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Reducing the Delivery Time of Order-to-Delivery Process

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Writing this preface section of this Master's Thesis makes me feel good. The courses during autumn and writing the Thesis during the winter have been rewarding but sometimes stressing and time consuming tasks. The year has been challenging and a large part of my free time during the last eight months I have spent by sitting in front of my PC typing different assignments and this Thesis. But now it really feels that the year is coming to an end. The time spend was not be wasted because the year has given me so much new things and also many new friends.

I want to thank my company for giving me this opportunity to study and also for giving time which I was able to spend on these studies.

At the school, I got to know many new amazing people. From the courses and also from all the class-mates I was able to learn much about the industrial management and especially about service business. I would like to say special thanks to my thesis instructor Dr Juha Haimala who provided his help whenever it was needed. Also thank you Dr Marjatta Huhta and Zinaida Grabovskaia for your comments and advices. It would be much harder for anyone to read without your precious help.

Also big thanks to my girlfriend at home that she was able to stand my frustration and sometimes not so positive mind. I think that we'll now have some more time for doing things together than during the last 8-9 months.

Karri Heinonen
Klaukkala May 11, 2015

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The main objective of this study is to suggest a new improved OTD process for the case company by which the case company should be able to reduce the delivery time of the current OTD process by 50%. The need for cutting the delivery time of the current OTD process has become significant since the case company management has made a decision of starting to offer some cable manufacturing line types with short delivery time in order to gain competitive advantage against the competitors.

This study uses qualitative methods to analyze the current state of the OTD process. The main sources for the data used in this study are collected from the interviews conducted for the key stakeholder of the OTD process. Also the case company internal documentation was studied and some data from the case company ERP-system was also collected and studied. The findings from the current state analysis were used suggested that the issues which cause delays in the current OTD process can be divided into three different categories. By studying the literature relevant to these three categories a conceptual framework for this study was created.

The outcome of this study is a new OTD process. This proposal is consisted of four different parts which all have effect to the total performance of the OTD process. For the case company it is important to understand that the performance of the OTD process is dependent on all these parts. For this reason it is important that all the proposed improvements are implemented.

The outcome of this study will help the case company to reduce the delivery time of the OTD process. However the proposed OTD process has to be tested and the performance evaluated before the case company is able to confirm the performance of the new proposed OTD process.

Key words	OTD process, lead-time, reducing, delivery time, process development

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Acronyms

OTD	Order-to-Delivery
OEM	Original Equipment Manufacturer
CODP	Customer Order Decoupling point
OPP	Order Penetration Point
ERP	Enterprise Resource Planning
DP	Down payment
LC	Letter of Credit
LSP	Logistics by the Service Provider
ETO	Engineer-to-Order
MTO	Manufacture-to-order
ATO	Assembly-to-Order
MTS	Manufacture-to-Stock
BOM	Bill of material
VSM	Value Stream Map

1 Introduction

This study explores order-to-delivery (OTD) process of the case company and factors which influence performance of OTD process. It focuses on finding current weaknesses and possible issues for improvements. Finally it proposes a new OTD process based on findings from current OTD process and on best practice and existing knowledge found from the literature.

OTD process is part of every company business processes. Performance of OTD process has a significant importance for most of the companies. It determines companies' capability to produce certain amount of goods in a certain time. The faster OTD process is the faster company is capable to respond to customer needs.

1.1 Key Concepts of This Study

The OTD process is defined as a process which is built from four sub-processes: the customer ordering, the supplier delivery, and logistics by the service provider (LSP) transportation, and the customer goods receipt sub-process (Mattsson 2004. Cited in Forslund et al. 2008: 41). Thus, OTD process includes at least three different actors: a customer, a supplier and LSP transportation.

For measuring OTD process performance, lead time or related key performance indicators are commonly used. Even though lead time makes an important factor for any company, it is not however considered as the most important OTD process performance indicator. A performance indicator such as on-time delivery is often considered to be more important. (Forslund et Jonsson 2007. Cited in Forslund et al. 2008: 42). Therefore, this study focuses on improving the on-time delivery time for the OTD process.

The on-time delivery means that company fulfills its customer delivery assigned tasks on time by the requirements of the delivery. If company truly wants to increase efficiency of the OTD process, it is important to understand that the performance of the OTD process is affected by the all factors which are involved in OTD process. This thesis concentrates on studying case company OTD process and suggests improvements to the process to improve the delivery time of the OTD process by 50%. The study is conducted by using a certain line delivery type as a reference. *A line delivery*, in the context of this study, means the delivery project of a cable manufacturing line including all the processes needed for the delivery. It covers the engineering activities starting from the point of received the order and ending at the point when all goods are packed at the case company site and waiting for transportation.

1.2 Business Challenge and Objective of This Study

Currently, all customer line delivery projects of the case company are delivered by using the so-called 24 weeks delivery model. This basically means that the OTD process for the line takes 24 weeks. This model allows case company to work in a flexible manner, with only few project delivery delays per year.

In order to gain competitive advantage in certain markets, the case company management has made a decision to introduce a short delivery time business model based on offering of one particular line type. As a result, the current lead time of the OTD process (24 weeks/6 months) has become too long for the new short delivery time based offer. To meet the new required schedule of three (3) months delivery time, existing OTD process has to become more efficient or a completely new OTD process has to be created.

The objective of this thesis is therefore to create a new OTD process. With the new improved OTD process the case company should be able to meet the required time preconditions for the short time line delivery (3 months).

To reach this objective and solve this business challenge, this study first analyses the current OTD process by using the data collected from the company internal documents, ERP-system and from a series of internal interviews. From this data, a picture of the current state of the process is build and the efficiency of the process is evaluated, with the current lead times of different processes being mapped. After that, workshop with the key stakeholders of the new short delivery time offer and OTD process was held in which ideas were gathered for building the initial proposal. Then the initial proposal was evaluated and final proposal was build. The outcomes of this study are proposals for; (1) new OTD process map, (2) new short delivery time based timing model, (3) new component management structures and (4) supplier commitment program which will help the case company to establish new short delivery time offer for a certain line type.

1.3 Scope and Structure of the Thesis

This study is done by using a certain cable manufacturing line as a reference. It means that the study only focuses on creating a shorter OTD process for this single line type. The OTD process of this line type is studied from the moment when company has received confirmed order from the customer and till the line delivery material is packed and waiting for transportation to the customer location. Additionally, this Thesis studies only the company internal processes it does not study any supplier or original equipment manufacturer (OEM) company processes.

This thesis is divided into seven sections. Section 2 describes the research methods and materials used in this Thesis and provide information of how the research is conducted. Section 3 analyses the current state of case company OTD process. This analysis is made in order to understand current OTD process better and to find out possible strength and weaknesses in the current situation. After the current state analysis, Section 4 discusses the findings from the literature review in order to find best practice and existing knowledge which can be used to tackle the business problem. In addition, section 4 also provides the conceptual framework for building the improved OTD process model. Section 5 presents the proposal building stage for initial OTD process and verifies it. Section 6 provides results from the validation of the proposed improvements to OTD process and presents final list of suggested improvements. Section 7 provides a summary of the thesis and evaluates the reliability and validity of the study.

2 Method and Material

This section discusses the research method and research design used in this study. This section will also present the data collection and analysis methods used in this thesis.

2.1 Research Approach

This study is done by using the case study research approach. According to Yin (2003), the case study should be considered as a possible research approach when the focus of the study is on answering the "how" and "why" questions. Additionally, the case study makes a good method for those studies where researcher is not able to influence the actions of the people involved in the study. Case study should also be considered as a research approach when the researcher wants to address cover contextual conditions because he/she believes that they are relevant and influencing the phenomenon under the study. Figure 1 presents the case study research process described by Yin (2003).

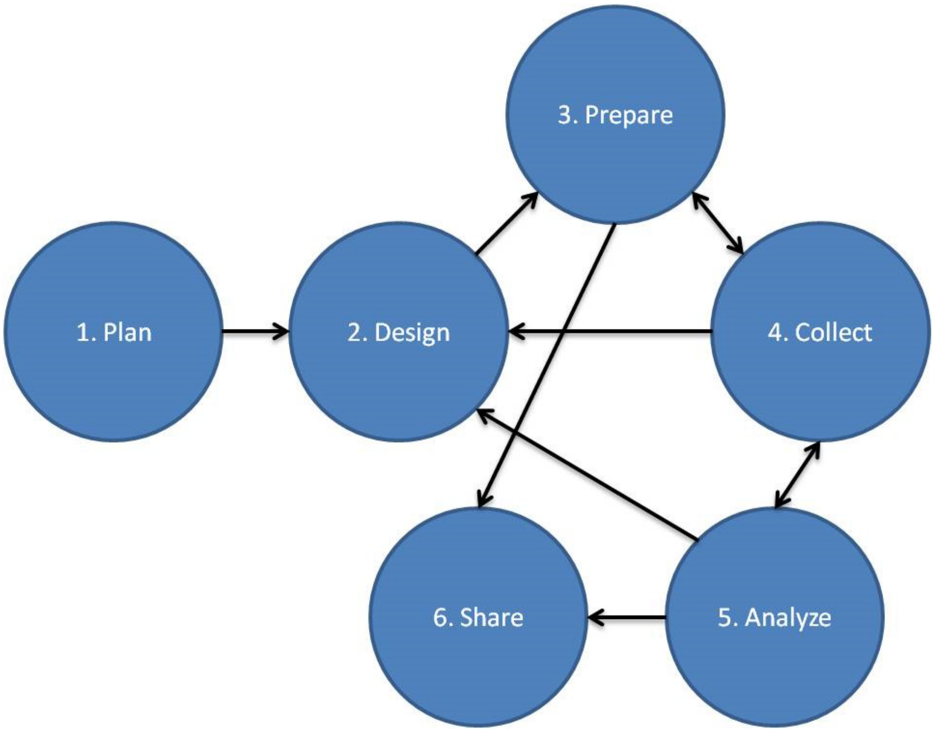

Figure 1. Case study research process (Based on Yin 2013: 1).

As seen from Figure 1, the case study makes a linear but iterative process. The first step is to plan what will be studied. After the planning, the second step is the design of data collection and implementation of the first case study analysis (data collection and analysis of the results). Repeat as many times as needed. Finally analyze and conclude (Yin 2009: 50). Yin (2005) also points that case study relies on multiple sources to converge in a triangulation fashion (Yin 2005: 14)

In this Thesis, the case study approach is used because it suits the business challenge and the case context well. Since the case study approach allows combining qualitative and quantitative data collection from multiple sources, such as interviews, surveys and other types of data, it was selected as a research approach for this study.

2.2 Research Design

The research started by identifying the business problem and objective of the study. After defining the research problem, research design for the case study was created. Research design of this thesis is illustrated in Figure 2 below.

As seen from Figure 2, after the business problem definition, current state analysis is conducted. In the current state analysis, the current OTD process of the case company is first studied on a more general level and then visualized. This makes it easier to build a bigger picture of the actual business problem. After the general level studying, the research goes deeper into the different parts of the OTD process: (a) line type chosen for the short delivery and (b) current OTD process for the chosen line. Different data collection (Data 1) and analysis methods are used to analyze OTD process. Finally, a whole picture of the current state of the OTD process is created and analyzed.

After the current state analysis, the study explores the literature in search for best practice and existing knowledge relevant to the improvement of the OTD process. Findings from best practice and existing knowledge are then collected and turned into a conceptual framework of this thesis. This conceptual framework is then used as guidelines for building the proposal to solve the current business problem. Figure 2 shows research design of this thesis.

