and new structures and tools are needed in the process the implementation difficulty is considered high. Figure 17 below visualises the different characteristics of the wastes in terms of the process time they can save and in terms of their difficulty to be implemented. Group D, the wastes of waiting is not inserted in the figure, since waiting can not be identified as a waste in process time. As explained can the waiting time be reduced by removing other wastes, and this is further discussed in section 5.7 Future state.

The location of the waste in Figure 18 explains that the waste differ in their impact on the process time and difficulty to improve. To motivate what waste to focus on, a diagonal line is drawn. The line represents what is considered worth to implement, when comparing the saved process time with the effort and cost it takes to improve. The waste categorised below the diagonal line is saving enough time compare to the effort it takes to implement, and is therefore considered worth to be implemented.
Further, the waste groups can be evaluated in terms of where in the purchasing process they exists. As mentioned in the problem description a lot of the late deliveries is caused by that the orders are not placed in time to the supplier. Therefore, it is realised that to increase the number of on-time deliveries, the number of orders placed in time to the suppliers have to increase. Continuously, to decrease process time that could achieve earlier placed orders is value adding to the purchasing performance. Process time that could be saved before the final order is placed to the supplier is therefore of higher value than the process time saved after the order is placed. This interpretation of process time includes a bigger perspective of the performance.

Waste E and F are representing smaller activities that is performed by employees at M&L. The improvement of these waste are easy to implement and considered as quick fixes. Even if they do not generate that big amount of process time, these waste occurs before the order is placed to the supplier, and are therefore considered to increase the purchasing performance. In figure 18 they are therefore moved further to the right when considering the purchasing performance, and not only the process time. This motivation makes both E and F under the diagonal line of what is worth to implement. However, to reach the most savings in process time, the figure visualises that waste A, B and I should be prioritised. They are generating a lot of process time, but are still considered to be worth implemented since the difficulty to implement the changes are moderate. The wastes hence provide a bigger saving in time and cost than what it generates to implement, and is therefore increasing the performance in the process. If analysing where these waste are located in the process it is realised that waste A and I occurs before the final order is placed to the supplier. Therefore the saving they generate in process time are considered to be more value adding for the purchasing performance in general than waste B. The finding that waste B occurs after the order is placed to the suppliers can actually motivate to focus on waste group F and E above B, since even if these generates smaller savings, the savings is more value adding in the aim to increase on time deliveries. If comparing the waste groups A and I, the figure visualise that waste A are generating a bigger saving in process time. However, waste I reduces the lead time significantly more than waste A, since a lot of waiting time are included between the approvals needed from other departments. In the aim to reduce the lead time before the order is placed this is an important consideration to include. If waste I could be prioritised, not only the process time before the order was placed to the supplier could be reduced, also the lead time has the potential of being reduced which will contribute to a higher performance. Therefore waste group I can also be moved to the right in Figure 18. With this different aspects considered in decision on what waste to focus on, the priority will be the following; I, A, F, E, B.

The waste that lies above the diagonal line, waste C, G and H are considered harder to remove. Waste C generates a little saving in process time and is considered hard to implement. This is since there are many employees involved if the process should change, and other departments than M&L are involved in this process step. Further, waste C occurs after the order is placed to the suppliers in both the studied situations and the small saving in process time can be defined as non-value adding to the performance. Therefore, waste C is not appropriate to spend time on and is further not considered in the study. Waste G and H are representing the total deviation process, and occurs due to that already placed orders has to be corrected. The entire deviation process is seen as a waste since if the order were placed with the correct information the first time, the deviation would not be necessary. The reason why deviations occur lies outside the responsibility of the M&L department. In many situations it strives from the fact that information on the new status of material is forwarded to late from the engineers in the R&D department. The deviation process is therefore hard to affect and change by M&L, instead a change in the process design and structure between the departments is necessary which would be both costly and time consuming, and most important not within the scope of the thesis. Therefore, the deviation processes themselves are not prioritised when searching answers for research question two in the thesis, how M&L can improve their activities to increase their performance. However, it is considered that the deviations would save both a lot of process time and lead time before the correct order is placed, and therefore increase the performance significantly if they could be removed. This is therefore something that it is suggested that the organisation has to prioritise in the long run. The answer to research question three, what input M&L is dependent on, is answering what information M&L needs in order to avoid deviations. This is described under section 5.5.2, Standardisation of input, and the defined information can be considered a first step towards removing the need of deviations.

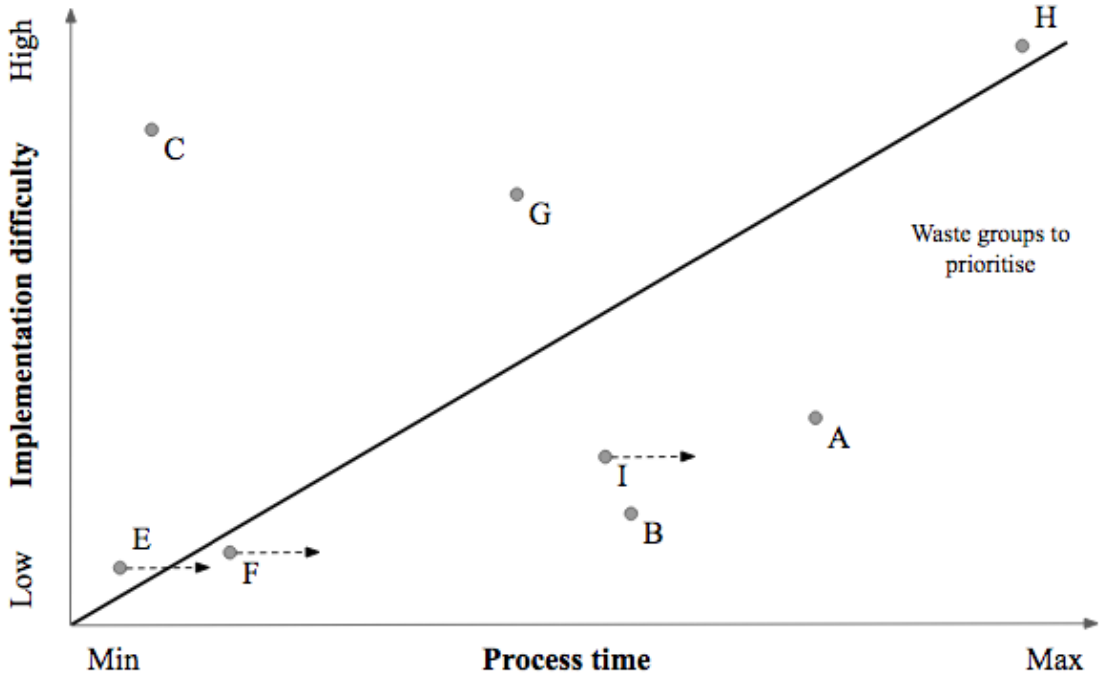

Figure 17. Comparison of wastes regarding difficulty to implement and process time saved

5.4 Coordinate the interfaces

It is explained that process based work needs different coordination mechanism to collaborate between employees, divisions and departments to achieve a high process performance (Cooke, 2010). Continuously, the context of purchasing in a new product development company created even more dependence relationships from the buyers towards engineers within the organisation since the information on what to purchase constantly changes. A conclusion is that process based work in new product development context face high challenges to manage the increased communication internally within the organisation and externally with suppliers that occurs in this situation. This complexity is further proved in the current situation of the studied purchasing process, where the empirical findings and analysis of the processes explains that the majority of the time spent by the employees is to exchange some kind of information, both internally and externally. It is also highlighted in the waste identification that there are a lot of waste that can be connected to the interactions, and the waste that is prioritised to focus on to improve is waste group I; Multiple hand-offs and approvals needed from other departments. This, together with waste group E, F and B, are connected to the coordination and further motivates coordination mechanisms as an improvement tool to help the purchasing organisation to contribute to on time deliveries.

The theoretical chapter explained that different coordination mechanisms were suggested to be used dependent on the characteristics of the process. These were complexity, interdependency and number of people involved (van de Ven et al., 1976). Further, in the empirical chapter the coordination mechanisms used in the three different processes today are explained. With the starting point at the M&L division, coordination was explained to exist both internally with the departments involved in the purchasing process, and externally with the suppliers. When analysing the findings of the coordination mechanisms it is realised that both similarities and differences between the processes exist, which gives the opportunity to discuss whether this is appropriate or not. Table 6 below summarises the coordination

mechanisms used in the current situation for the main activities. The table presents the main activities performed by M&L to the left, and then presents which one of the three coordination mechanisms; Impersonal (I), Personal (P) and Group (G) coordination that are used. Each activity are separated in what coordination mechanisms used internally in the organisation and externally with suppliers. In some activities, there are no coordination which is represented in the table by (-). Further, in some activities more than one coordination mechanism are used, in those situations both are present, for example I & P (Impersonal and Personal coordination). A more detailed explanation to the table are described below. The coordination mechanisms used in each main activity are in each section compared to the literature, and suggestions of changes that can lead to a higher performance in the coordination are presented.

Table 6. Coordination mechanisms used in the different processes for different activities

Activity	**Type of coordination used in Process 1:** Internal / External	**Type of coordination used in Process 2:** Internal / External	**Type of coordination used in Process 3:** Internal / External
Collect Information	I & P / -	I & P / P	I / -
Place order to supplier	- / P	- / P	- / G
Handle Deviation	I & P / P	I & P / P	P / G
Track & Trace	- / I & P	- / I & P	- / I & G
Collect Material	I / -	I / -	I / -

Collect information

The collection of information, defined as collecting information on what to buy, the quantity and the price the supplier is charging for each material, are today not performed entirely equal between the processes. In process 1 both impersonal and personal coordination is used when integrating internally with departments in the organisation. Impersonal in the collection of BOM-list and PR and personal to clarify the information given in the BOM-list. In process 2 also impersonal and personal communication are performed, where there is impersonal collection of what to purchase and the quantity, through the BOM-list. While the request of price is personal coordination. Here also personal coordination are used externally since the buyer had to turn to the supplier to collect the price. Process 3 only use impersonal coordination to collect the information. In this situation the activities and coordination mechanisms differ between the processes and continuously it is considered that there exist a potential to standardise the process by only using impersonal coordination. The information that is needed to place the order is the same in all type of processes, and therefore the way to collect this information should not be handled differently. The use of impersonal coordination are motivated since the information is transferred in one way, which means that there are no interdependencies. Also, the unit size of the people involved can be considered large, since the same information goes to many employees. This was by van de Ven et al. (1979) explained as motivations towards an impersonal coordination. A standardisation to impersonal coordination of this activity can reduce the waste category E; Extra processing when collect information, who is connected to this specific activity, but also some of the waiting time which was highlighted in the empirical chapter and could be linked to this activity. Further, there is no reason to perform these activities differently between the processes within the organisation. If the information transferred is quality assured, there is no process that is considered more complex than the others in this

specific activity. The impersonal collection of the input and price specifically requires that this information exists for the buyer to access. The quality assured information of the products and the requirement of existing price is further explained under section 5.5.2 Standardisation of input.

Place order to supplier

Placing the order to the supplier is performed only by external coordination, but not performed equally in the purchasing process. Here it is Process 3 that differs from the other two by performing group coordination while the other two performs personal coordination. In process 3, the activities placing the order to the supplier, handle potential deviations and one part of the tracking are performed with group coordination were weekly meetings are held with the supplier. Van de Ven et al. (1979) explains that group coordination should be used where the uncertainty is very high, the interdependence relationships are high and when the unit size are low, which actually is not the characteristics of process 3. The empirical chapter explained this process as non-critical to the project, since the material bought was explained as a "carry over". Further, the complexity of the purchase was explained to be low. Both since the communication with the supplier was good, and since the buyer did not have to request that much information from the organisation when the materials were bought. At one point this could be considered to contradict the characteristics van de Ven et al. (1979) uses to motivates group coordination. The process do not have high uncertainty due to the carry over, and is therefore not as critical to the project. On the other hand, the relationship with the supplier is very successful, and there are seldom problems with the purchase from the supplier, and this can be a result of that the group coordination was implemented. Therefore, it can not be motivated to remove the group meeting that is successful and well working for all parties.

Process 1 and 2 are as mentioned both performing personal coordination. This is according to van de Ven et al. (1979) best used were the interdependencies are high. Since the buyer and supplier need to communicate regarding the order, the coordination mechanisms are not suggested to be changed.

Deviation handling

The deviations was proved to be a big issue in the purchasing process today, represented as waste G and H, and a lot of the activities performed in the deviation handling was considered separate wastes, waste F and I. Process 1 is in the current situation handling deviations impersonally when the deviation is collected, and personally both internal and external when the change is performed. Here interdependencies exists and when uncertainty in the activity is slightly increased the use of personal coordination can be reinforced. However, other suggestions can be made in the deviation handling than the coordination mechanism, and are explained in section 5.5.1 Standardisation of work processes. The deviation handling in process 2 is also handled by personal coordination, both internally and externally. The characteristics of this process was proved to have a high uncertainty, with a lot of interdependencies. Therefore the personal coordination mechanism used in the process is motivated (Van de Ven et al., 1979). However, since the value stream map and waste identification showed that the buyer spends a lot of time on the internal communication, trying to reach representatives from R&D for information in the deviation process, represented as waste I, the implementation of group coordination can be considered. The characteristics that motivates to use group coordination are high uncertainty in the activities, high interdependencies between involved parties, and not a large group of people involved (Van de Ven et al., 1979). Process 2 are facing a high uncertainty, since as explained in the waste analysis much of the wastes occur since the part number and the status is changing during the process. Therefore, there is a high risk that the part number will be updated after the BOM-list is collected, which increases the uncertainty significantly. The interdependency between the buyer and representatives from R&D is high. The buyer are dependent on the information of the changes in part

numbers, but R&D are also dependent on the information of what the buyer gets from the supplier. Finally, the amount of people that needs to be involved in the information exchange in the organisation are not that many, which also support the use of group coordination. In this purchasing process it is realised that the characteristics of purchasing in a new product development context are visible, were the purchases are never repeated, instead always updated. Eriksson & Rönnbäck (2011) stress that in this type of situations, the communication between responsible engineers from the R&D and purchasing employees are a prerequisite, which further motivates that a change in coordination mechanism is a possibility to improve the purchasing performance. Using group coordination between representatives at R&D and the responsible buyer will potentially decrease the waste of;

- Searching for information without a response
- Sending the same request to different departments to increase the chances of feedback
- Explaining to the supplier that they can not provide the correct information

The potential of decreasing the process time for the buyer, give a clearer answer to the supplier, and continuously take care of the relationship with suppliers is considered to be good motivators for the implementation of group coordination internally. An example of where group coordination is making the work easier for the involved parties is in process 3. Here it is not used internally in the organisation, but instead between the buyer and the supplier to counter deviations through good communication, and can be used as a motivation and prove that it can be performed with a successful result.

Tracking and tracing

The tracking and tracing are today performed by both impersonal and personal coordination in process 1 and 2, and in process 3 group coordination is performed. Personal and impersonal coordination mechanisms are considered motivated. However, there is a much bigger share that is performed through personal coordination with the supplier, since the impersonal mostly consist of automated updates in a tracking system provided by the 3PL. As mentioned personal coordination should be used were interdependencies exists and where the activities are uncertain (van de Ven et al., 1979), and the optimal situation would be that the material planners within M&L did not have to request information on updates on the orders from the suppliers. Instead it could be transferred automatically as soon as new information arises and a change to impersonal coordination could be implemented, similar to the information from the 3PL's. However, this put a lot of pressure on the supplier, and as the situation looks today a lot of the material gets critical due to the late orders from the organisation. Therefore, a combination of personal and impersonal coordination is considered needed. If the majority of the orders are placed on time to suppliers in the future, with no deviations made, an implementation of more impersonal coordination can be investigated and discussed.

Collect material

The current state of the three different processes showed that the collection of material today are performed by impersonal coordination internally. However, the empirical chapter explains that the material planners sometimes have to go down to the warehouse and confirm the arriving materials. This was in relation to issues regarding wrong part numbers and order numbers. If deviations are made in the orders, the employees in the warehouse have to be able to collect this information. In that kind of situation the material planners would not need to confirm the incoming goods and the process could be standardised to use impersonal coordination. The improvements regarding the documentation of information is further explained under standardisation of work processes. The impersonal coordination would save a lot of time for the material planners, and would further make the materials arrive at the build site faster.

Table 7 below summarises the recommendations of how the coordination mechanisms can change with the aim to increase the efficiency and performance in the interaction between the departments. The standardisation against impersonal coordination in the collection of information and material will reduce the waiting time and process time and continuously compress lead time of the process. This will increase the efficiency and continuously performance of the process. The group coordination in the handling of deviation will reduce both the waiting time and the process time of that activity, hence also improve the purchasing performance in the process.

Table 7. Suggested coordination mechanism for different activities within the processes

Activity	**Suggested coordination in Process 1** Internal / External	**Suggested coordination in Process 2** Internal / External	**Suggested coordination in Process 3** Internal / External
Collect Information	*Standardise to (I)*		
Place order to supplier	- / P	- / P	- / G
Handle Deviation	I & P / P	*G* / P	P / G
Track & Trace	- / I & P	- / I & P	- / I & G
Collect Material	*Standardise to (I)*		

5.5 Standardisation of work processes and input

The section above explains how to manage the interaction and communication itself between the departments involved in the purchasing process. To further analyse how the performance can be improved Figure 5 in the theoretical chapter visualise how different standardisations also is one type of coordination mechanisms. In a process based work like the purchasing process where several departments are involved in the process, standardisation of the activities leads to an easier coordination, since the different departments know what is expected from them. Thus, different types of standardisations can ease the different use of impersonal, personal and group coordination explained above. Mintzberg (1979) explained four types of standardisations that can benefit the performance in process based work, these were standardisations of work process, output, knowledge and norms. Since the limitations of the thesis presented that employee skills and management were excluded from the study, the standardisation of knowledge and norms is excluded from the following analysis. Instead the focus is on the standardisation of work process and input, and as explained in Figure 4 these can also be connected to the Lean principles that Larsson (2008) suggests to use in administrative work processes to improve the performance. These were explained as standardise/stabilise the work, balance the process and create a continuous flow of the administrative process. How different types of standardisation can be used to reduce the waste, improve the efficiency in the activities and continuously decrease the time before the order is sent to the suppliers are explained below.

5.5.1 Standardisation of work processes

Standardisation of work processes means to coordinate the activities and workers with instructions that could be followed by everyone (Mintzberg, 1979). This is connected to the principle of creating a

continuous flow explained by Larsson (2008), which is defined as making the process as simple and uncomplicated as possible. Since the explained purchasing process is complicated due to its conditions and context, it is understood that a standardisation of the entire process is hard to achieve. The complex process with constantly new purchases requires that mutual adjustment and personal coordination are made. However, it is realised that there are processes or tools that could be standardised to improve the work and remove some of the wastes that are detected in the process.

Responsibilities within M&L

It is highlighted in the empirical chapter that the processes within the M&L division at some points lack standardisation of who performs what. The tasks are today divided between the buyers and material planners, who should be responsible of the buying and the tracing separately. Due to that the material planners are quite new in the organisation and the buyer's performed the track and tracing before it is still some uncertainties about the responsibilities. If the responsibilities within M&L are clarified, the internal communication and division of work gets easier, which is supported by Larsson's (2008) theory of standardising the administrative tasks to create a simplified process. This would also make it easier for the external parties, both suppliers and internal departments to contact the right person which will further reduce situations in the communication were several of the employees within the M&L division are included. This is represented as waste group B, were employees in the group has to read and process information not intended for them. If clearer responsibilities of who performs the work could be reached, and further communicated to the organisation and suppliers, this type of waste in the process could be reduced.

The empirical chapter explained a good example in process 2 where the tracking and tracing, that "should be performed" by the material planners, were performed by both the buyer, material planner and a representative from R&D, hence from another department than M&L. This do not only increased the time wasted in group B, but is also increases the risk of misunderstanding and that process steps are overlooked in the belief that someone else is performing it. Further, it confuses the supplier that has to communicate with three representatives from the organisation regarding the delivery date of the material. Even if the purchasing process is not an isolated activity, the responsibilities between different departments and further employees within departments has to be clear.

Today, a division of the activities within the M&L group exists. The buyers are responsible for the purchase only up until the order is placed to the supplier. Then, the material planners should take over the responsibility. This proves that the division of tasks and the standardisation of responsibilities exists within the group, the problem is that it is not used. If there are certain purchases were it is easier and more convenient for the buyer to track and trace the material, these situations can be decided by the group. This could for example be certain suppliers or purchased materials. In those situations it has to be the buyer that is responsible all the way until the material arrives at the site in Gothenburg. In all other situations the buyer has to leave the responsibility to the material planner after the order is placed.

One documentation (BOM-list)

One procedure or tool that has the potential of being standardised are the use of different lists in the project. This was highlighted as waste A in the processes. By standardising the procedure, that everyone involved in the process updates one and the same list that everyone can access to time can be saved. The redundant lists can be removed and therefore the required time to fill in the same information in each list is reduced. A suggestion is that one excel list should be used, and that it can be categorised and filtered in different ways. For example the buyers could use the BOM list to filter their own materials, and the material planners could filter on the orders that are placed to suppliers or is on their way from

suppliers. This would reduce the need for the buyers and material planners own list to keep track of their personal information. Further, the list should include a column with potential issues in the orders, this could then be filtered out at the material meetings when the current issue tracker are discussed. To implement one list that can be updated and accessed by everyone can be compared to Youssef's (1992) motivation to implement tools that facilitates speed in the process.