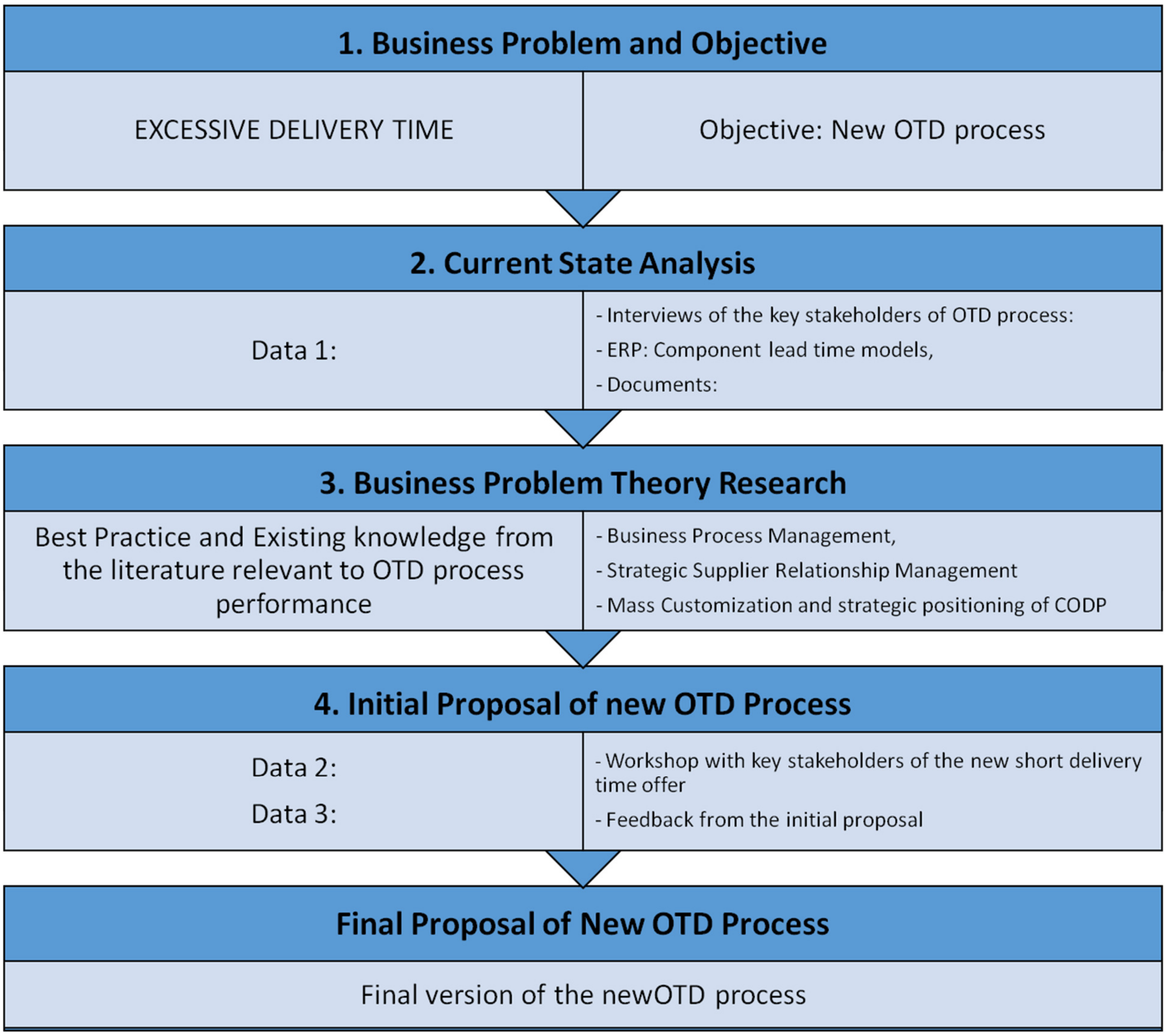

Figure 2. Research design of this Thesis.

As seen from Figure 2, stage 3 focuses on finding best practice and improvement suggestions from the literate. These findings are then put forward and discussed with the stakeholders in the case company. This is done in a workshop which is conducted to gather ideas and opinions about the OTD process improvements. Ideas and suggestions from this workshop (Data 2) are used as a basis for building the initial proposal.

Feedback to the initial proposal is then collected from the key stakeholder in the OTD process. This feedback (Data 3) is then used to enhance the initial proposal and to create final version of the improvement suggestions for the OTD process.

2.3 Data Collection and Analysis

This study builds on the data collected from three sources gathered from the case company. Data has been generated from studying: (a) the company internal documents, (b) by interviewing key stakeholder, and (c) from the company ERP-system. Data for this study is gathered also from one workshop and from the feedback received from the initial proposal made to solve the business problem. These data are counted together with the interviews as they were conducted in a free discussion mode. Totally, three rounds of data collection are conducted in the study. They are described in more detail below.

Data 1

Data 1 was collected in the first phase of this study. Data 1 was then used in the current state analysis. In *Round 1* of data collection, three different collection sources were used. First, company internal documents were searched and studied in order to find information relevant for the current state of the OTD process for this study. Table 1 presents list of internal documents used in this study.

Table 1. Internal documents used as Data 1.

Data 1. Internal Documents	Collected From	Document Title	Analysis
1.	Company intranet	Delivery of New Production Capacity	3.3
2.	Company intranet	Projektin maksupostit ja ajoitukset pääpiirteittäin	3.3
3.	Company intranet	Secondary Coating Line OEL 40	3.1

As can be seen from Table 1, the core documents related to delivery and delivery composition were used as sources for Data 1, which relate to the current OTD process.

Second, the company ERP-system was explored. Table 2 presents the details of the data collected from the ERP-system.

Table 2. Data collected from the company ERP-system.

Data	Collected From Project(s) No. / Compo-nent	Data Type	Analysis
Data 1. ERP-system data	XXXXXXXXXX	Project Timing Gantt Chart	Section 3.2.1
Data 1. ERP-system data	XX XXXX	Component Timing Model	Section 3.2.1

As can be seen from Table 2 above, two different kinds of data were collected from the ERP-system. These were the component timing models and project timing gantt charts.

Finally, the interviews were conducted with the key stakeholders responsible for different parts of the OTD process. The interviews were conducted as semi-structured theme interviews with a predetermined questions (Appendix 1), but also allowing to the interviewed persons to tell their own opinion about the relevant issues. Details of the conducted interviews are presented in Table 3 below.

Table 3. Interviews conducted for current state analysis.

Data 1. Interview	Position	Date + Duration	Documentation	Method of analysis
1	Engineering manager	19.02.2015	Tape + notes	content analysis
2	Engineering manager	15.03.2015, 1h 15min	Tape + notes	content analysis
3	Component manager	17.03.2015 30 min	Tape + notes	content analysis
4	Mechanical Engineer	17.03.2015 50 min	Tape + notes	content analysis

The main purpose of the interviews shown in Table 3 was to get more information about different activities in the OTD process. Another important goal in interviews was to identify possible problems and challenges in the current OTD process. All the interviews were tape-recorded and analyzed afterwards from the tapes and field notes. For the analysis of the interviews and document data in this study, the thematic analysis was used, with identifying the relevant themes from the interviews notes and categorizing the most important issues into groups for further analysis. The results were then used as part of the current state analysis.

Data 2

In *Round 2* of data collection, the data was collected from the workshop which was organized in order to gather suggestions and opinions for building the initial proposal. From the workshop, the data was document into the field noted which were verified with the participants in the form of a powerpoint presentation (Data 2) in this thesis. This presentation can be found from Appendix 5.

Data 3

Finally, *Round 3* of data consisted of the feedback session which collected feedback to the initial proposal. The feedback received from the initial model was used to build the final version of the Proposal. Details of discussions for Data 2 and 3 collections are shown in Table 4.

Table 4. Information about Data 2 and Data 3 collection.

	Participants	Type of Meeting	Duration	Notes
DATA 2	Director of Engineering Product Manager Engineering Manager	Workshop	2h	Memo Appendix 5.
DATA 3	Director of Engineering	Discussion	1h	Memo Appendix 6.

As shown above in Table 4, Data 2 was collected from the workshop which was held by the company management responsible for the short delivery time offer and by some key stakeholders. Data 3, was collected from a discussion held with case company director of engineering. During this discussion the initial proposed new OTD process was evaluated and improvement suggestions were given. Memo from the workshop (Data 2) is attached in Appendix 5 and memo from the discussion is attached in Appendix 6.

2.4 Validity and Reliability Plan

Validity and reliability are two main concepts of qualitative academic research. Validity relates to the outcome of the research and the quality research process and its outcomes. The question to test validity can be presented as "Was what was found a response to the question originally asked?" (Quinton and Smallbone 2006: 127). Validity also reflects to questioning the collected data and methods of analysis. Collected data should be accurate and a different interpretation needs also to be taken into account. To be able to provide valid outcome, the researcher has to consider different explanations existing in the literature and collect enough input from different stakeholders in order to avoid researcher's bias. (Maxwell 1996: 109)

To ensure validity in this study, multiple interviews with the relevant personnel need to be organized in order to gain a clear picture of the current OTD process in the case company. The analysis of the current OTD process has to be based also on the company internal documentation and on studying the relevant data from case company ERP-system. At the proposal building phase, feedback from the OTD process need to be collected from the key stakeholders for building the initial new OTD process proposal. Finally, evaluation of the final proposal also needs to be arranged.

Reliability in qualitative research relates to the quality of results of the study. Results of a reliable study would be same even if the study were conducted by a different researcher or at different point of time, or even by using different methods (Golafshani 2003). To ensure the reliability in this thesis, multiple different data sources will be used at different point of time.

The validity and reliability issues taken into consideration in this study will be eventually evaluated in Section 7.3.2.

3 Current State Analysis

This section presents the results of the current state analysis of the current OTD process of the case company. First, it shortly describes the case company and the line type chosen for the short delivery time offer. Then, it describes the current OTD process of the selected line delivery project. After that, this section studies the key tasks of the process. Finally, the key findings of the current state are summarized.

3.1 Case Company

The case company of this study is located in Finland and it has a long history in the Finnish machine building industry. At the moment, the case company has around 350 people working globally and about 110 of them are located in Finland. The company's turnover is about 80-150M€/year.

The case company main business is the delivery of complete factories, production lines, components and services for wire & cable and pipe & tube manufacturing companies. The case company has the widest portfolio of different machines, components and services for its customer segment. During its long history, the case company has sold more than 4000 extrusion lines.

3.2 Type of Line Chosen for the Short Delivery Time Offer

Since the case company concentrates on producing cable manufacturing lines, it has a wide range of different cable manufacturing line solutions to offer for many different applications. These solutions range from fiber optic coating line to extra high voltage cable manufacturing lines.

For the short delivery time offer, the case company management has chosen a single line type. The composition of this line type is described in Appendix 4. Figure 3 below present a simplified image of the line.

Figure 3. OEL 40 - Fiber Optic Cable Secondary Coating Line

At the moment, this line type for coating optic cables is offered to the customers in three different versions which provide different levels of value for the customer. These three different value levels are: (1) Enter, (2) Extend, and (3) Explore. In a simplified description, Enter line is affordable for a wider group of suppliers, and it has a limited productivity and processing speed (300m/min), if compared to Extend and Explore lines. Extend line offers an increased processing speed (500m/min) and is more flexibility for the production. Finally, Explore line is the most sophisticated piece of equipment among the three and it provides the highest processing speed (1000m/min) and possibilities for production.

Each of these value levels has its own characteristics. For obtaining higher processing speed, Extend and Explore lines contain more processing components. Currently, this EOL 40 line type is sold to customers with a standard delivery time of 24 weeks and is always configured to the customer needs. Appendix 3 contains the typical component compositions of different value lines.

3.3 Current OTD Process of the Chosen Line Type

For trying out a shorter delivery time model, the case company has selected the cable manufacturing line type described in the previous section. Before suggesting which actions need to be taken to reduce the delivery time, the current OTD process in this line needs to be investigated.

The current OTD process includes the tasks that happen between the order received from the customer and until the delivery to the customer is completed. In the case company, this process involves people from almost all departments of the company. The whole process map is illustrated in Appendix 1. Figure 4 below shows a simplified model of the process.

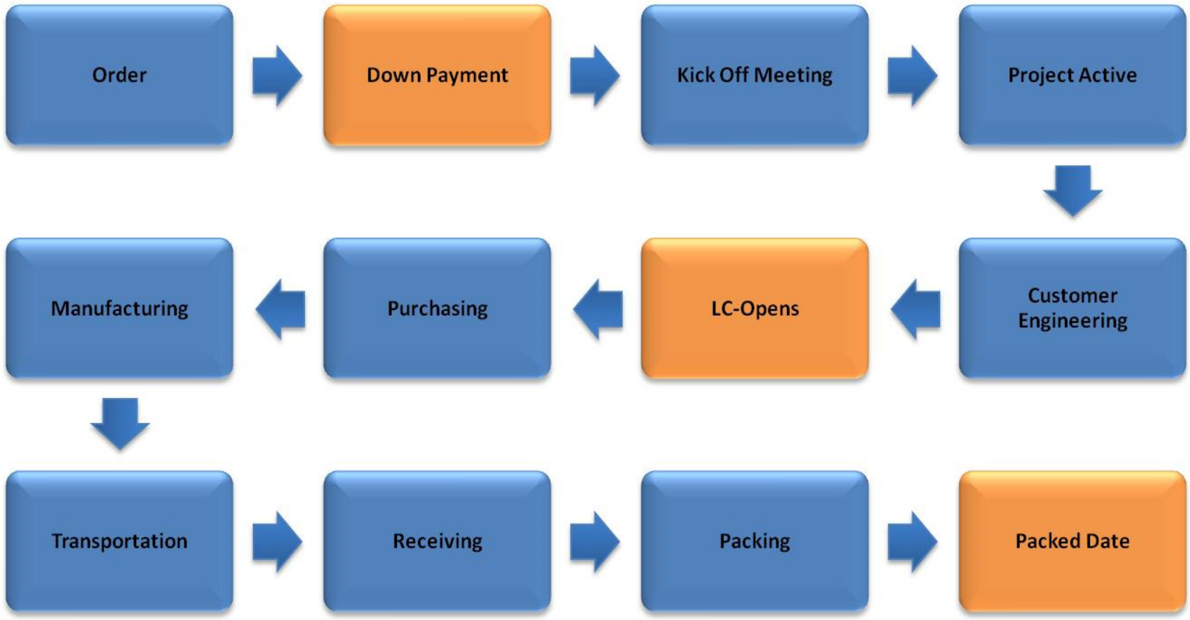

Figure 4. Simplified model of OTD process.

As seen from Figure 4, the current OTD process is divided into multiple steps. In the process, each step has to be completed before next step of the process can take place. This model gives an order for each task but it does not give any timing for any of the tasks indicated in the model.

As can be seen from Figure 4, after the order has been received, the customer has to make down payment as mentioned in the contract. After down payment (DP) is made, the project manager arranges the project kick off meeting. After the kick off meeting, the project manager makes the project active. When the project has been activated, it releases certain activities in the ERP system. Among these activities are the engineering activities which now can be released by engineering. These engineering activities include mechanical -, electrical –, and software engineering. After customer engineering has been finished, engineers who have been responsible for customer engineering create a purchase requisition lines of the components.

When engineering has created the purchase requisitions of the components, the next step in the OTD process is the purchaser's task to create the purchase orders for components manufacturers. Before purchasing is able to send the purchase orders for subcontractors, the customer must have opened a letter of credit (LC). By the LC the case company is securing its receivables from the customers.

By the company rule, LC has to be opened latest 20 weeks (5 months) before shipping, and it is one of the remarkable milestones of the OTD process, since the delivery time is normally counted from the date when the customer has opened the LC. If the LC is not opened, the purchasing activities won't be released and the delivery date of the project will be postponed. After LC has been opened, purchasing creates the purchase orders for the required components.

After the purchase orders have been created, the next phase in the OTD process is manufacturing of the components. The case company has outsourced its manufacturing of components already a while ago. Additionally, only a few of the components are made at Vantaa which means that the company is highly dependent on its subcontractor's capability of delivering these components on time. Currently, there are 5 direct subcontractors who are directly involved in the manufacturing and supplying of the components of the case line. These subcontractors are not only responsible for manufacturing of the components; their responsibility also includes packing of the components for the transportation from their site to Vantaa, and they are also expected to order the transportation.

After transportation when the components have arrived at the company premises, it is the company that becomes responsible for packing and receives the components. At the last phase of the OTD process, which happens in the case company, the final packing of the components occurs. This is the rule of the case company that all the previous actions should be finished before the packed date, defined by ERP system timing model, which probably makes another most significant milestone in the whole OTD process.

This model, although it has established itself quite a long time ago, has certain challenges which were mentioned when the current state of the OTD process for the case line was investigated. As a general comment from the interviews, two interviewed persons claimed that the actual process model is not very well descried and the responsibilities for certain actions are not totally clear.

> *Sometimes it feels like the mechanical engineer who has done the customer engineering for the mechanics is also responsible to do all unspecified tasks.*
>
> *Interviewee 3.*

> *It feels like you are member of a rally but you have to escort the stick from the start to the finish line.*
>
> *Interviewee 4.*

This finding suggests that the process responsibilities should be clearly defined to prevent miss understandings.

The details, such as timings and lead times of different activities of the current OTD process that were described on the general level above, are described in more detail in the sections below.

3.3.1 Current OTD Process Lead Time

Currently, timing of each project is performed inside the company ERP-system (IFS). The ERP system contains all the tools and models for the timing of each project. The timing models in the ERP-system are based on gantt charts and backward scheduling. In the company ERP system, every component has its own individual timing model which is fixed on the components type structure. Figure 5 below present the component timing model, as it is calculated in the company ERP system.

Valid Report Codes | Activity Hours | Gantt | Sub Project | Activity List | Activity | Resource | Tasks | Analysis

Activity ID	Activity Description	Early Start	Early Finish	Total Work Days
000	HOURS	31.1.2014	11.9.2014	160
001	TRAVEL EXPENSES BEFORE SHIPMENT	31.1.2014	11.9.2014	160
104	ENG.MEC	3.2.2014	14.2.2014	10
114	ENG.MEC.CUST	4.4.2014	4.4.2014	1
200	ENG.EL	3.2.2014	14.2.2014	10
300	ENG.SW	12.5.2014	16.5.2014	5
402	PURCH GEN PM 1000	10.2.2014	20.6.2014	95
500	CMP.IN	20.6.2014	20.6.2014	0
620	ENG.EL.DOC	20.6.2014	23.6.2014	2
900	CMP.DONE	27.6.2014	27.6.2014	0

Figure 5. Timing model of individual component in the ERP-system.

As seen from Figure 5, the component timing model includes all the significant information of component delivery. In the figure, CMP.DONE means the component packed date. CMP.IN is the wanted delivery date of the component. ENG.MEC, ENG.EL and ENG.SW mark the customer engineering timing information. All the ERP-system timing models are based on the so-called 24-weeks standard timing model applied in the case company which then has been slightly modified to fit with each component special requirements.

In the customer project engineering phase component type structures are first copied to the customer project structure. When a component structure is copied to a project, its individual timing model is also transferred to the project. At this point, the ERP system performs the backward scheduling of each component. Backward scheduling is always started from the defined packed date and then system places time windows for different activities based to the calendar based on the component timing model. The packed date is not the actual delivery date to the customer but it is decided to be a major milestone for all project activities. This has been done in order to reduce the number of delivery delays. The logic behind not mentioning the actual shipping day is that when people knew the actual shipping day they sometimes slipped from the schedules because they thought that it is okay.

Figure 6 below presents the component timings after the component has been transferred to the activated project.

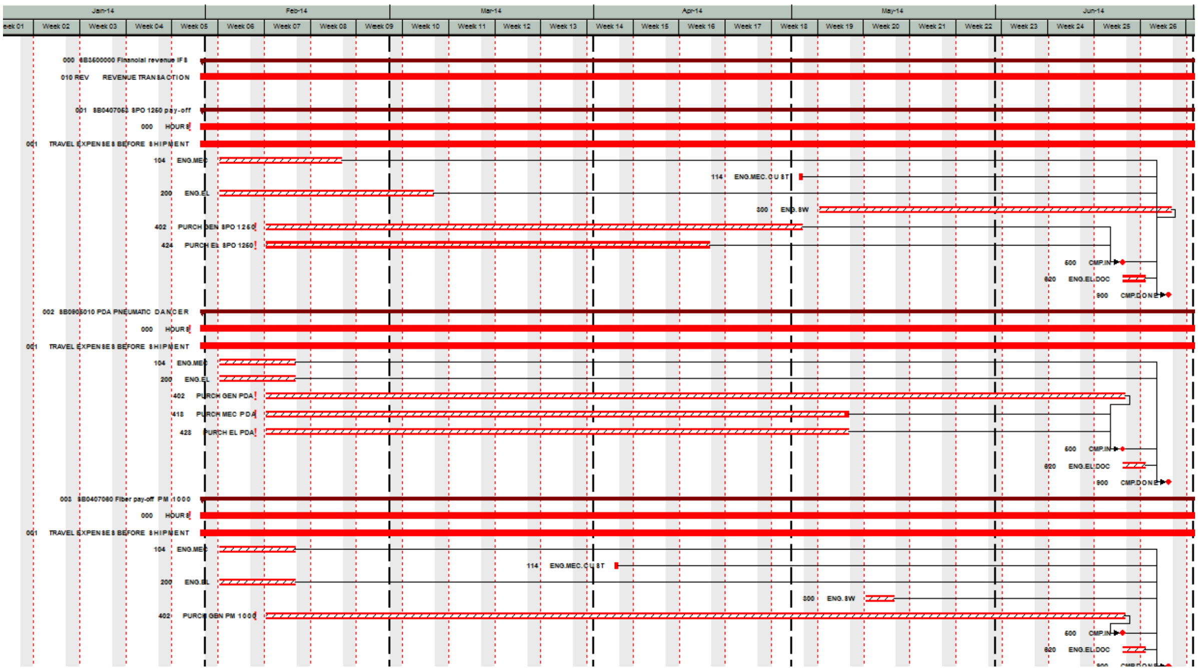

Figure 6. The project timing gantt chart from the company ERP-system.

Figure 6 shows the gantt chart presenting the timing model of three different components in a certain project. This Gantt chart gives a visual presentation of the component timing models. It shows the timing milestones of different activities during the project. As the person interviewed during Data 1 collection expressed it:

> *"First, the idea that project delivery is based on timing models is good and it works well. I think that it is almost like a standard in all industries and ERP-systems. And the feature that makes it possible to have an individual timing model for every component is great this allows us to make adjustment if component has any special features concerning delivery time requirements".*
>
> *Interviewee 2*

As interview results and examination of the ERP-system show, the current component timing models work well in the company current OTD process. However, there is a certain weakness related to a specific feature in the system. As one person stated in the data 1 interview said:

> *"The ERP-system does support only a single timing model for a component. Some components have alternative structure for example different motors and other one may have significantly longer delivery lead-time. This means that we always have to adjust the component timing model by the longest delivery time component.*
>
> *Interviewee 2*

As the interview shows, the company ERP system is not able to support more than one timing model for any component. This means that if the case company wants to deliver component faster than the actual component timing model suggests engineering manager or some other person who has the authority to adjust timing models on the customer project has to make the changes manually.