Deviation handling

As mentioned in the empirical chapter different types of deviations occurs. The deviations was further described as a waste, and it was analysed that the handling of the deviations could be performed differently in the purchasing process. Under section 5.4, Coordination of interfaces, process 2 and similar processes are suggested to implement group coordination to handle the activities within the deviation process, since the activities are considered highly uncertain, and a lot of interdependencies exists. For the purchasing processes where the context are less complex, another type of standardisation can be made. The current state map and the waste identification showed that a lot of both process time and lead time is spent on the deviation process, since the information has to be transferred back and forth between the divisions. A standardisation of how to handle therefor has the potential to compress the time spend and increase the efficiency in the deviation handling.

It was understood in the empirical findings that it is difficult to completely avoid deviations. If the output from the other departments can be standardised, which are analysed in the following section, the amount of deviations may decrease. The impossible removal of deviations without changing the input instead makes the focus to be held on managing deviations as efficient as possible with clear responsibilities and guidelines. Responsibilities are important, as discussed before, to reduce unnecessary transportation of information but also to reduce extra processing. Further, guidelines can help the employees in their way of working with deviations and if a requirement about approving deviations within one week were to be implemented, the lead time for the deviations can be reduced. If this were to be implemented on the deviation within process 1, the lead time could be reduced from 88 to 40 hours. This will provide the opportunity to do the deviation before the order is placed to the suppliers, as it is meant to be performed. This will further secure that the information of the orders are correct and that they are documented correctly. Correct information within the organisation and at the suppliers will ease the communication and the collection of the material. This is considered to increase the efficiency since this time can be spent on more value adding activities.

5.5.2 Standardisation of Input

Standardisation of input means that the expected result should be reached every time, to standardise the output and continuously the input for the next activity (Mintzberg, 1979). A standardisation of input is further a way to stabilise the process and reduce deviations in the output and input, which by Larsson (2008) is explained to contribute to a higher performance in processes. The purchasing process studied at the organisation face problems due to the many departments involved, and the information that is transferred sometimes lacks quality and accuracy in time, which creates extra processing for the buyers and material planners in the M&L division. As the empirical chapter explains the purchasing process is meeting the delivery deadlines to about 80%, which can be considered as the output of the entire purchasing process. However, this thesis aims to investigate what input that is optimal for the M&L division to achieve a high performance of the purchasing process within the division. It was early realised that the output from the other departments, collected as input by M&L was not standardised. Sometimes the BOM-list includes articles that is not quality assured which mean that changes could occur later in the process, sometimes the supplier is not sourced before the BOM-list arrive and the

price of the material is not set. This creates a lot of rework and extra processing for the employees within M&L and are highlighted as different waste groups in the processes. To standardise the output from the departments ahead in the process therefore seems to create a potential of both saved process time, but also lead time. This would be a way to streamline the process, compress the time that is needed and continuously contribute to on time deliveries of the materials to the project starts. To clarify the input, the processes and detected wastes were analysed. The input needed from the other departments are defined in table 8 below.

Table 8. Input needed from departments involved in the purchasing process

Input:	**Department:**	**Impact:**
Quality assured BOM-list, delivered on time	VI	Will improve the work in general and reduce many of the wastes detected in the processes
- What to purchase	VI	Decreased time to collect information, reduce waste E
- The material confirmed from the engineers (equal part number as the supplier)	VI	Reduce deviations, waste G and H
- The quantity	VI	
Sourced suppliers	China	Decrease the delayed orders for new purchases
- If there is a preferred supplier (for new purchases)	R&D	Reduce waste E
- Price	China	Reduce waste E
One contact person for each material	R&D	Reduce waste B & I
- Put pressure on the PSS-owner to only include information that concerns M&L	R&D	Reduce waste B
Forecast on future projects	Organisation	Will help the employees to be more involved and to plan their work

The list of the input that M&L needs stress the importance of an on time and quality assured BOM-list. For the studied processes the BOM-list was received 17 weeks before the building of the model starts, which is considered to be late due to that it is agreed on that the list should be delivered 20 weeks before. However, the material in process 2 was delivered one week late due to that the correct order could not be placed even if the BOM-list was received. This was due to an update in part number and this highlights that it is not enough to have an on time BOM-list, it also has to be quality assured to avoid deviations in the process. A quality assured information on what to purchase means that the information are controlled and confirmed by the responsible engineers. If it is not possible for the engineers to insert the correct part number in the BOM-list a suggestions is that this should clearly be stated in order for the buyer to know that something will be purchased, and the order should not be placed until the right part number is determined. The aim is to reduce the number of times already placed orders have to be updated or cancelled, i.e. the number of deviations. Further, the list stress the importance that the

supplier have to be sourced and the price of the material available. This is important in situations where the purchase has not been done before, and the buyer can not reach the information from old orders in the system. The sourcing is performed by the purchasing organisation located in China, and there has been a lack in sharing the information of new suppliers and prices to the buyers in Sweden. Situations where the buyers several times has to request information about price has occurred and is defined as a waste particularly in process 2. One solution to this could be that a price list exist on the intranet that could be reached by both China and Sweden. As soon as there are updates in price from the supplier to the sourcing team in China, this should be inserted in the price list. This also supports the recommendation of standardising the collection of input, explained in section 5.4 Coordinate the interfaces. Further, the importance of having one responsible person from R&D for each material has proved to be an important input for the M&L division. A lot of extra processing is performed in the processes when trying to reach information regarding changes or updates in the orders. The quality assured input suggested will hopefully reduce this type of activities, but it is realised that deviations will occur in the purchasing process. In this situation it is important that the buyers has one contact person in the R&D division. Even if the person at the moment can not respond it is up to the responsible employee to reach the information and get back to the buyer. The list of input continually explains the importance of not including M&L in conversations they should not be involved in. Unnecessary time is spent in the process to understand the information that is received, and the employees in M&L should only be included when they are expected to take part of the information. This is connected to the suggestion to implement clearer responsibilities within M&L explained in chapter 5.5.1 Standardisation of work process. If the responsibilities within M&L are clearer and the division of the work are communicated to the organisation, it is also easier for the external departments to achieve this input for M&L. Finally, there is a desire for M&L to get more involved in the projects from the beginning, to be able to forecast and prepare the work that is coming in the purchasing processes.

This specification of the wanted or expected input should be communicated to the departments it involves. It is stressed by Cooke (2010) that one of the most important thing to achieve a high performance in processes is for the employees to understand the overview of the process. The identification of input together with the wastes that is highlighted in this report can contribute to an understanding of how the activities in the beginning of the purchasing process affects the later ones, in this case performed by the M&L division. As a final remark it has to be mentioned that this input is defined with the M&L divisions perspective, which means that the manpower it takes to change the activities in the other departments to be able to perform the kind of input needed by M&L is not analysed. This is due to the limitations the thesis have had. Instead, the thesis provides an understanding of the amount of process time and lead time that could be saved if the optimal output, hence input for the M&L division could be achieved, and how the current situation looks like today when it is not.

5.6 Connection between improvement and waste reduction - summary

The following section summarise how the different waste groups defined in section 5.3 Waste analysis, can be reduced with the improvements suggested in section 5.4 Coordinate the interfaces and 5.5 Standardisation of work process.

The waste categorisation in section 5.3.3 showed that waste groups to prioritise are I, A, F, E, B. They would generate the most saving in process time and purchasing performance at the same time as they are moderate in their difficulty to be implemented. The saving in process time for waste group I, A, F and E also reduce the time before the order is placed to the supplier, and is therefore considered to

contribute to a situation where orders can be placed earlier to the supplier, and the materials have an increased opportunity to be delivered on time.

Section 5.4 and 5.5 are suggesting improvements in the current process that would reduce the waste that were prioritised, and this is summarised in table 9 below.

Table 9. Summary of how the waste groups in focus could be reduced

Waste I; Multiple hand-offs and approvals needed from other departments	Will be reduced by the implementation of group coordination in purchasing processes with the same characteristics as process 2, explained in section 5.5
Waste A; Equal information-update in different lists	Will be reduced by standardising the work process and implement one documentation, explained in section 5.5.1
Waste F; Extra processing when interacting with supplier	Can be reduced by implementing group coordination in process 2, explained in 5.3. Further it is reduced by implementing standardisation of input, explained in section 5.5.2
Waste E; Extra processing when collect information	Can be reduced by standardising the collection of information explained in section 5.4. A prerequisite for this change is that also a standardisation of input is implemented, explained in 5.5.2
Waste B; When it is expected to take part of information not intended for the employees within M&L	Will be reduced by standardising the work process and implement clear responsibilities within M&L, explained in section 5.5.1. Further it is reduced by implementing standardisation of input, explained in section 5.5.2

Finally, the deviation processes themselves are mentioned in the waste categorisation as to difficult to implement for this thesis to include, even if it is considered that reduced deviations would have the greatest impact on an increase in on-time deliveries and thus the purchasing performance. Instead, it is prioritised to understand what the M&L department could do to ease the deviation process. Besides the suggestions of improvements for different activities above that are included in the deviation process, the list of standardised input that the division needs, explained in section 5.5.2, is a good start towards reducing the deviation processes. It is further up to the included departments to investigate how they can produce the input that M&L needs to be able to perform purchasing processes without deviations.

5.7 Future state

If the suggestions described in the previous sections were to be implemented, the activities in the purchasing process would look differently than they are today. To create an understanding of how the design and course of actions would change, future state maps of the examples explained in the empirical chapter is made. Process 1 and 2 are in the two following sections presented with explanations of how the activities in this specific purchasing processes is affected by the suggestions of improvement. The process time that is saved is again highlighted, and to understand how the improvements contributes to on time deliveries the extended lead time for the suppliers are highlighted. Finally, to explain how the

result can be generalised to the entire purchasing process, the findings are compared to processes in the project with the same characteristics.

In both of the processes, there were changes in the orders that arrived late. It has been hard for the authors to predict if the standardisation of input will make the final information of what to buy to arrive sooner to the buyer. If this will be improved is beyond M&L's control, and is therefore hard to rely on. The future state map is designed after that the information of the correct status is collected as it was in the examples studied, which also is a driver that the lead time of the two processes is exactly the same in the future state maps as in the current situation. This will further be explained in each section below.

5.7.1 Future state maps of process 1

If the previous described improvements were to be implemented the purchasing process for M&L can be improved and the improved process are visualised in a future state map below (Figure 18). The blue boxes in the figure represents where in the process the suggestions of improvements will decrease the process time for some activities and help to remove a few activities. The removal of the activities will not only lead to a reduction in process time, but it will also reduce the lead time before the final order is placed to the supplier, which will increase the supplier lead time. Even if the material was delivered on time to the build start, it was not either delivered on the date that was agreed on which implies that there exist room for improvement.

By quality assuring the input the activity confirm part number could be removed and the lead time could be decreased with 16 hours since it is no need to wait for an answer from the PSS-owner before the buyer can continue the work. This lead time is added to the supplier lead time. By implementing one documentation the process time are decreased in six activities. Further, clear responsibilities both contribute to savings in process time but also to remove the main activity confirm MRD together with the outside activity MRD discussion. Standardising the deviation process can reduce the lead time of the deviation process from 88 to 40 hours by implementing a standard that all deviations have to be approved by all departments within one week. The quality assured input could stress that the deviation and change in the order also could be reduced in this process. However, the conclusion is made that this lies outside the control of M&L. Therefore, the change of the order is not removed in the future state map.

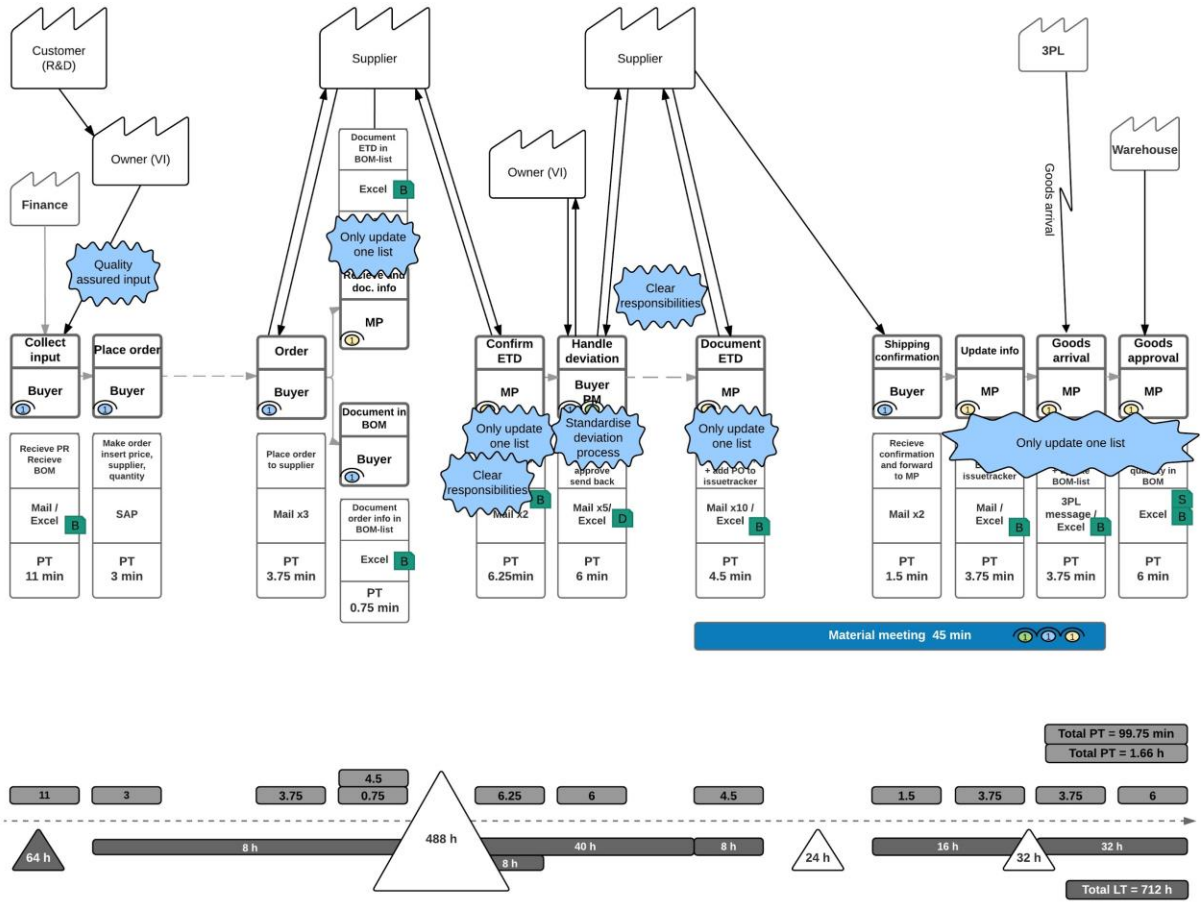

Figure 18. Future state map for process 1

Figure 18 explains that the total lead time of the process has not changed. However, as explained some of the lead time that was needed for M&L to perform activities has now been moved to the supplier. In the current state map (Figure 13), the supplier lead time was 464 hours from when the order was placed to when the change was detected, the deviation process. After implementing quality assured input, the lead time before the order was sent to the supplier potentially decrease with 16 hours. Therefore, the order can be sent to the supplier earlier and this time can be added to the supplier lead time, which will then be 488 hours in the future state map and are shown as the big white triangle in Figure 18. Further, the process time have decreased significantly. In the current state the process time for process 1 was between 63.5 minutes and 231 minutes which generated an average time of 146.75 minutes. The future state have a process time between 40.5 minutes and 160 minutes which gives an average time of 99.75 minutes, these calculations are found in appendix 7. This represent an average saving in process time of 47 minutes. However, as mentioned in the empirical chapter this saving will decrease if it turned out that the time spent where close to the minimum value, and vice versa. The generalisation made in the empirical chapter showed that 33 % of all the 70 different material purchased for this project have similar characteristics as the one in this process, hence the savings made within this process can also be applicable for the material with same characteristics. 33 % of 70 different materials purchased for this specific project, equals 23 materials. The average saving of 47 minutes times 23 different materials, equals a total saving of 1081 minutes, which represent 18 hours in the project.

5.7.2 Future state maps of process 2

The future state map for process 2 is visualised in Figure 19 below and creates the understanding that there are big changes in comparison to the current situation. The blue boxes represent were the suggestions of improvements affect the activities in the process. The removal of the activities will not only lead to a reduction of process time, but also reduce the lead time before the final order is placed to the supplier and thus increase the supplier lead time. This material was delivered one week late, and therefore contributed to the 20% of the material that was defined as late deliveries in the empirical chapter. The future state map present opportunities of how late deliveries can be counteracted by deliver information earlier to the supplier.

The standardised collection of quality assured information would both decrease the process time for that activity and reduce the amount of times the buyer would have to request that information from different parties. This further leads to a reduction of 200 hours in lead time that can be placed on the supplier's lead time. When the information in the BOM-list is collected, it was suggested to implement group coordination between the buyer and R&D. In the current situation, the information of exactly what to purchase is received very late in the process. The group coordination reduces the number of times the buyer seek information in the organisation, which are explained in the empirical chapter to generate a lot of non-value adding time in the process. Instead the buyer can receive information personally from representatives for the material, and continuously be sure on what information to give to the supplier. In the future state map the time for the material meetings within the sub-process in the current situation are replaced with the coordination meeting. It is realised that in this specific process the material meetings discuss deviations of the selected material, this is what the coordination also will do. However, the coordination meeting is working to prevent deviations and involved employees who can provide information at the meeting. The amount of time is not considered to increase or decrease significantly, and therefore the process time is not changed. Further in the process there are many situations where time is saved due to the implementation of one list to gather all information of the purchase. Finally, clearer responsibilities will reduce the amount of time that not responsible employees within M&L are included when they do not have to.

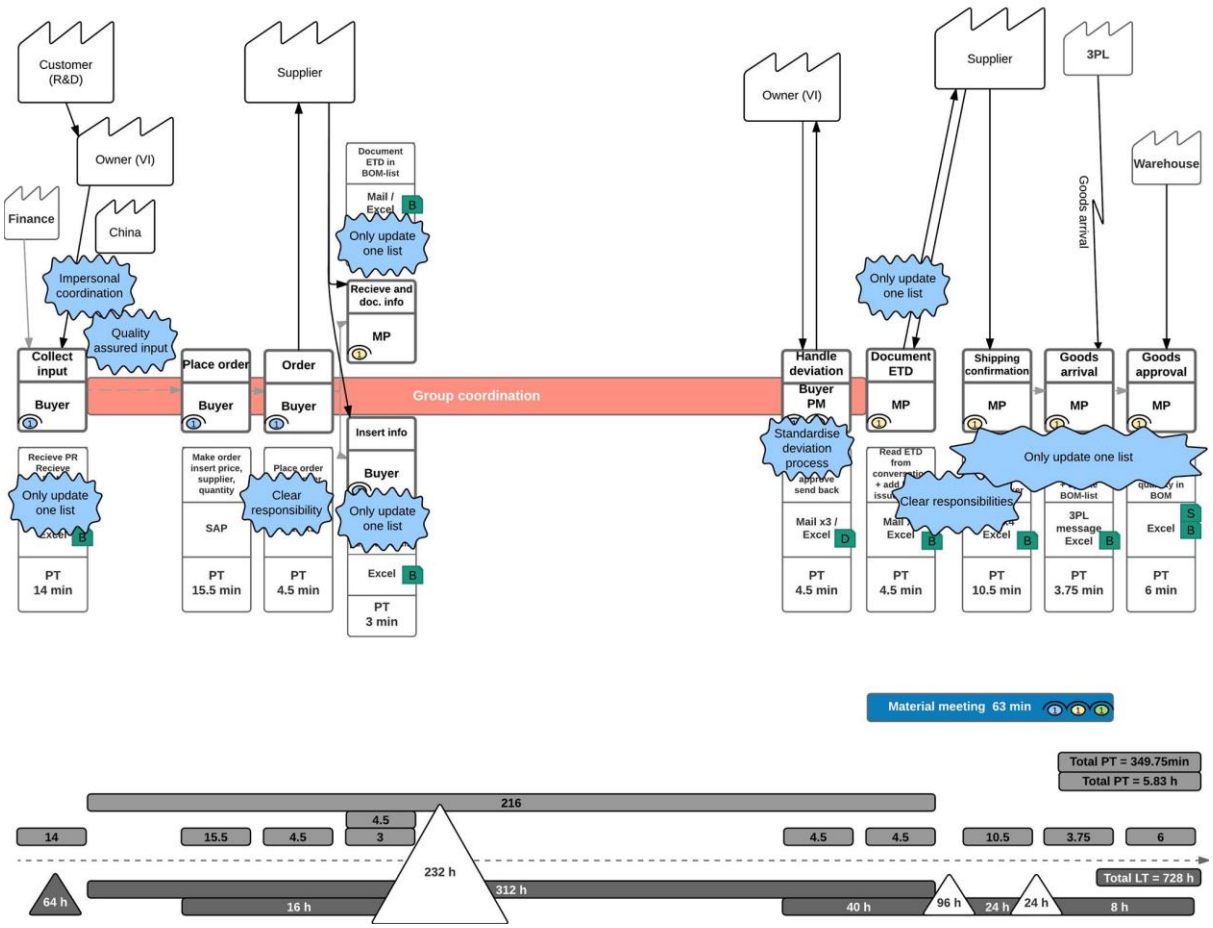

Figure 19. Future state map for process 2

When comparing the lead times in the current situation versus the future state map one can see that it does not differ. However, some of the lead time is moved from the organisations activities to the supplier. Within the collection of information the waiting lead time of the correct input was 264 hours in the current situation. In the future state map the lead time of collecting the information is 64 hours. The 200 hours that is saved is instead moved to the supplier lead time, since it is realised that the order could be placed sooner. In the current situation the supplier did not get the 8 weeks lead time that is agreed on between the parties, since the order with the correct status was places to late. In the future state map the supplier lead time is extended, which gives them better conditions to deliver on time. However, the conclusion is made that even if M&L improve their activities and save time that instead could be placed on the supplier lead time, the late change in the order makes the increase in supplier lead time difficult to use.