Summing up, on a general level, it seems that the current component timing model is working fine and it supports well the company's current requirement on current OTD process. However from the interviews it came out that company's ERP-system is capable of supporting only a single timing model for each component. Because the aim of this study is to cut the current OTD process lead time by 50% current timing models cannot be used. This creates a need for some kind of solution which would enable new component timing models that are able to support this new shorter OTD process lead time.

This need for an additional component timing models to support the new shorter OTD process lead time makes the most significant finding from Data 1 interviews. It is important to take into account when building an improvement proposal In Section 5.

Other activities of the OTD process are studied more precisely in the next sections, starting from the Customer engineering phase.

3.3.2 Customer Engineering Phase

Customer engineering activities include mechanical engineering, electrical engineering and software engineering processes. Engineering activities are the most time consuming part of the current OTD process conducted inside the company.

Almost every line is at least a little bit different than the previous ones; and its individual components may have even more variation on what specific features the customer want on them. For this reason, the company engineering in the normal OTD process is done by the so-called Engineered-to-Order (ETO) basis. This means that all components go through the whole customer engineering process each time order for any component is received. Basically for each project components the standard structure is copied to the project structure and after this customer specific features are chosen for the component.

Customer engineering in the company is managed by the engineering department. Inside the department, different components have been shared for different engineering groups which are: (1) line equipments, (2) extruders, (3) process equipments. These groups are responsible for their own portfolio of components. Each of these groups has around 6 persons who share the responsibility to different components. For example, the line equipment group has more than 110 different components in its responsibility.

For each component, the company has an engineer responsible for mechanical part of the component management and other person responsible for managing the electrical issues of the component. Because of the huge amount of different machines each person has multiple components on his responsibility. Persons responsible for the component type structure are usually also responsible for the components customer project engineering. Appendix 4 shows a full list of persons responsible for customer engineering of the case line components.

As it is seen from Appendix 4, a single person may have more than one component on his/hers responsibility on one project. In the current OTD process, this does not usually cause any problems because the time window for customer engineering is normally at least two weeks.

For some components, the company has more than one person who is capable of performing the customer engineering, in case the person responsible is not at work or is busy on other task. But for some components, the knowledge of other persons may not be as good as it would have to be in order to make them capable of helping others. This may cause some delays if the person who is responsible for customer project designing task is out of office for a long time. One of the interviewed persons stated that:

> *"If you have lot of work load on your responsibility you might not be able to finish customer engineering on time. Now for some components there is only a single person who is familiar with the component. If there would be a back up person then it would be possible to share the load more evenly".*
>
> *Interviewee 3.*

As mentioned above, if someone responsible for the customer project designing is absent from the office for a long time, it may cause delays. But there are also other factors that play a significant role in causing possible delays in the OTD process. As the key stakeholders (A, B, C) of the case company told:

> *"Missing information from the customer specifications is a one thing which causes extra work and it also increases the possibility for errors in customer engineering".*
>
> *Interviewee 1*

> *"Sometimes you have to wait for the missing customer specifications. This may cause delays to customer engineering. Or if you start the customer engineering before you have received all the specifications you may have to do the engineering again.*
>
> *Interviewee 3*

As these interviews shows, a missing customer specification or other missing information on the project may cause that the persons responsible for the customer engineering are not able to finish their task on time. Or the person responsible for the engineering may have to set an incomplete BOM ready for purchasing. Then this person is forced to finish the customer engineering when the missing information has been received from the customer. In such cases, there is also a greater possibility for human error and even possibility to forget to finish the engineering and sent the updated BOM top the subcontractor.

Other focal issues which were seen as a possible source for delays and unexpected costs by stakeholders were significant customer modifications. As one of the interviewed persons said:

> *Timing models are built for standard components. If there comes a significant customer specific modification then customer engineering can be in troubles to complete engineering on time. Sometimes these modifications can be dramatic.*
>
> *Interviewee 1*

As mentioned above, modification can cause problems for customer engineering. Modifications mean modifications which are not included in the components type structure and have to be designed from the scratch. It is difficult to estimate the actual required labor hours and there is also a possibility to unexpected problems in machine functions.

But customer engineering also holds a great possibility for increasing efficiency of the OTD process. At the moment, the time reserved for customer engineering is 2 weeks. When the sold components are standard the customer engineering time is much less. As it was said by one of the interviewed persons:

> *"If we are talking about a standard component time required for the process from the copying product structure to the customer project and then creating the purchase request takes only 30 minutes."*
>
> *Interviewee 2*

As the findings from Data 1 suggest, there are at least 3 significant issues which can currently cause delays for the customer engineering process. These issues are: (1) Missing customer specifications, (2) Possible modification and (3) Resource management.

After customer engineering has been finished and the component structures are set ready for purchasing, the time now comes for the purchasing department to start their work. Next section discusses purchasing activities more closely.

3.3.3 Purchasing

Purchasing is the final step before the component manufacturing can begin. The case company has outsourced all manufacturing already some time ago and for this reason most of the component are ordered as complete machines from the suppliers.

When customer engineering has created a purchase request for component purchaser is able to create the purchase order for the supplier. The only restrictive factor is the customer LC which has to be open. In this way, the case company wants to secure receivables from the customer.

For most of the components there is a named supplier which is used if there are not any urgent or special issues. If there are no any special issues in purchase orders, the purchaser is normally able to create and release purchase order for a component in a day

The most important finding from the purchasing activities is that the purchasing activities can be done in really short time if the LC has been opened and there is already a predefined supplier for the component.

3.3.4 Manufacturing

Case company has outsourced basically all of its component manufacturing. This has been done already some time ago but in recent years manufacturing has been moved from Finland to other countries in search for cheaper manufacturing costs. Appendix 4 represents the full list of the case line components and component suppliers. As it can be seen from the appendix 4 there are 5 direct suppliers involved in manufacturing of the components included in the delivery relevant to this thesis.

Supplier 1 seems to be heavily loaded for this process by manufacturing responsibility of five different components. Supplier 2 has also multiple components on its manufacturing responsibility but machines will be manufactured on two different sites. On the current OTD process suppliers have usually had about 10-20 weeks to complete component manufacturing processes. This is because the timing models have been made by using the longest delivery time components as a base for the timing model. Also for this reason case company does not have precise information about real manufacturing lead time of all of the components. Of some components the manufacturing lead time is known but it is very essential to get that information from all of the machines. Knowing the manufacturing lead times is essential for designing new OTD process. Relevant to the manufacturing lead times it should also be checked that which OEM components (motors etc) have the longest delivery time.

One of the interviewed persons also rose up the issue that suppliers do not always deliver components in time they have promised.

> *"Some of the suppliers are unpredictable on what comes to the delivery times. They may just inform that delivery time is something between 12-14weeks."*
> *Interviewee 2*

As mentioned above, some suppliers can be unpredictable and they do not always stay in the delivery time they have promised. In the new short delivery time model, it would be impossible to live with this kind of situation.

Summing up, this missing information about the actual component manufacturing lead times makes the most significant finding from the Data 1 interviews. Additionally, a high load for a few suppliers in the current OTD process has to be kept on mind and supplier capability to perform in needed time has to be checked.

3.3.5 Receiving, Packing and Delivery to Customer

The packed date determines the date when all the material for the delivery must be packed. For the packing at Vantaa site there is usually reserved a time of 1 week. Most of the machines are pre packed by the subcontractors and those only need to be fitted into the container. Some machines may not be packed in the way that those could be straight packed into the final package. In these cases components may even have to be fully opened from their original package and then repacked from the beginning. This is a time consuming process and it also creates some additional costs.

For some components, there are no existing packing instructions or the instructions are not made in such detail which would give enough information and requirements for the subcontractors.

3.4 Key Findings of the Current State Analysis

The current state analysis of the OTD process was done by analyzing company's internal documents, ERP system data and by interviewing key stakeholders of the process. There were three focal points discovered from the current state analysis: (a) a clear picture of the current OTD process and its components; (b) current 24 weeks delivery timing model; and (c) the issues which relate to the performance of the current OTD process and can have significant effect to the total length of the process. These issues can be arranged to three different categories which are related: (1) process; (2) suppliers; and (3) components. Table 6, on page 26 presents a list of the key issues related to these three categories.

By combining the current OTD process model and 24 weeks delivery timing model, it was possible to draw a value stream map (VSM) of the current process. This value stream map present the whole OTD process in a one figure and it also shows the time used to different activities in the process. This value stream map (VSM) of the current process is presented in Figure 7 below.

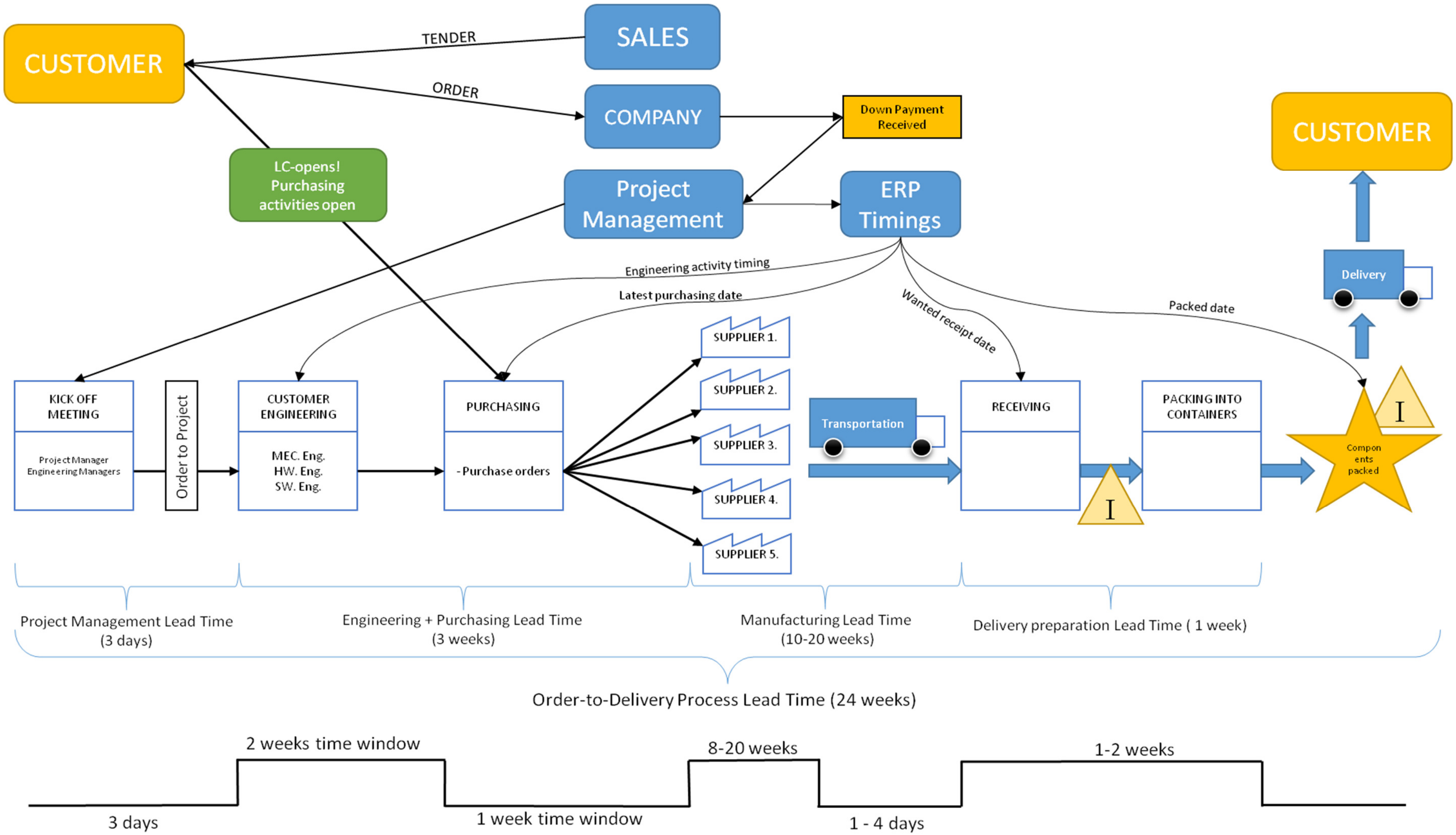

Figure 7. Value stream map of the current OTD process.