Continuously, the changes in the map generates a total saving in a process time of 68,5 minutes minimum to 165 minutes maximum, these calculations can be found in appendix 7. The average process time that is saved is hence 117 minutes. Again, this time saved and potential to improve the processes will be affected if it turned out that the actual time was closer to the minimum or maximum time defined. A value closer to the minimum time would decrease the opportunity to improve the process, and a value closer to the maximum time will increase the improvement possibilities. The great savings potential in process 2 further proves that there exist an even greater savings potential in the processes in general. In the empirical chapter it was explained that 62 % of the material had similar characteristics as the material studied in process 2 and 51 % was purchased from the same supplier. To produce a generalisation that is reliable it can be stressed that the findings of the savings potential in process 2 can

be generalised to these 51 % that represent purchase from the same supplier. 51 % of the total 70 material purchased to the specific project equals 36 materials. The average savings potential of 117 minutes times 36 materials equals a total average saving of 4176 minutes, which represent 70 hours. Even though it is realised that this generalisation can vary, and that the different time savings in each process will differ, it is understood that the suggestions of improvement will generate a big saving in the purchasing process in general.

5.7.3 Generalisation of the Future State

The two previous sections described how the suggested improvements would contribute to savings in process 1 and 2. Further these findings were generalised to the materials with the same characteristics in the same project, which gave a potential total saving in this project. The generalisation to the entire project gave 18 hours for the material with similar characteristics as process 1, and 70 hours for the materials with the same characteristics as process 2. This gives a total saving of 88 hours in this specific project. If approximately 10 projects are performed in a year and this would generate in a yearly saving of 880 hours for the six employees in the M&L division. As explained in the empirical chapter, process 3 was studied to visualise a different type of purchasing process and has acted as an inspiration and not a source of qualitative data of process time.

The project studied was explain to have a high maturity level, and further this was considered to decrease the complexity since old information and relationships with suppliers made the activities easier to perform. If generalising the results of the savings potential in this project, together with the information that the activities are easier to perform than in projects with a lower maturity level, the opportunity to save even more process time in other projects can be hypothesised. Of course, this type of discussion is uncertain, since it can not be proved due to that only one project has been included in the thesis. However, it seems reasonable to stress that similar savings can be made in other processes, and since some of these processes has a greater complexity, even more time might be saved than in the studied example in this thesis.

The connection between time compression and efficiency made in section 5.1 How to increase the purchasing performance, explained that the time that could be saved further increase the efficiency in the process, since the utilisation of resources are increased. By compressing process time and create a more efficient purchasing process it is further realised that the goal of reaching on-time deliveries can be facilitated, which implies that the purchasing process would also be more effective. The increased efficiency, leads to an increase in effectiveness, which means that continuously the purchasing performance could be increased through both mentioned parameters.

6. Discussion

The following chapter discuss the results of the thesis and how it can contribute to the organisation. Further, what has affected the validity of the results are discussed and the results ability to be generalised is evaluated. Finally, what areas a potential further research would have focused on are mentioned.

6.1 Interpretations of the Result

The findings in the thesis proved that the purchasing process at the studied organisation has great improvement possibilities. Several waste groups were identified and connected to different types of activities, and the implementation of improvement mechanisms and principles is considered to remove or reduce the waste in the purchasing process. The recommendations put a lot of emphasis in the coordination mechanisms in the purchasing division and its surrounding departments. This was since the result of the empirical study showed that the majority of the activities performed by the M&L division were to interact with each other, suppliers, and other departments involved in the purchasing process. Continuously, the waste identification showed that more waste could be connected to the interactive activities, than the administrative ones. This finding is strengthened by the fact that the purchasing process is seldom isolated to one department, and tools and mechanisms to communicate between the departments is a prerequisite to achieve a high purchasing performance (van Weele, 2014). Therefore, the finding that this was the situation in the given situation at the organisation did not come as a surprise to the authors.

The great extent of improvement possibilities that were found in the organisation can be considered to strive from two different perspectives. This first one is that due to the context of the new product development organisation, the purchasing process gets more complex. The purchases are seldom completely repeated, which means that in many situations the information on what to buy is new. This also leads to a situation where the buyers are very dependent on the engineers in the organisation, since they can not rely on old information on the material. The second perspective that can be considered a reason why the internal processes lacks in their performance is the fact that the organisation is very young, and the fast growth in a short time frame has made the internal processes unstructured. Today the structure in the process are not followed since it is not adapted after the increased amount of purchases. Instead the employees are trying to do their best to solve the problems that arises, since no approach exists to instead prevent the problems in the process. It is surprising that despite this, the organisation has continued to grow rapidly, which is very impressive.

6.2. Contributions of the Result

The results in the thesis is considered to contribute to the organisation's understanding of the current situation, highlight problem areas in the process and further give suggestions of how these can be improved.

The analysis of the value stream maps and identification of waste is connected to the understanding of the current situations, but further also highlight were in the processes that non-value adding time are spent. This is considered the most important contribution to the organisation, since it is highlighted that some of their daily activities actually do not contribute with value in the purchasing process, and therefore could be removed or reduced. Some of the activities that are highlighted as waste do not by

themselves generate a lot of process time, and therefore the perception can be that it does not matter whether they are improved or not. However, as explained in the analysis, small process steps that are performed in each process without adding value creates a lot of process time in the entire purchasing process. The potential to compress and save time creates a possibility of increased efficiency in the future process. This will, as mentioned, further contribute to an increased possibility to reach the goal of on-time deliveries. Hence, the increased efficiency will contribute to an increase in effectiveness, and this in combination is improving the purchasing performance in the process. The potential of improving the purchasing performance is not only considered to improve the current situation at the organisation. Furthermore, it is improving the process, reducing the waste and increasing the utilisation of the resources in a long-term perspective. This continuously affects the purchasing division and the organisation in a sustainability perspective, were the increased performance contributes to a more sustainable purchasing process.

Further, it is considered that without appropriate measurements in the purchasing process it is hard to use the results the thesis provides and improve the performance in the process. It is mentioned in the empirical chapter that no KPI's exists today in the purchasing process, which in itself is surprising for the upcoming and successful organisation that is studied in the thesis. This means that the processes can be performed with different outcomes and results without anyone actually is highlighting where the problems exists, and how often problems arises in the process. To use performance measurements is by several researches stressed to be extremely important to generate a high purchasing performance (van Weele, 2014; Caplice & Sheffi, 1995), and is something that the organisation is suggested to implement in order to facilitate the improvement of the purchasing process.

As a final remark to the contribution of the result, it is visualised in the example processes studied that late changes in the orders occurred. Even if it is not realistic to stress that this can be generalised to all purchasing processes, deviations were explained to be a big issue in the organisation. Late changes in the orders can make it hard for the supplier to deliver on time even if the activities before the final orders are improved. This means that the contribution of the results in this thesis still are dependent on a decrease in deviations to achieve on time deliveries, which is an important takeaway in the aim to increase the performance

6.3 Validity of the Result

To discuss the validity of the result, the methods that were used to create the empirical chapter and the analysis is discussed. The information in the value stream maps of the currents situation were collected by observations, interviews and old documentations. The fact that specific order numbers could be followed increase the validity in the maps, since the information is connected to that specific material and continuously is very precise. The duration of time each activity was presented in minimum and maximum values, which increases the validity of the result since it is realised that the time it takes to perform the different activities will seldom be exactly the same. When the information were collected, research of how to design the value stream maps were collected and discussed with supervisors at Chalmers. The value stream maps were then presented and discussed with the employees in the M&L division, who confirmed the information. Further, the findings of the current situation was frequently discussed with representatives in the organisation which gives the presentation of the current situations in the report, with focus on the value stream maps, a high validity.

The selected method that were used to analyse the value stream maps was also collected through literature and had a high emphasis on waste identification. The identification of waste was made from the learnings that was generated from the literature. However, it is realised that the author's personal understanding and interpretation of the literature can create a bias in the waste identification, which continuously can be considered to decrease the validity of the waste identification. To increase the validity, the wastes found in the current situation of the organisation was compared to waste identified in other administrative processes. It was realised that similar wastes was found in other processes in projects performed by other authors, and this increased the validity of the identified waste.

Further, the suggested improvements were conducted through literature when the current situation and waste in the process were identified. However, the suggested improvements has not been discussed with the organisation which reduces the validity of the implementation possibilities. To secure validity, a closer collaboration with the organisation where employees could contribute with personal experience and input to the suggested improvements could have been made. This was however hard to enable since the employees in the organisation had limited time to contribute in the project.

The method to choose three specific materials to follow was previously explained to increase the validity, since the information in each process became very precise. However, the characteristics in these three purchasing processes was generalised to the entire purchasing process of the project. This was made to increase the understanding of that small savings can generate bigger savings in a general perspective. The generalisation of the three materials in Figure 12 was made together with the responsible buyers and the purchasing manager in the organisation which can be considered to increase the validity. However, it is realised that this type of generalisation makes the result uncertain, since the activities and continuously potential savings in the three different processes will not be exactly the same in the other processes with similar characteristics. This makes the validation of the result in this perspective to be moderate. Further, it can be discussed how the selected project the three materials was gathered form contributes to the result. The project was in the empirical chapter presented to have a high maturity level, which was explained to decrease the complexity since both less materials were bought, the buyers in some purchase could rely on old information regarding the orders, and that the communication with the supplier were facilitated. The different characteristics in projects with different maturity levels could be considered to decrease the validity of the result in the report, since the results are gathered from one project. For example the presented lead time and process time for the activities and further wastes could differ if a project with lower maturity level was chosen. Nevertheless, the way to perform the activities do not differ between the projects. The same activities exists and are performed in the same order in all purchasing processes and therefore the result is considered to be able to be generalised to the entire purchasing process, independent on what project that is considered.

6.4 Generalisation of the Result

It is realised that it is hard to generalise the result since the project is performed with the specific organisations context in focus. A big contribution to the result was the current state explanation and visualising in the value stream maps. This information can not be generalised since the aim is to present the organisations current situation and the wastes that were identified is strongly connected to the context and the structure of the organisation that has been studied. Nevertheless it was realised that similar waste could be detected in other administrative process with other surrounding conditions. Similar waste do not however prove that the characteristics of the waste is the same in organisations with other context, and the result is therefore still considered limited in the ability to generalise.

Furthermore, the suggestions of improvements that contributes to the result were produced after the wastes that were identified, and this also makes the improvement suggestions hard to generalise.

Even though that the specific result is not generalised, the method of identify the current situation, visualise the process in a value stream map, identify wastes and finally analyse how the wastes could be improved or removed, is a common way to perform improvement projects in processes. To use this approach in the aim to reach the desired result can therefore be considered to have a high possibility of generalisation, in comparison to the results themselves.

6.5 Further studies

If the research could have been extended it would have been desirable and interesting for the result to do a more thorough research in the other departments included in the purchasing process. This would have generated a greater understanding of what the preconditions are in the other departments to produce the input for M&L, and hence an understanding if the pressure that is putted on the other departments is difficult for them to fulfil. Since the purchasing process was proved not to be an isolated activity, both by researches and from the empirical study, a further research within the other departments would have created a greater opportunity to improve the purchasing process as a whole. This is further something that can be recommended to the organisation, that even if the activities within M&L are analysed and suggestions of improvements presented, the importance of evaluating the entire purchasing process, with all departments included can not be stressed enough.

What further would have been interesting to study is how the implementation of KPI's could have generated a greater possibility to increase the purchasing performance in the process. It was highlighted that no performance measurements and KPIs exists today, and it is considered to be of great importance in the aim to achieve a high purchasing performance (Caplice & Sheffi, 1995). If a broader study could have been made, a study of what performance measurements that are most appropriate in the context the division are present in would have been prioritised. Continuously, this is also something that is suggested to the organisation, to implement performance measurements in the purchasing process. This would facilitate an evaluation of how the performance change if the suggested improvement procedures from this thesis were implemented.

7. Conclusion

This chapter conclude the thesis by answering the purpose of the study; Improve the purchasing process at M&L to be more efficient and contribute to on time deliveries. To answer the purpose three research questions were defined and the most important findings for each research question are summarised below.

1. What activities are included in the purchasing process performed by M&L?
The first question is answered by the definition of the purchasing activities performed by M&L presented in the empirical chapter. Through interviews with the employees and direct observations of their work these activities was defined as; Collect input, Place order, Handle deviation, Material meeting, Track and trace, and Collect material. These six groups was considered to be the main purchasing activities performed by M&L since all of them, except handle deviation, are included in all purchasing processes. However, the activity handle deviation is present in most of the processes and is considered to be the most time consuming activity and is therefore also included as one of the main activities.

To further answer the question, three different materials were selected in collaboration with the M&L group and resulted in two value stream maps for two of the materials. The materials was defined to have different characteristics in their complexity and their criticality to the project, which in itself is an important finding for the first research question, that all the material purchased do not have the same characteristics. The value stream maps presented the duration in process time for each activity and the lead time for the entire purchasing process. This contributed to a good understanding of the activities and were the time was spent in the process. Process 1 was concluded to have a total process time of 147 minutes in average, while process 2 had an average process time of 467 minutes. The difference in process time was released to strive from the fact that process 2 was defined to be more complex to perform than process 1. The comparison between the three processes further showed that the activities were performed differently, and the conclusion can be made that no standardised way to perform the purchasing process exists. However, the activities performed by M&L could be generalised in two different categories; activities to interact/communicate and share information with other parties, both internally and externally, and activities of administrative characteristics, insert orders and document information. The empirical findings with focus on the value stream maps showed that the majority of the activities was to interact with others, which continuously generated in a focus on the coordination in the current situations. It was realised that different coordination mechanisms were used in the five main activities in the three different processes, these mechanisms was impersonal, personal and group coordination. The findings of how the coordination mechanisms were used are summarised in table 7.

The summary of the findings above highlights what main activities the M&L division are responsible for, and by studying three different materials it is explained that the way to perform the activities differ in the current situation, which is answer to the first research question. Further, it is concluded that an understanding of the current situation is a prerequisite to be able to improve the process. The findings in the current situation will affect the improvement process, and a thorough mapping of the current process steps facilitate the future analysis.

2. How can the activities performed by M&L be improved to increase the purchasing performance?

Through the analysis of the value stream maps, several wastes were identified in each of the processes and the waste identification showed where in the process there are room for improvements. In the waste analysis a generalisation of the different waste was made where it was possible to group some of the wastes that was similar. The waste groups was compared regarding their difficulty to be implemented and how much process time they could save. Figure 17 in the analysis showed that waste A, B, E, F and I are the waste groups that is considered worth to implement. To understand how the reduction of the waste affects the purchasing performance in general a consideration of reduced lead time was included in the analyse. Waste I; Multiple hand-offs and approvals needed from other departments, were stressed to be the most important one, since it could both decrease process time but also lead time in the process. Therefor it will have the highest contribution to the total purchasing performance. This waste group was followed by A, F, E and finally B, in that given order to prioritise.

To reduce the identified waste it was suggested to both change the coordination mechanisms at some situations, and to standardise some of the activities in the process. The biggest suggestion regarding the coordination mechanisms was to implement group coordination for handle deviation in processes with the same characteristics as process 2. This could reduce waste group I and F. Further a standardisation in coordination mechanisms were suggested in the collection of information and material. Separate activities in the purchasing process was further suggested to be standardised. These were; Responsibilities within M&L, One documentation, and Handle deviations. With clear responsibilities the internal communication and division of work could be improved but also the external communication with other departments and suppliers. This could reduce waste group F. The implementation of one documentation could reduce the use of multiple lists, hence reduce waste A. Finally a standardisation of the input was suggested who could reduce waste E, this is further explained under research question 3.

To summarise the findings for research question two, it is realised that areas with great improvement opportunities exists in the purchasing process. M&L can increase their performance by improving activities with standardisation of work processes and a change in coordination mechanisms. The future state maps visualised that the implementation of the suggested improvements could result in a savings of 47 minutes for process 1 and 117 minutes for process 2. If these savings are generalised to other materials with the same characteristics, the savings in process time is considered to be great. The big opportunity to save process time implies that the purchasing process will be more efficient and continuously contribute to on-time deliveries in the future state which will increase the performance in the purchasing process. Moreover it can be concluded that a small changes and savings can generate in big impact on the purchasing performance, and should not be underestimated by organisations in general.

3. What is the input that M&L need from dependent departments to perform their activities?

Since the purchasing process is not an isolated activity, but involves different departments within the organisation it is understood that coordination between the departments are crucial. It was realised that M&L are highly dependent on the input provided from the other departments within the purchasing process. The value stream maps clearly visualised in different waste categories that there are improvement potential for the input provided to M&L. The difference in process time between the two processes further showed that the input was different in purchasing processes for different material. Therefor a suggestions was to implement a standardisation of the input for M&L. This input was

produced after an analysis of the waste categories and other empirical findings conducted from interviews and observations.

The suggested input needed for M&L is summarised in four different areas; An on time and quality assured BOM-list, Sourced suppliers, One internal contact person for each material, and Forecasts of future projects. An on time and quality assured BOM-list will make the number of deviations in the projects to be reduced. The deviations was visualised to have a great savings potential in process time and a quality assured BOM-list could make the deviations to be reduced significantly and continuously increase the purchasing performance. Sourced suppliers with the correct price will reduce the time spend in collection of information in the processes. This standardisation of the input is also a prerequisite for the suggestion to standardise the activity collect information to impersonal coordination. One internal contact person for each material is suggested in order to avoid the extra processing when request information from different parties, which was highlighted to be a big issue, especially in process 2. The last defined input is forecast of future projects, which is purposed with the aim to get M&L involved earlier in the projects. They hence get the opportunity to plan their activities and the organisation could benefit from their experience and relationship with suppliers.

It can be concluded that dependence relationships in processes increase its complexity, and to manage the relationships is of great importance for the contribution of the performance in organisations. The specification of desired input answers the last research question of the thesis and it is important that M&L communicates the specifications of input to the concerned departments in order for them to be able to produce the desired input.

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Appendix 1 - Interview template

General template used in all interviews

- What is your role? Describe it briefly.
- Explain the purchasing process for the boxcar.
    - Describe your contribution to the purchasing process.
    - What are your general view/opinion of the work in the purchasing process?
    - How does the purchasing process for the boxcar differ from other materials?
- Explain the deviation process
    - How is that affecting your work?
    - How often do it occur?

Template for Purchasing Manager

- What is the organisational strategy?
- What position do the purchasing division has in the organisation?
- What is deciding how you work today? Are there existing guidelines etc.?
- Has the purchasing process changed due to the increased volume?
- Describe the M&L division
    - How is the activities performed?
    - How are the work divided?
    - How is the collaboration in the group?
- What are your goals/KPI;s?
    - For the entire purchasing process
    - For the activities performed by M&L specific
- How are the work divided between employees?

Template for Buyers

- What cost centers are you responsible for?
- Is there any specific characteristics for those cost centers?
- What information are you depend on to be able to place the orders?
    - From who do you get that information?
- How is your contact with suppliers?
    - How are they contacted? How frequently?
- How is your contact with internal representatives?
    - How are they/you contacted? How frequently?
- How are you documenting the information from suppliers/internal representatives?
- Describe the specific material that is observed from your cost center.
    - How can the findings be generalised in the bigger picture?
    - Do these kind of situations occur in the other purchase you perform?
    - How often?
- How much time do you spend on the boxcar project?
- What do you feel is the biggest issue in your daily work?

Template for Material Planners

- What cost centers/suppliers are you responsible for?
- How is your contact with suppliers?
    - How are they contacted? How often?
- How is your contact with internal representatives?
    - How are they/you contacted? How often?
- How are you documenting the information from suppliers/internal representatives?
- What do you feel is the biggest issue in your daily work?
- How can the specific materials that is observed be generalised to all the materials that you track?

Template for representatives from Integrated departments

- How is your department contributing to input needed by M&L?
- How do you communicate with the M&L division?
- What other departments are your dependent on?
- Are you aware of the current situation in the purchasing process (that much of the material do not arrive on time?)