Figure 7 shows the whole OTD process as it is currently implemented. From this picture, it is easy to see the flow of information and material. This figure also shows the timing model based delivery milestones: (1) Engineering activity timings, (2) latest purchasing time, (3) wanted receipt date and (4) packed date. From this figure, it is also easy to see that the manufacturing lead time has by far the longest lead time 10-20 weeks compared to, for example, the engineering and purchasing lead time which should at maximum be 3 weeks. This figure however draws a picture of the process in the case when there are no disruptive issues.

As mentioned earlier, the findings from the CSA interviews also revealed the disruptive issues in the process which were categorized in three categories; these issues are presented in Table 5 below.

Table 5. Key issues found from the CSA which have effect on the OTD process performance.

PROCESS	**SUPPLIERS**	**COMPONENTS**
- Incomplete / Missing customer specification. - Customer commitment to the delivery (Opening of LC). - Unclear process responsibilities and process. - Customer engineering workload. - Component structures support only 1 timing model	- Unknown actual manufacturing lead times. - Capability - Commitment to delivery times	- Significant modifications - Critical Components - Quality

As Table 5 presents, the key issues which may disrupt the current OTD process performance include three types of causes. It is necessary to open these issues more detailed to understand what their possible effect on the OTD process is.

I. Process related issues

Some times for some reason project has been made active even thou the customer information is *incomplete or* there is *missing customer specification.* If the project customer specification is incomplete at the time when project kick off meeting is held some of the customer engineering activities can be delayed. If the engineering has to wait for a long time to receive missing information lots of time is wasted and possibility for delivery delay is higher.

Case company does not open any major purchasing activities before customer has opened the LC. If customer does not open LC or LC opening is delayed there is less time for manufacturing, if the delivery time is not shifted forward. In these situations c*ustomers' commitment to the delivery (Opening of LC*) stops the project.

At the moment there is no clear process map or list of responsibilities concerning certain actions in the OTD process. These u*nclear process responsibilities* can sometimes cause misunderstandings and/or delays.

Sometimes the *customer engineering work load* can be quite uneven with different people inside the same group. This is because for some components there is basically only one person who knows the component well enough. In the current 24 weeks model this is not usually a real issue but might become an issue in the short delivery time offer.

Case company is using an ERP-system delivered by IFS. The basis for all components is component structures. These structures include all the important and needed information for component delivery. These c*omponent structures support only 1 timing model.* Current timing models are for 24 weeks delivery time.

In order cut delivery time of the current OTD process issues mentioned above has to be solved.

II. Supplier related issues

In the current OTD process component timing models are made by using the longest delivery components as a base for all components. For some simple components this is actually really long but case company does not have knowledge of the actual manufacturing time of its suppliers. Because of the *unknown actual manufacturing lead times* it is hard to create new timing models or compare supplier performance.

Since the few current suppliers are heavily loaded in the delivery of components for this project, it means that poor performance capability of these suppliers can cause serious delays to delivery. Supplier's capability to perform in required time limits is therefore essential for the success of the process.

As it came out from the Data 1 interviews, some suppliers do not possibly keep their promised as for the planned delivery times. *Commitment to delivery times* is a serious issue for case company delivery performance.

Since the time used in the manufacturing process by the suppliers issues mentioned above have high importance on what comes to the performance of the OTD process. For this reason this group of findings needs to be tackled when creating the short delivery time based OTD process.

III. Component related issues

Significant modifications can cause problems because they might require considerable amount of time. These modifications may also cause extra costs if there come some unexpected problems.

Some of the OEM components have long delivery time. In the case company these components are called *critical components* because their long delivery time has to be taken into account in the OTD process. These components are usually not a problem in the current 24 weeks model but these may become issue in short delivery time offer.

If suppliers deliver components that do not fill the *quality* requirements of the case company these components may have be returned to the suppliers for repair. This may take up to 2 weeks to receive component back to Vantaa. The case company usually requires the component to be delivered to Vantaa prior 1 week before shipping to customer.

Summing up, the issues which affect the performance of the OTD process were divided into three categories which were: (1) Process, (2) Supplier and (3) the component related. In order to cut the delivery time of the OTD process, all the issues related to these categories has to be taken into account. Next section studies literature related to these findings in order to find best practice and existing knowledge to tackle the issues.

4 Reducing the Order-to-Delivery Process Lead-Time

This section discusses the findings from the literature and best practice related to the OTD process and how to make it more effective in the context of the industry. The section is divided in to three parts: First, it describes business process management as a method to continuously improve business processes. Secondly, it introduces strategic supplier relationship management in context of the effective supply chain management. Thirdly, this section overviews the mass customization concept as an effective way to manage the component structures and to reduce the engineering and manufacturing lead times.

4.1 Business Process Management

Pritchard and Armistead (1999: 10) argue that terminology is one of the difficulties with business process management. Since the term process can be found from so many different disciplines it is hard understand what business process management (BPM) actually means. Due of this, we start by defining the terms business process and BPM.

For most of the companies, the term business process comes originally from two different disciplines total quality management (TQM) and business process re-engineering (BPR). Business processes can be understood as a series of interrelated activities, crossing functional boundaries with inputs and outputs. (Armistead et Machin (1997: 886). By Hinterhuber (1995: 63) business process is a set of integrated and coordinated activities which are required for producing products or offering services.

For BPM there are several different definitions found from the literature. These definitions range from IT-focused views to BPM as a holistic management practice. Table 6 on the next page, presents some of the definitions of the BPM found from literature.

Table 6. BPM definitions found from the literature.

Author(s)	BPM Definition
Elzinga et al., (1995; 119)	Thus business process management (BPM) is a systematic, structured approach to analyze, improve, control, and manage processes with the aim of improving the quality of products and services. BPM is thereby the method by which an enterprise's "Quality" program (e.g., TQM, TQC, CQI) is carried out. The quality of the enterprise's products and services is a direct reflection of its ability to improve its processes via BPM.
Armistead et Machin (1997)	BPM is concerned with how to manage processes on an ongoing basis, and not just with the one-off radical changes associated with BPR.
Zairi (1997; 214)	BPM is structured approach to analyze and continually improve fundamental activities such as manufacturing, marketing, communications and other major elements of a company´s operation.
Pritchard et Armistead (1999)	BPM is a `holistic` approach to the way in which organizations are managed.
Smith and Fingar (2003).	BPM is a general methodology that supports the design, management, and improvement of business processes in order to raise the productivity of a company.

As the definitions in the Table 6 above show, it can be said that BPM approach is all encompassing and it is dependent on company activities like strategic elements, operational elements, use of modern tools and techniques, people involvement and, more importantly, on a horizontal focus which will best suit and deliver customer requirements in an optimum and satisfactory way. (Zairi 1997: 78)

In the context of this study BPM is seen as a holistic organizational practice by which company is able to continually improve its processes.

4.1.1 Benefits of BPM

As the definitions suggest BPM is adopted for company use to because it is proven method by which company is able to raise its efficiency and profitability. Pritchard and Armistead (1999) found on their study that many companies endorse BPM as a means to achieve business excellence. In general BPM enables "efficiency while maintaining effectiveness and complying with regulations". (Larson et Larson: 2011). Table 7, present's list of three main drivers and three main benefits achieved mentioned by the companies who participated in the authors study.

Table 7. Drivers and benefits of BPM. Adopted from (Pritchard and Armistead 1999: 12)

	Three main drivers	Three main benefits achieved
1.	The need to improve responsiveness.	Improved relationship with customer
2.	The competitive threat	Better cross-functional working
3.	The need to improve quality	A change in organizational culture

As shown in Table 7 above, the three main drivers which have forced companies to adopt are significant drivers in any company business. The three main benefits achieved could have positive impact on any company results.

4.1.2 BPM in Action

For companies BPM is the way to continuously improve and manage their key activities to be able to ensure their ability to deliver high quality standards of products and services. (Zairi, 1997: 79) But not all companies are the same. Every company has its own features.

By Zairi (1997) BPM has to be governed by the following rules: First, the process major activities have to be properly mapped and documented. Secondly, it has to be understood that BPM creates a focus on customer through horizontal linkages between key activities. Thirdly, company must have systems and documented procedures to ensure discipline, consistency and repeatability to gain quality performance. Fourthly, because BPM relies on measurement of activity to asses performance of each individual process company has to set targets and output level which can meet the company objectives. Fifthly, BPM has to be based on continuous approach of optimization through problem solving and repeating out extra benefits. Sixthly, company must use best practice to inspire the BMP to ensure that superior competitiveness will be achieved. Seventhly, company must understand that BPM is as approach for achieving cultural change and it does not result simply through having good systems and right structure in place. (Zairi 1997: 65)

As Pritchard and Armistead (1999) suggest, there is no one way to do take BPM in to action in different companies. But they say that there is a commonality of approach which can be understood. As mentioned above by Pritchard and Armistead there is no one model for implementing and start using BPM in company daily basis. Next this section gives an example of company called Rank Xerox which has implemented BPM as part of it management method.

Rank Xerox Ltd is well known for its leadership in total quality management (TQM). What drive the quality improvement affords at Xerox is initiative called "leadership through quality". Leadership through quality is based on the use of key tools including:
Problem solving -, quality improvement -, benchmarking -and self- assessment process. Zairi (1997: 72) In the context of this study problem solving process is the most significant and it is illustrated in the Figure 8.

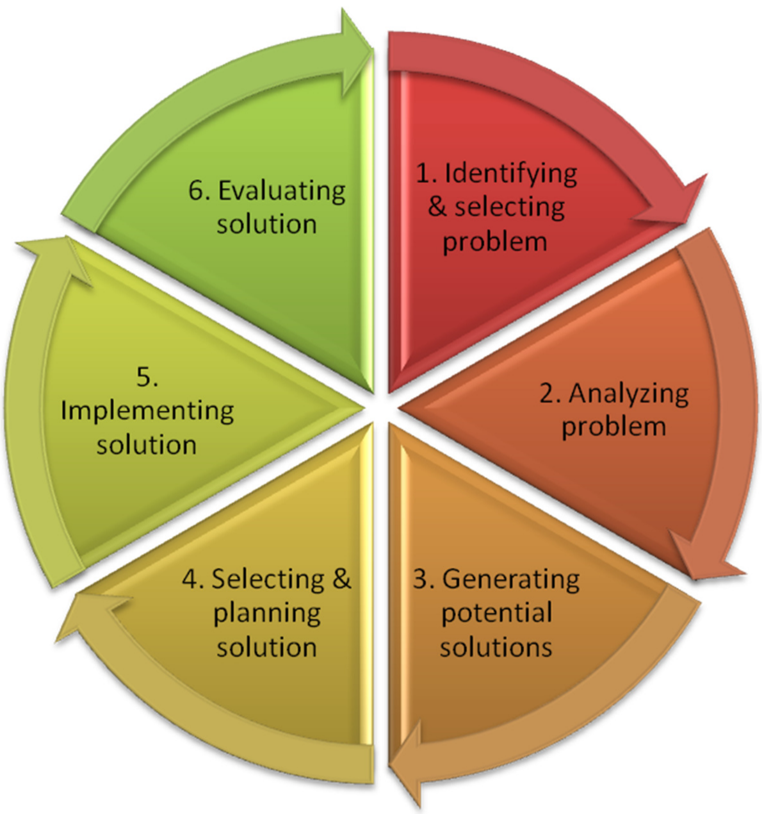

Figure 8. Problem solving process at Rank Xerox Ltd. Modified from Zairi (1997: 73)

As shown in the Figure 8, the problem solving at Rank Xerox is never ending continuous process which always start by identifying and selecting problem. After problem identification problem is analyzed and then potential solution to solve the problem are generated. Then solution to the problem is selected and planned. In the next phase this solution is implemented and in the final phase the implemented solution is evaluated. After this the process begins again from the beginning. The problem solving process can be used by people to close gaps in performance and to analyze problems, develop solutions and to create actions plans.

Summing up, BPM is a holistic organizational practice by which company is able to continually improve its processes. Factors like, need to improve responsiveness, competitive threat and need to improve quality have made companies to adopt BPM practice. The benefits many companies have actually got by adopting BPM range from improved relationship with customers to better cross-functional working and change in organizational culture. Many companies have developed their own tools for BPM which they use in their continuous development practice.

4.2 Strategic Supplier Relationship Management

Dyer et al (1998) suggest that the company ability to strategically segment their suppliers into two primary groups is the key to future competitive advantage: one group of suppliers that provide important but non-strategic inputs and another group that provides strategic inputs. Those key suppliers who provide strategic inputs are the most essential partners for the success of the companies. Ivens et al. (2013) define the key suppliers as:

> *"Those supplier relationships on which the buying company heavily depends, now or in the future".* (Ivens et al. 213:138)

Therefore, as many studies suggest, that relationships with these suppliers should be managed by different manners than relationship with the suppliers with non-strategic input. It is done due to the strategic importance of these suppliers.

4.2.1 Selecting Strategic Suppliers

When selecting strategic suppliers companies want to be sure to make the right decision because building a strategic supplier relationship is both expensive and time consuming. Also the cost of suppliers' poor performance can be huge for the company. Purchasing function has become an important function because of significant impact of material cost, increased investments in advances manufacturing technologies and growing emphasis of using Just-In-Time (JIT) production. All this requires effective decision in suppler selection and evaluation. (Sarkis et Talluri 2002:18)

To tackle this problem there are many different models available for strategic supplier selection. Sarkis and Telluri (2002) demonstrate use of method called Analytical Network Process (ANP) which is generalized from the popular Analytical Hierarchy Process (AHP). They show how companies are capable of performing strategic supplier selection process by using ANP decision model. ANP model has several advantages when compared to the traditional methods used for supplier evaluation. ANP selection process considered strategic, operational, tangible and intangible measures in the evaluating process. Table 9 below presents a summary of the factors and components used in ANP supplier evaluation process.

Table 8. Summary of the factors used in the ANP supplier evaluation process. (Sarkis et Talluri 2002: 22)

Strategic Performance Metrics	Organizational Factors
COST (Barb. and Yazgac 1997)	CULTURE (Ellram 1990)
QUALITY (Choi 1996)	TECHNOLOGY (Ellram 1990; Barb and Yazgac 1997)
TIME (Choi 1996)	RELATIONSHIP (Choi 1996)
FLEXIBILITY (Choi 1996)	

As seen from the Table 9, the amount of different factors and component used in the ANP process is extensive and it covers many aspects of buyer-supplier relationship. These factors are not important only when selecting and evaluating suppliers but also when the relationship with strategic supplier has been established and build further on. Company has to keep these factors in its mind continuously as it will be shown in the next section.

4.2.2 Building Strategic Suppliers Relationships

The problem of optimally managing suppliers has been around for a long time. Over the time two widely differing supplier management models have emerged from practice and also from academic research. The traditional view is often called arm´s length model. This model advocates maximizing the bargain power and minimizing dependence on suppliers (Dyer et al 1998: 57). This has been used by the big three car manufacturers in the USA GM, Ford and Chrysler (Liker et Choi, 2004: 104). The search for the lowest price has caused that relationship with suppliers has been most of the times confrontational. But reducing costs is just not enough anymore (Hales et al. 2011).

In contrast to the arm´s-length model, the close supplier relationship does not advocate maximizing bargain power or minimizing supplier dependency. Many studies indicate that companies are able to get more value out from their suppliers by creating strong relationships with their suppliers (Jack, E. P. et Powers, T. L. 2015). This close relationship based model is used by, for example many Japanese firms including car manufacturers Toyota and Honda. Figure 9 below, presents a comparison of the traditional sourcing model and the model based on close supplier relationship.

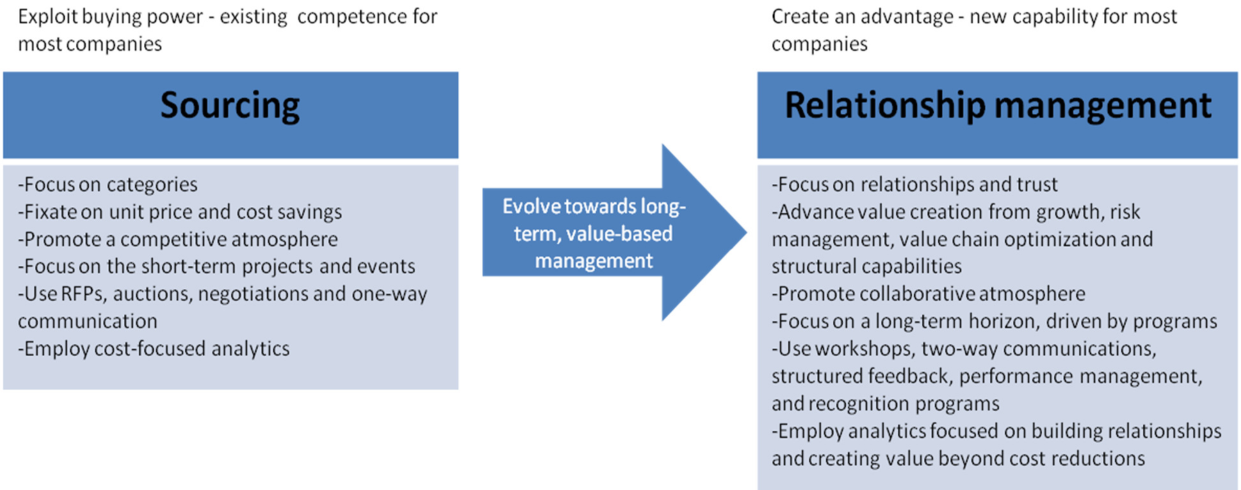

Figure 9. Sourcing compared to collaborative relationship management.

As shown above in the Figure 9, the traditional sourcing activities descried on the left side of the figure have totally different objectives compared to the model which promotes close relationship and collaboration with suppliers. Success of Toyota and Honda has been often attributed to use of this model (Dyer et al 1998; 57) (Liker et Choi, 2004).

Honda and Toyota have even successfully adopted this supplier-partnering model in the North America. While attempts of the American companies to accomplish this have not been successful (Liker et Choi, 2004). But what is the secret behind the success of these Japanese companies?

In their study, Liker and Choi (2004) found that Honda and Toyota have their own partnering models, but they had strikingly similar scaffolding. Figure 10, presents the supplier-partnering hierarchy by Liker and Choi (2004).

Figure 10. Supplier partnering-hierarchy used by Toyota and Honda. (Based on Liker and Choi 2004).

As described in the Figure 10, the supplier partnering-hierarchy model used by Toyota and Honda is extensive and multilayer task. This model suggests that: (1) companies should understand how their suppliers work by studying how they work and by learning from their business. (2) Companies should turn their suppliers' rivalry into opportunity. (3) Companies should supervise their suppliers by using reports and by giving immediate feedback when needed. (4) Companies should develop their suppliers' technical capabilities by developing their problem solving skills and by honing their innovation capabilities. (5) Companies should share information with their suppliers but sharing must be done selectively. (6) Companies should share their best practice and initiate kaizen project with their suppliers.

Toyota and Honda do not just use one or two of these elements in the Figure 10. They use all six together as a system (Liker et Choi, 2004: 108). But even using Toyotas and Hondas methods in creating close partnering strategic relationship it is not an easy road to success. It requires extensive efforts and massive commitments from both of the partners. Buyer firm may even have to overhaul purchasing processes and integrate supplier´s engineering team directly into their own processes. (Tan, K. C. et al. 2002: 627).

For building an effective and well managed relationship model, Anderson and Narus (1990) and Day et al. (2013) note that trust is an important factor in supplier-purchaser relationship and in is built by meeting or exceeding performance objectives through co-operation. By Lambert and Knemeyer (2004: 2) in partnership model both parties must have same expectations. If the expectations are different partnership is by a great change going to fail. Jack and Powers (2015) found three factors which had positive affect to managing strategic supplier relationship: Top management support, technological preparedness and relationship quality. Strategic supplier management was positively related to quality outcomes and to financial performance.

Summing up, strategic suppliers are those suppliers on which companies are now or in the future most dependent on. Literature suggests that the relationship with these strategic suppliers should be managed differently, in more sensitive and collaborating way, in order to get the most value out from the buyer-supplier relationship. Many Japanese companies, which have been successful in creating close partnerships with their key suppliers, are using so called partnering model. This model requires lots of work from both of the partners but it has provided good result on many companies.

4.3 Mass Customization and Customer-order Decoupling Point

Term Mass customization (MC) has emerged in the late 1980s when Davis (1987) published his book "Future Perfect". General term MC relates to the ability to provide customized products or services in high volumes and reasonable price trough flexible process. (Haug et al. 2009: 633) Wikner and Rudberg (2005: 624) describe MC as a compromise between ability to create customized products and provide short lead times.

In MC concept it is quite normal that some parts are manufactured while customer is waiting but quite often some parts have been prefabricated because the production lead-time is longer than the actual required delivery time. A concept which quite often has been used to capture this aped is called customer order decoupling point (CODP). (Wikner and Rudberg 2005: 624)

CODP, sometimes also called order penetration point (OPP), is defined by Olhager (2003: 319-329) as the point in the manufacturing value chain where product is linked to a specific customer order. Thereby CODP separates manufacturing stages that are forecast-driven (upstream) from the customer order driven (downstream). He points that different positioning of COPD or OPP relate to different manufacturing situations such as engineer to order (ETO), manufacture to order (MTO), assembly to order (Ato) and make to stock (MTS). Olhager (2003: 319-329)

Same kind of approach is also emphasized by Wikner and Rudberg (2005). Figure 11 on the next page, presents approach by them.