Appendix 2 - Interviews conducted

Interviewe	**Occation**	**Approach**
Purchasing Manager	2017-01-19 2017-01-20 2017-01-24 2017-02-09 2017-02-16 2017-03-08 2017-04-13	Initial interview Initial interview Initial interview Follow up interview Follow up interview Secure information Discussion of generalisation
Buyer 1	2017-01-19 2017-02-13 2017-02-23 2017-03-08 2017-03-15 2017-04-13	Initial interview Follow up interview Follow up interview Secure information Secure information Discussion of generalisation
Buyer 2	2017-01-20 2017-02-23 2017-03-08 2017-03-15 2017-04-13	Initial interview Follow up interview Secure information Secure information Discussion of generalisation
Buyer 3	2017-01-20 2017-02-13 2017-02-23 2017-03-08 2017-04-13	Initial interview Follow up interview Follow up interview Secure information Discussion of generalisation
Material Planner 1	2017-01-26 2017-02-23 2017-04-13	Initial interview Follow up interview Secure information
Material Planner 2	2017-02-23 2017-03-15 2017-04-13	Initial interview Follow up interview Secure information
Representative from Project Lead	2017-03-15	Initial interview
Representative from VI	2017-01-25 2017-04-26	Initial interview Secure information
Representative from R&D	2017-01-02 2017-04-26	Initial interview Secure information

Appendix 3 - Time interval

Activity	**Buyer process 1**	**Buyer process 2**
Gather info from BOM-list	6 min - 10 min	6 min - 10 min
Make an order in SAP	1 min - 5 min	11 min - 20 min
Send order email	1 min - 5 min	1 min - 5 min
Open/read email	30 sek - 1 min	30 sek - 1 min
Answer/write email	30 sek- 1 min	30 sek - 1 min
Update a list (BOM/Deviation-list)	30 sek - 1 min	1 min - 5 min
Phonecall	1 min - 5 min	6 min - 10 min
Lync-conversation	1 min - 5 min	1 min - 5 min
Material meeting	1 min - 5 min	1 min - 5 min 6 min - 10 min

Activity	**Purchasing Manager**
Open/read email	30 sek - 1 min
Answer/write email	30 sek - 1 min
Approve deviation	1 min - 5 min

Activity	**Material Planner**
Open/read email	30 sek - 1 min
Answer/write email	1 min - 5 min
Update list (BOM-list/Issue tracker/Ongoing PO)	1 min - 5 min
Gather info from list (storage list, deviation)	1 min - 5 min

Appendix 4 - Process chart current state

Process 1

	Main activity	Sub activity	Operator	outsite activities / cc mail	LT	PT (min-max)		PT (avg)	Calculation	Tot PT
1	Collect input	1. Recieve BOM 2. Recieve PR	Buyer		64 h	6-10 min 1-5 min	7-15	8 3	8+3=11	11
2	Place Order		Buyer		8 h	1-5 min	1-5	3		3
3	Confirm partno.	4. Confirm with PSS-owner 5. Recieve confirmation	Buyer Buyer		16 h	30 sek - 1 min 30 sek - 1 min	1-2	0.75 0.75	0.75*2=1.5	1.5
4	Order	6. Send order 9. Recieve confirmation	Buyer Buyer			1-5 min 30 sek - 1 min	1.5-6	3 0.75	3+0.75=3.75	3.75
5	Fill in BOM		Buyer		8 h	30 sek - 1 min	0.5-1	0.75		0.75
5	Insert info	7. Recieve order 9. Recieve confirmation 10. insert info ongoing PO 11. Fill in BOM	MP MP MP MP			30 sek - 1 min 30 sek - 1 min 1-5 min 1-5 min	3-12	0.75 0.75 3 3	0.75*2+3*2=7.5	7.5
6	Confirm ETD	12. Confirm with supplier 15 Recieve ETD confirmation 16. Update ongoing PO 17. Update BOM	MP MP MP MP	cc buyer cc buyer	464 h 8 h	1-5 min 30 sek - 1 min 1-5 min 1-5 min	4.5-18 min	3 0.75 3 3	0.75*3+3*3=11.25	11.25
7	Deviation	13. Receive deviation 14. Contact supplier 18. Receive confirmation 19. Confirm deviation 20. Confirm deviation	Buyer Buyer Buyer Buyer Senior Buyer	cc senior buyer VI confirm deviation	88 h	30 sek - 1 min 30 sek - 1 min 30 sek - 1 min 30 sek - 1 min 1-5 min	3.5-10 min	0.75 0.75 0.75 0.75 3	0.75*5+3=6.75	6.75
8	Confirm MRD	21. Receive question about MRD 22. Reply MRD date	Buyer Buyer	10 mails pss-owner <--> supplier	16 h	30 sek - 1 min 30 sek - 1 min	6-12 min	0.75 0.75	0.75*12=9	9
9	Document ETD	23. Receive ETD (conversation) 24. Add PO to issuetracker 25. Update ongoing PO 26. Update BOM	MP MP MP MP MP B PM	10 mails pss-owner <--> supplier mtrl-meeting start		30 sek - 1 min 1-5 min 1-5 min 1-5 min	8-25 min	0.75 3 3 3	0.75*10+3*3=16.5	16.5
10	Confirm Updates	27. Call supplier to clarify update	Buyer			1-5 min	1-5 min	3		3
11	Shipping Confirmation	28. Recieve shipping confirmation 29. Forward shipping confirmation	Buyer Buyer		16 h	30 sek - 1 min 30 sek - 1 min	1-2 min	0.75 0.75	0.75*2=1.5	1.5
12	Update info	30. Receive shipping confirmation 31. Update BOM with tracking no 32. Update issuetracker 33. Update ongoing PO	MP MP MP MP		32 h	30 sek - 1 min 1-5 min 1-5 min 1-5 min	3.5-16 min	0.75 3 3 3	0.75+3*3=9.75	9.75
13	Goods arrival	34. Receive arrival confirmation 35. Update BOM with ETA 36. Update ongoing PO 37. Remove from issuetracker	MP MP MP MP		32 h	30 sek - 1 min 1-5 min 1-5 min 30 sek - 1 min	3-12 min	0.75 3 3 0.75	0.75*2+3*2=7.5	7.5
14	Goods approval	38. Gather info from storage-list 39. Update BOM with quantity 40. Move from ongoing to done	MP MP MP			1-5 min 1-5 min 1-5 min	3-15 min	3 3 3	3*3=9	9
				Material meeting			15-75 min			45
				Total	**712 h**		**63.5-231**			**146.75**
							1.01-3.85 h			2.45 h

Process 2

	Main activity	Sub activity	Operator	outsite activities / cc mail	LT	PT (min-max)		PT (avg)	Calculation	Tot PT
1	Collect input	1. Recieve BOM	Buyer			6-10 min		8		
		2. Transfer info from BOM to Purchasing list	Buyer			1-5 min		3		
		3. Recieve PR	Buyer			1-5 min		3		
		4. Request price R&D	Buyer			30 sek - 1 min		0.75		
		5. Recieve new contact person	Buyer			30 sek - 1 min		0.75		
		6. Request price Lear China	Buyer			30 sek - 1 min		0.75		
		7. Recieve new contact person	Buyer			30 sek - 1 min		0.75		
		8. Request price China buyer	Buyer			30 sek - 1 min		0.75		
		9. Recieve price	Buyer		264 h	30 sek - 1 min	11-26	0.75	8+3*2+0.75*6=18.5	18.5
					16 h					
2	Inform supplier	10. Call supplier	Buyer			6-10 min	6-10	8		8
3	Place order		Buyer			11-20 min	11-20	15.5		15.5
4	Order	12. Send order	Buyer			1-5 min		3		
		14. Request confirmation	Buyer	cc MP, PM		30 sek - 1 min		0.75		
		15. Receive order confirmation	Buyer	cc PM	16 h	30 sek - 1 min	3.5-10	0.75	3+0.75*5=6.75	6.75
5	Insert info	17. Update Purchasing list	Buyer			1-5 min	1-5	3		3
5	Insert info	13. Receive order	MP			30 sek - 1 min		0.75		
		16. Receive order confirmation	MP			30 sek - 1 min		0.75		
		18. Fill in BOM	MP			1-5 min		3		
		19. Insert info ongoing PO	MP			1-5 min	3-12	3	0.75*2+3*2=7.5	7.5
					32 h					
6	Receive status info	20. Supplier can't deliver TT3 status	Buyer	cc MP, PM		30 sek - 1 min		0.75		
		21. Answer it will be discussed today	Buyer	cc MP, PM		30 sek - 1 min		0.75		
		22. Ask PSS-owner	Buyer			30 sek - 1 min		0.75		
		23. Recieve info Lear will update	Buyer			30 sek - 1 min		0.75		
		24. Insert PO in issuetracker	Buyer			1-5 min		3		
				Discussion with VI at mtrl-meeting		6-10 min		8		
		25. Inform supplier changes will be delivered w.4	Buyer		16 h	30 sek - 1 min	23.5-44	0.75	0.75*9+3+8*3=33.75	33.75
					128 h					
7	Cancel or update order	26. Recieve info, cancel or update order?	Buyer	PSS-owner ask R&D		30 sek - 1 min		0.75		
		27. Ask PSS-owner	Buyer			30 sek - 1 min		0.75		
		28. Request update	Buyer	PSS-owner forward		30 sek - 1 min		0.75		
		29. Request deviation	Buyer			30 sek - 1 min		0.75		
		30. Receive info, cancel or update order?	Buyer			30 sek - 1 min		0.75		
		31. Request update about order	Buyer			30 sek - 1 min		0.75		
		32. Recieve order update (0187 --> 0963)	Buyer	Request deviation		30 sek - 1 min		0.75		
		33. Send new partno. to supplier	Buyer	cc MP, PM		30 sek - 1 min		0.75		
		34. Recieve order confirmation	Buyer	cc PM	56 h	30 sek - 1 min	7.5-15	0.75	0.75*15=11.25	11.25
8	Insert info	35. Update purchasing list	Buyer			1-5 min	1-5	3		3
8	Insert info	36. Recieve order confirmation	MP			30 sek - 1 min		0.75		
		37. Update list (vilken??)	MP			1-5 min	1.5-6	3	0.75+3=3.75	3.75
					8 h					
9	Clarify info			Dan <--> Supplier 2 mail cc MP, B, PM						
		38. Send update and clarify info	MP	cc B, PM		1-5 min		3		
		39. Recieve info, supplier try to pick up ASAP	MP	cc B, PM		30 sek - 1 min		0.75		
		40. Answer thank you	MP	cc B, PM		30 sek - 1 min	8-19	0.75	0.75*14+3=13.5	13.5
10	Deviation	41. Recieve deviation	Buyer	cc PM		30 sek - 1 min		0.75		
		42. Confirm deviation	Buyer			30 sek - 1 min		0.75		
		43. Confirm deviation	PM			1-5 min		3		
				VI confirm deviation	72 h		2.5-8		0.75*3+3=5.25	5.25
11	Document ETD			SM <--> Supplier 3 mail cc PM						
		44. Recieve ETD	MP			30 sek - 1 min		0.75		
		45. Add PO to issuetracker	MP			1-5 min		3		
		46. Update BOM with ETD	MP			1-5 min		3		
		47. Update ongoing PO	MP			1-5 min		3		
				Mtrl-meeting start			6-21		0.75*6+3*3=13.5	13.5
11	Insert info			SM <--> Supplier 3 mail						
		48. Recieve ETD	Buyer			30 sek - 1 min		0.75		
		49. Update purchasing list	Buyer			1-5 min	2.5-8	3	0.75*3+3=5.25	5.25
					64 h					
12	Shipping confirmation	50. Request order update	MP	cc B, PM		1-5 min		3		
		51. Recieve ETD confirmation	MP	cc B, PM		30 sek - 1 min		0.75		
		52. Request trackingno.	MP	cc B, PM		1-5 min		3		
		53. Recieve trackingno.	MP	cc B, PM		30 sek - 1 min		0.75		
		54. Update BOM with trackingno.	MP			1-5 min		3		
		55. Update issuetracker	MP			1-5 min		3		
		56. Update ongoing PO	MP		24 h	1-5 min	10-35	3	0.75*10+3*5=22.5	22.5
					24 h					