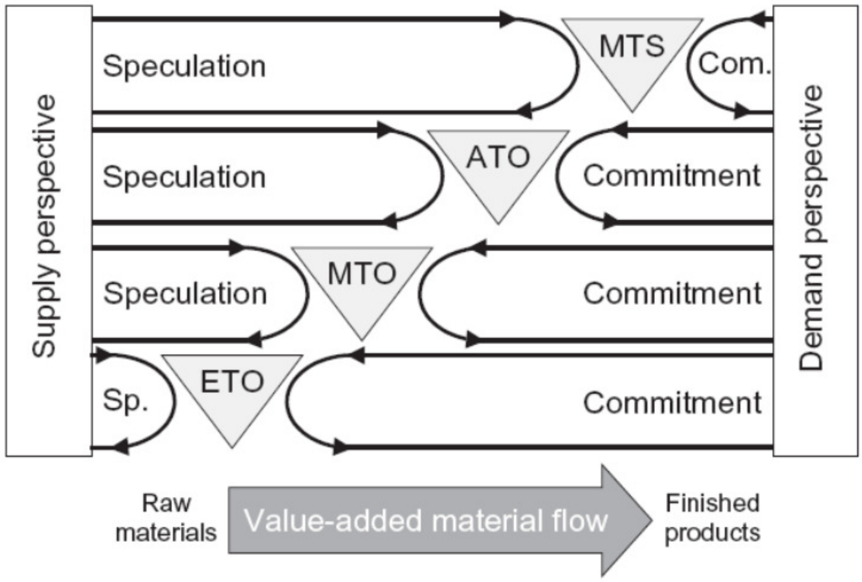

Figure 11. Linear CODP positioning by Wikner & Rudberg. Extracted from (Wikner et Rudberg 2005: 626)

As seen from Figure 11, effect of moving COPD to downstream or upstream the value-added material flow either increases the amount of speculation and creases amount of commitment or increases the amount of commitment and creases amount of speculation. Moving COPD further downstream requires that more value adding services has to be carried out under uncertainty. If we move the COPD upstream more activities can be based on actual customer order. (Winker et Rudberg 205:626) If company products have wide range of customization available and customizations enter production in early stage MTO policy is necessary. In contrast if customization enters at the late stage ATO policy can be more appropriate. (Olhager 2003)

Benefits of moving CODP forward (downstream) for companies include the reduced customers' orders delivery lead-time and higher manufacturing efficiency. Reduced lead-time is achieved because of more manufacturing activities can be done before customer order. As a negative side companies need to understand that moving CODP forward may cause higher inventories if company wants to keep the possibility of high customization for customers. (Olhager 2003)

In their study Tercine and Hummingbrid (1995) suggest that, different product environments (different positioning of CODP) indicate different opportunities for reducing lead time. In their study they say that:

> *"Firms producing products in an Engineer-to-Order environment begin the process with product conceptualization. The opportunity to reduce total lead-time for these firms begins from the reduction of product development lead times"* (Tercine et Hummingbird 1995:12).

Basically this means that, most of the companies who work by ETO basis are able to reduce their OTD process lead times by shifting the CODP forward and by doing this creating less customizable products.

Companies can also shift CODP backwards (upstream). The main driver for moving CODP backwards is to increase the knowledge of customer content. This means that higher degree of customization can be allowed. Shifting COPD usually means that delivery lead-times get longer if production lead-times stay at the same level. (Olhager 2003)

In his study, Olhager (2003) suggest a model which can be used for positioning the CODP. He claims that for positioning of CODP two major factors are significant. 1. Production delivery lead time ratio (P/D ratio) and the relative demand volatility (RDV). These two factors can be placed into a diagram and four basic situations can be identified. Both factors can range from high to low, which lead to four combinations from which to choose the product delivery strategy. Figure 12 below; present the diagram of RDV and P/D ratio.

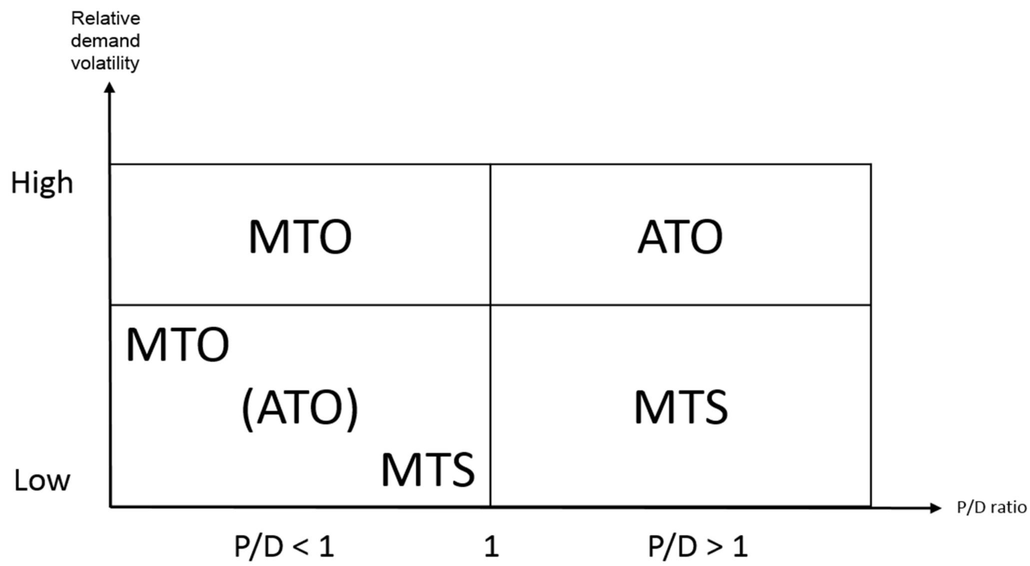

Figure 12. Model for choosing the right product delivery strategy. Adapted from Olhager (2003: 319-329)

In the figure above, when P/D ratio is 1 it means that manufacturing lead time of the product is same as the delivery lead time. This basically means that when value of P/D<1 manufacturing has to be started before customers order and when P/D>1 manufacturing can wait for customer order. If RDV is low and P/D<1 then MTS strategy is a right choice for the company. In contrast if RDV is high and PD>1 then right manufacturing strategy should possibly be ATO. (Olhager 2003)

Summing up, mass customization and by strategically positioning the CODP companies are able to reduce their manufacturing and customer engineering lead time. Thus it is also important to notice that shifting the position of the CODP has its effect on the level of mass customization company is able to provide for its customers.

4.4 Conceptual Framework of This Thesis

Section 4 discussed the literature and best practice which can be used to tackle the key issues of the OTD process. This section makes a summary of these aspects and methods. This is done by combining all the knowledge discussed in the previous section. The result is the conceptual framework of this study which is presented in Figure 13 on the next page.

Conceptual framework is a visualized version of the ideas which will be used to create the proposal and final version

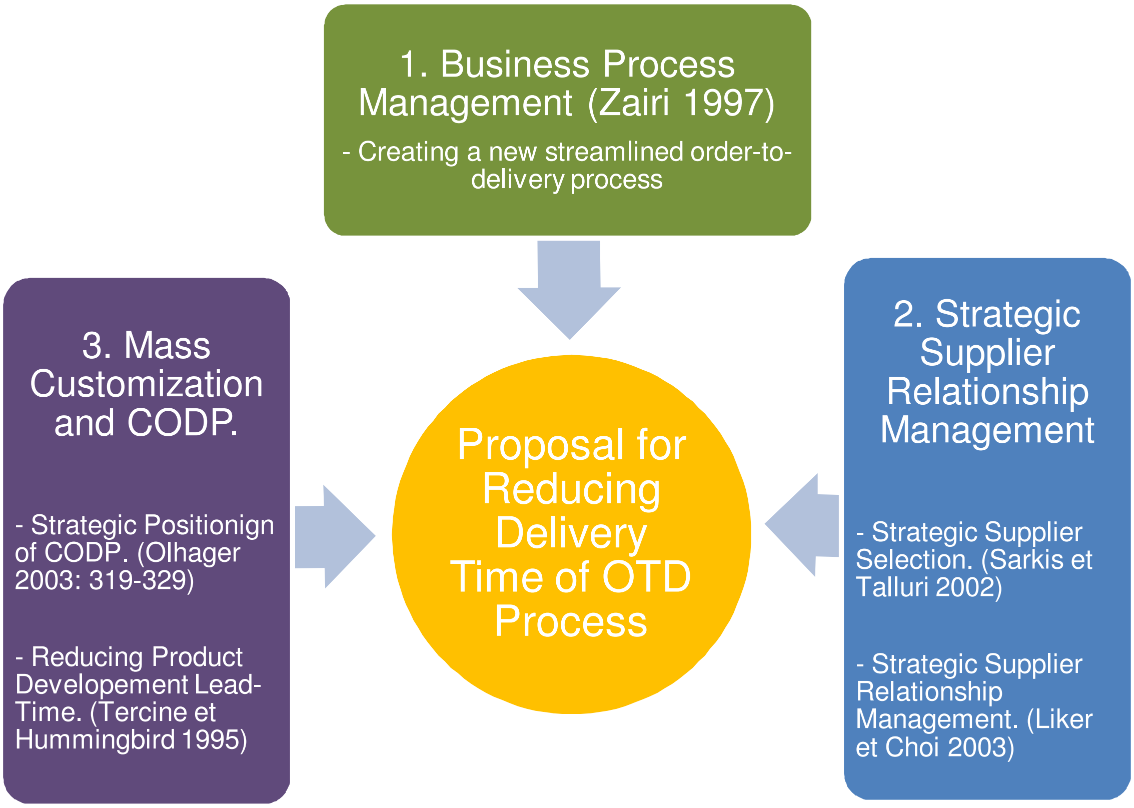

Figure 13. Conceptual framework of this study used to build proposal for cutting the delivery time of OTD process.

As Figure 13 above shows, the CF of this thesis consists of three different ideas or methods. First, BPM methods can be used to tackle the issues which relate to the problems in the process itself. Secondly, strategic supplier relationship management can be used to tackle the possible problems which case company can have with its supplier. Thirdly, ideas from mass customization and strategic positioning of CODP can be used to solve problems which relate to the actual components which are included in the actual delivery.

In the next section, this study utilizes the conceptual framework to tackle the business problem of this thesis and build the proposal for the case company.

5 Building Proposal for the Case Company

This section presents the proposal for the case company of a streamlined OTD process. First, this proposal includes a new process timing model which can be used as a basis for building the timing models for the components in the ERP-system. Secondly, this proposal shows how the case company could reduce the customer engineering and component manufacturing lead time. Finally, this section discusses the ways to tackle the problems which relate to the current company ERP-system and component management.

5.1 Drafting Proposal for Reducing the Lead Time of OTD Process

The CSA performed earlier in this study revealed the weaknesses and points that need to be improved or changed to make it possible for the company to reduce the delivery time of OTD process by 50% from 24 weeks to 12 weeks.

CSA showed firstly, that case company has some issues in the OTD process which make it inefficient and unsuitable for the new short delivery time based offer. For this reason BPM should be adopted by the company and new streamlined process should be created. Secondly, CSA revealed that case company has some issues with its suppliers which make it hard to achieve the goal of reducing OTD process lead time by 50% as the goal of this is. For this reason strategic supplier relationship management methods should be used for supplier selection and supplier performance leveraging. Thirdly, from the CSA it came out that there are some issues related to the components which are included in the selected short delivery time based line delivery. For this reason methods of mass customization and strategic positioning of CODP should be used to reduce the required engineering and manufacturing lead times.

5.2 Findings of Data Collection 2

For drafting the initial proposal, the company management that is responsible for the new short delivery time based offer conducted a workshop where they listed the requirements and features which has to be included in the new process. They also made decisions which concern the total delivery of the OTD process. The memo from this workshop is attached as Appendix 5. This memo is used as Data 2 for building the initial proposal for the streamline OTD process. The core elements of the process are discussed below one by one.

5.3 New OTD Process Timing Model

The original OTD process timing model is based on the 24 weeks delivery time (6 months). This current model has allowed the company to be quite flexible with the timing for many tasks, so that the delivery delays are currently rare. As the goal of this thesis is to reduce the delivery time of the OTD process by 50%, there is only a 12-week time window left for all the OTD process activities.

Based on Data 2, the new OTD process timing models was the first thing discussed and build as part of the new, shorter OTD process. This model can then be used as a frame for the other OTD process activities and it also helps to visualize the process itself. Building of the new 12-week (3 months) process was started by dividing the 12 weeks' time into parts allocated for different process activities of the line delivery process. Figure 14 presents the first version of the new timing model.