13	Goods arrival	57. Recieve arrival confirmation 58. Update BOM with ETA 59. Update ongoing PO 60. Remove from issuetracker	MP MP MP MP			30 sek - 1 min 1-5 min 1-5 min 30 sek - 1 min	3-12	0.75 3 3 0.75	0.75*2+3*2=7.5	7.5
					8 h					
14	Goods approval	61. Gather info from storagelist 62. Update BOM with quantity 63. Move from ongoing to done	MP MP MP			1-5 min 1-5 min 1-5 min	3-15	3 3 3	3*3=9	9
				Material meeting		6-10 min	162-270			216
				Material meeting		1-5 min	21-105			63
				Total	**728 h**		**287-646**			**466.5**
							4.78-10.77 h			7.78 h

Appendix 5 - Waste calculation

Process 1

Waste	Activity (main)	Activity (sub)	Activity (outside/cc)	PT (min-max)	Waste time (min-max)	PT (avg)	Waste time (avg)
1	3			1-2 min	1-2	1.5	1.5
2a		10 16 32 33 36 37 40		1-5 min 1-5 min 1-5 min 1-5 min 1-5 min 30 sek - 1 min 1-5 min	6.5-31	3 3 3 3 3 0.75 3	18.75
2b		*24* *25*		*1-5 min* *1-5 min*	*2-10*	*3* *3*	*6*
3a	6		2 st	30 sek - 1 min	1-2	0.75	1.5
3b	*7* *8* *9*		*1 st* *10 st* *10st*	*30 sek - 1 min* *30 sek - 1 min* *30 sek - 1 min*	*10.5-21*	*0.75* *0.75* *0.75*	*15.75*
4	*10*			*1-2 min*	*1-2*	*3*	*3*
5	7 8 9 10			3.5-10 min 6-12 min 8-25 min 1-5 min	18.5-52	6.75 9 16.5 3	35.25
6	11			1-2 min	1-2	1.5	1.5
7		*20*		*1-5 min*	*1-5*	*3*	*3*
8	1						3840 (waiting)
9	N/A	N/A					N/A
				Total:	**28-89**		**58.5**

Process 2

Waste	Activity (main)	Activity (sub)	Activity (outside/cc)	PT (min-max)	Waste time (min-max)	PT (avg)	Waste time (avg)
10		2		1-5 min	1-5	3	3
11		4 5 6 *7* 8 9		30 sek - 1 min 30 sek - 1 min 30 sek - 1 min 30 sek - 1 min 30 sek - 1 min 30 sek - 1 min	3-6	0.75 0.75 0.75 0.75 0.75 0.75	4.5
12	2			6-10 min	6-10	8	8
13a		17 19 55 56 59 60 63		1-5 min 1-5 min 1-5 min 1-5 min 1-5 min 30 sek - 1 min 1-5 min	6.5-31	3 3 3 3 3 0.75 3	18.75
13b		*35* *37* *45* *47* *49*		1-5 min 1-5 min 1-5 min 1-5 min 1-5 min	*5-25*	*3* *3* *3* *3* *3*	*15*
14a	4 12		3 st 8 st	30 sek - 1 min 30 sek - 1 min	5.5-11	0.75 0.75	8.25
14b	*6* *7* *9* *10* *11* *11*		*4 st* *6 st* *12 st* *1 st* *6 st* *3 st*	*30 sek - 1 min* *30 sek - 1 min* *30 sek - 1 min* *30 sek - 1 min* *30 sek - 1 min* *30 sek - 1 min*	*16-32*	*0.75* *0.75* *0.75* *0.75* *0.75* *0.75*	*24*
15	6 7 8 8 9 10 11 11			23.5-44 min 7.5-15 min 1-5 min 1.5-6 min 8-19 min 2.5-8 min 6-21 min 2.5-8 min	52.5-126	33.75 11.25 3 3.75 13.5 5.25 13.5 5.25	89.25
16	*6* *7*			*23.5-44 min* *7.5-15 min*	*31-59*	*33.75* *11.25*	*45*
17		*43*		*1-5 min*	*1-5*	*3*	*3*
18	1						264 h (waiting)
19	N/A	N/A					N/A (waiting)
				Total:	**74.5-189**		**131.75**

Appendix 6 - Waste groups

Similarities	Similar with differences	Differences
2+13 3+14 7+17 8+9+18+19 (waiting)	1+11 4+12	5 15 10 connected to 2+13 16 6

Categorisation of wastes	New name
2+13+10	A
3+14	B
7+17	C
8+9+18+19	D
1+11	E
4+12	F
5	G
15	H
16	I

Appendix 7 - Process chart future state

Process 1

	Main activity	Sub activity	Operator	outsite activities / cc mail	LT	PT (min-max)		PT (avg)	Calculation	Tot PT
1	Collect input	1. Recieve BOM 2. Recieve PR	Buyer		64 h	6-10 min 1-5 min	7-15	8 3	8+3=11	11
2	Place Order		Buyer		8 h	1-5 min	1-5	3		3
4	Order	6. Send order 9. Recieve confirmation	Buyer Buyer			1-5 min 30 sek - 1 min	1.5-6	3 0.75	3+0.75=3.75	3.75
5	Fill in BOM		Buyer			30 sek - 1 min	0.5-1	0.75		0.75
5	Insert info	7. Recieve order 9. Recieve confirmation 11. Fill in BOM	MP MP MP			30 sek - 1 min 30 sek - 1 min 1-5 min	2-7	0.75 0.75 3	0.75*2+3=4.5	4.5
					488 h					
6	Confirm ETD	12. Confirm with supplier 15 Recieve ETD confirmation 17. Update BOM	MP MP MP		8 h	1-5 min 30 sek - 1 min 1-5 min	2.5-11	3 0.75 3	0.75+3*2=6.25	6.25
7	Deviation	13. Receive deviation 14. Contact supplier 18. Receive confirmation 19. Confirm deviation 20. Confirm deviation	Buyer Buyer Buyer Buyer PM	VI confirm deviation	40 h	30 sek - 1 min 30 sek - 1 min 30 sek - 1 min 30 sek - 1 min 1-5 min	3-9	0.75 0.75 0.75 0.75 3	0.75*4+3=6	6
9	Document ETD	23. Request ETD 24. Recieve ETD 26. Update BOM	MP MP MP MP B PM	mtrl-meeting start	8 h	30 sek - 1 min 30 sek - 1 min 1-5 min	2-7	0.75 0.75 3	0.75*2+3=4.5	4.5
					24 h					
11	Shipping Confirmation	28. Recieve shipping confirmation 29. Forward shipping confirmation	Buyer Buyer		16 h	30 sek - 1 min 30 sek - 1 min	1-2	0.75 0.75	0.75*2=1.5	1.5
12	Update info	30. Receive shipping confirmation 31. Update BOM with tracking no	MP MP			30 sek - 1 min 1-5 min	1.5-6	0.75 3	0.75+3=3.75	3.75
					32 h					
13	Goods arrival	34. Receive arrival confirmation 35. Update BOM with ETA	MP MP		32 h	30 sek - 1 min 1-5 min	1.5-6	0.75 3	0.75+3=3.75	3.75
14	Goods approval	38. Gather info from storage-list 39. Update BOM with quantity	MP MP			1-5 min 1-5 min	2-10	3 3	3*2=6	6
				Material meeting		1-5 min	15-75			45
				Total	**712 h**		**40.5-160**			**99.75**
							0.68-2.67 h			1.67 h

Process 2

	Main activity	Sub activity	Operator	outsite activities / cc mail	LT	PT (min-max)		PT (avg)	Calculation	Tot PT
1	Collect input	1. Recieve BOM 3. Recieve PR 9. Collect price	Buyer Buyer Buyer		64 h	6-10 min 1-5 min 1-5 min	8-20	8 3 3	8+3*2=14	14
				Group coordination start						
3	Place order		Buyer			11-20 min	11-20	15.5		15.5
4	Order	12. Send order 14. Request confirmation 15. Receive order confirmation	Buyer Buyer Buyer		16 h	1-5 min 30 sek - 1 min 30 sek - 1 min	2-7	3 0.75 0.75	3+0.75*2=4.5	4.5
5	Insert info	17. Update BOM-list	Buyer			1-5 min	1-5	3		3
5	Insert info	13. Receive order 16. Receive order confirmation 18. Fill in BOM	MP MP MP			30 sek - 1 min 30 sek - 1 min 1-5 min	2-7	0.75 0.75 3	0.75*2+3=4.5	4.5
					232 h					
10	Deviation	41. Recieve deviation 42. Confirm deviation 43. Confirm deviation	Buyer Buyer PM	VI confirm deviation	72 h	30 sek - 1 min 30 sek - 1 min 1-5 min	2-7	0.75 0.75 3	0.75*2+3=4.5	4.5
11	Document ETD	44. Request ETD 45. Recieve ETD 46. Update BOM with ETD	MP MP MP	Mtrl-meeting start		30 sek - 1 min 30 sek - 1 min 1-5 min	2-7	0.75 0.75 3	0.75*2+3=4.5	4.5
					64 h					
12	Shipping confirmation	50. Request order update 51. Recieve ETD confirmation 52. Request trackingno. 53. Recieve trackingno. 54. Update BOM with trackingno.	MP MP MP MP MP		24 h	1-5 min 30 sek - 1 min 1-5 min 30 sek - 1 min 1-5 min	4-17	3 0.75 3 0.75 3	0.75*2+3*3=10.5	10.5
					24 h					
13	Goods arrival	57. Recieve arrival confirmation 58. Update BOM with ETA	MP MP		8 h	30 sek - 1 min 1-5 min	1.5-6	0.75 3	0.75+3=3.75	3.75
14	Goods approval	61. Gather info from storagelist 62. Update BOM with quantity	MP MP			1-5 min 1-5 min	2-10	3 3	3*2=6	6
				Material meeting			21-105			63
				Group coordination			162-270			216
				Total	**728 h**		**218.5-481**			**349.75**
							3.64-8 h			5.83 h