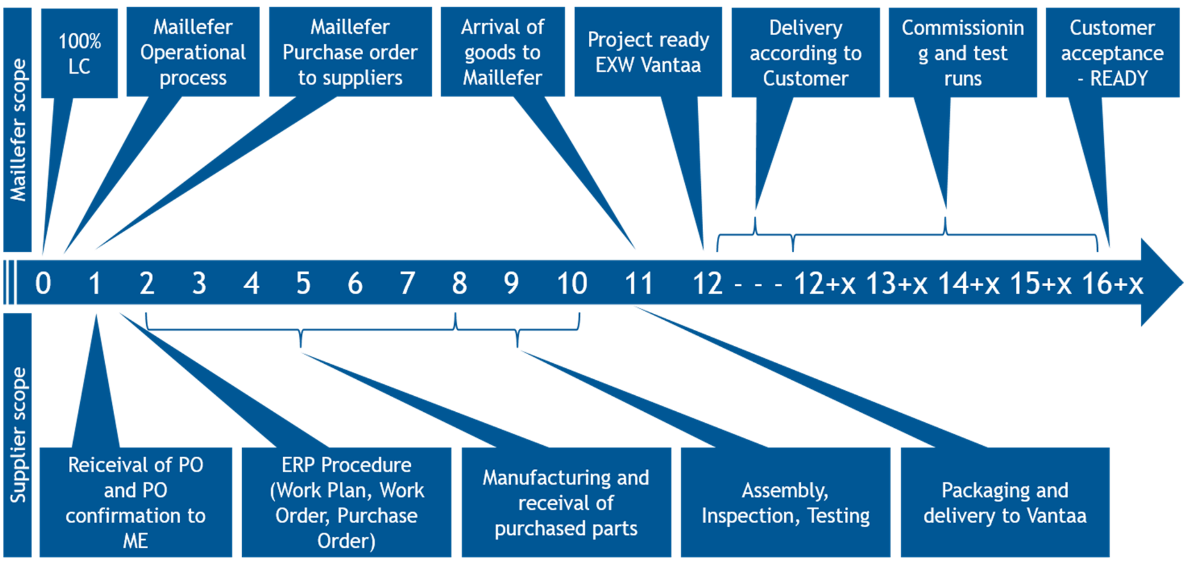

Figure 14. The new 12 week's OTD process timing model. (Case company 2015 Memo).

As seen from Figure 14 above, the process has been divided into activities and each activity has been allocated a certain time in which it should be completed. In the model, week 1 has been assigned for the operational processes which include: (1) project management tasks, and (2) contractual issues. Week 1 also contains the customer engineering and purchasing activities. Then, the next 10 weeks are signed for suppliers manufacturing procedures. After manufacturing has been completed, the desired components should arrive to Vantaa, a week prior to shipping to the customer.

5.4 New OTD Process Draft

After specifying the timing, the new OTD process proposal was created by using the methods of BPM. In this study, the model introduced by Zairi (2005) was selected among many different models used by different companies to leverage the performance of their processes. In this study, the problem-solving process by Rank Xerox presented earlier in Section 4.1.2 was also used to create the initial OTD process draft.

To draft the new process, first, the actual problems were identified. Problem identification was already done during the CSA and the findings suggested that the biggest issues in the current OTD process are: (a) Incomplete / Missing customer specification, (b) Customer commitment to the delivery (Opening of LC), (c) Unclear process responsibilities, (d) Customer engineering workload, and (e) Component structures in the company ERP-system that support only one component timing model.

Secondly, the key issues affecting the process efficiency were analyzed to find out the root cause of the issues. Table 9 presents the findings from this analysis.

Table 9. Analysis of the issues which may cause problems in the current OTD process.

	ISSUE	WHY	WHAT
a.	Incomplete / missing customer specifications	Because projects have been made active before all customer specifications have been received. This might be because there has been rush of sales to get the sales deal closed.	Missing customer specifications may cause significant delays for completing customer engineering.

b.	Customer commitment to the delivery (Opening of LC),	For some reason customer has not opened LC.	Purchasing is not able to create purchasing orders
c.	Unclear process responsibilities and process	Process is not documented and descried. Responsibilities are not well defined.	Misunderstandings and inefficiency.
d.	Customer engineering workload	For some components case company has only 1 person who is well familiar with the machine. Some machines have complicated component type structure.	Company and OTD process is highly dependent on these persons.
e.	Component structures support only 1 timing model	This is a feature of company ERP system.	Current component structures do not support new short delivery time based offer.

After analyzing the issues which cause problems to the current OTD process, as shown in Table 9 above, the third phase in the proposal building was initiated. At the third phase, potential solutions to solve these problems were generated. The results are summarized in Table 10 below.

Table 10. Potential solutions for the problems in the current OTD process.

	ISSUE	HOW TO PREVENT
a.	Incomplete / missing customer specifications	Set gates which determine what has to be done before process can jump to next action. Predefined components and delivery scope.
b.	Customer commitment to the delivery (Opening of LC),	100% LC at the same time with PO or right after PO. Full payment at the same time with PO.
c.	Unclear process responsibilities and process.	Define responsibilities. Define process
d.	Customer engineering workload	Divide customer engineer task evenly and train back up persons for all components. Automate some steps?
e.	Component structures support only 1 timing model	Create new component structures and timing models for the short delivery time offer components.

After generating potential solutions, the planning of the new OTD process was done. The initially proposed OTD process is presented in Figure was build. As it can be seen from Figure 15, in the proposed model first four days each have its own actions. These actions can be completed each in one day but it requires that each person responsible knows what he/she must do and everybody must be at work.

If summarized, after collecting suggestions for the new process, the changes include the following points. Typically, when sales have received order and 100% LC has been opened by the customer, the sales confirm to project management that project can be opened. On the second day after this confirmation, the project manager turns the sales contract into the project and opens all project activities. This third day has been reserved for engineering activities. In order to complete customer engineering in one day, the predefined short delivery time product structures are loaded to the project and set READY FOR PURCHASE. These predefined component structures are described in the next section. On the next day after engineering has been completed, the purchaser creates PO`s for predefined suppliers. Suppliers then have approximately 10 weeks to complete manufacturing. Then, during week 11, all the components should arrive to the case company facility at Vantaa. Week 12 is reserved for packing and other shipping preparation activities.

This new proposed logic for the shorter time-to-order process is shown in Figure 15 below.

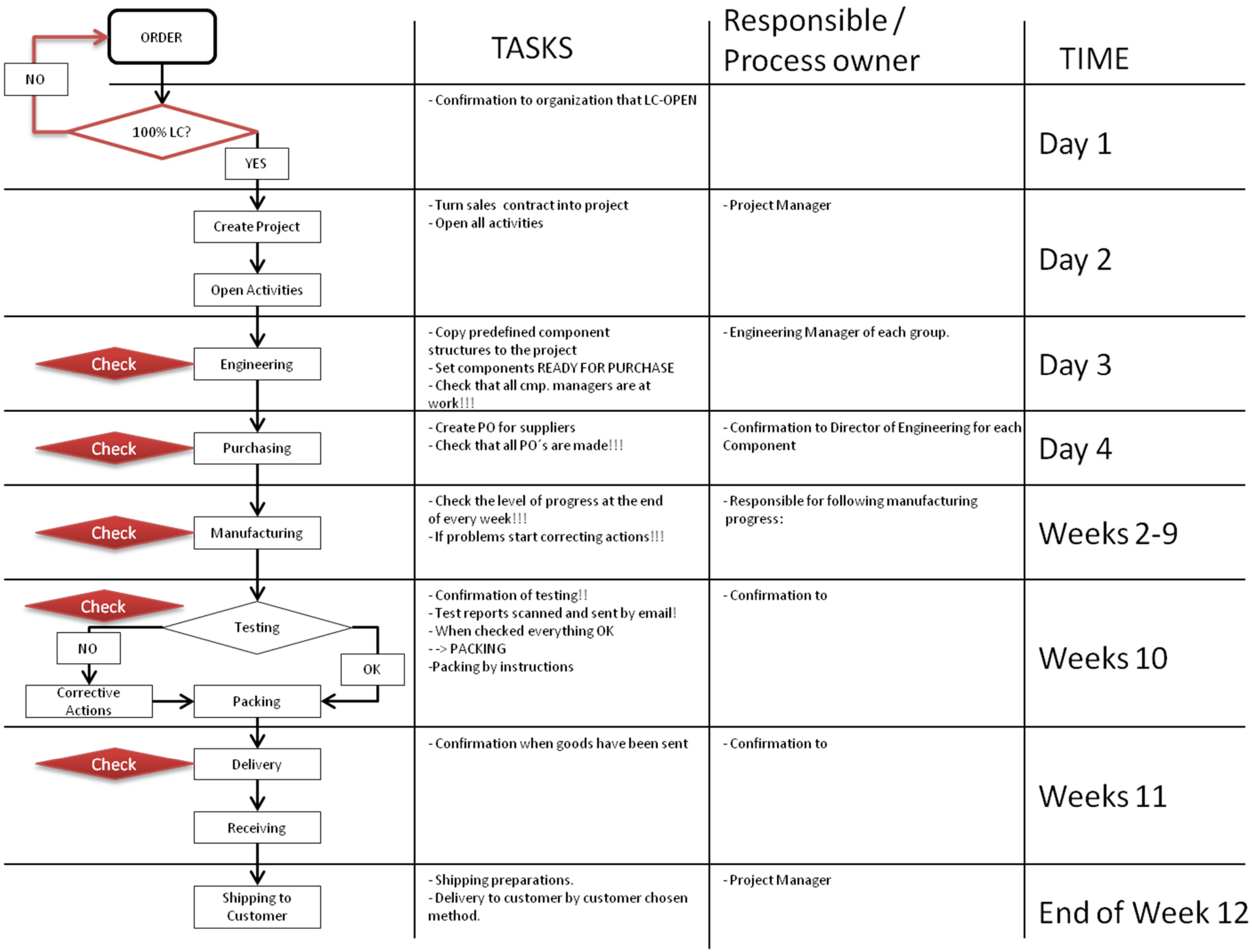

Figure 15. Initial proposed OTD process.

5.5 Component Manufacturing Strategies and CODP

As mentioned earlier in the CSA, the case company is at the moment working on the ETO (engineer-to-order) basis and many components have been customized to fit customer specifications. Due to this reason, the documentation that goes to the supplier does not stay the same, and suppliers have to check the documentation every time. At the work shop were from data 2 is collected company management and business owners made a decision that the line for short delivery time based offer is provided only for pre agreed acceptance products. This decision provides some guidelines for building component delivery strategy and component structures.

5.5.1 Component Manufacturing Strategies and CODP

As Olhager (2003) described in his study positioning CODP affects to customers´ order delivery lead time and to production efficiency. Tercine and Hummingbird (1995) suggest that for companies working by ETO basis the process should start with reducing OTD lead-time by conceptualizing product and move to MTO (manufacture-to-order) work basis.

By the decisions made in the workshop, from where Data 2 was collected, a short delivery time offer is provided only with predefined components and only for predefined acceptance parameter in the time limits of 12 weeks. Outside this time window, the customer is able to ask for modifications. This decision makes it possible to create fixed components type structure to the company ERP-system.

5.5.2 ERP system Component Structures

As mentioned in the earlier section, there was a decision made that only predefined components are offered for the customers in the time limits of 12-weeks. By using this information, a new short delivery time component type structures proposal of the new short delivery time component sales and the engineering structure was created. Figure 16 presents the proposed model for the component engineering structures.

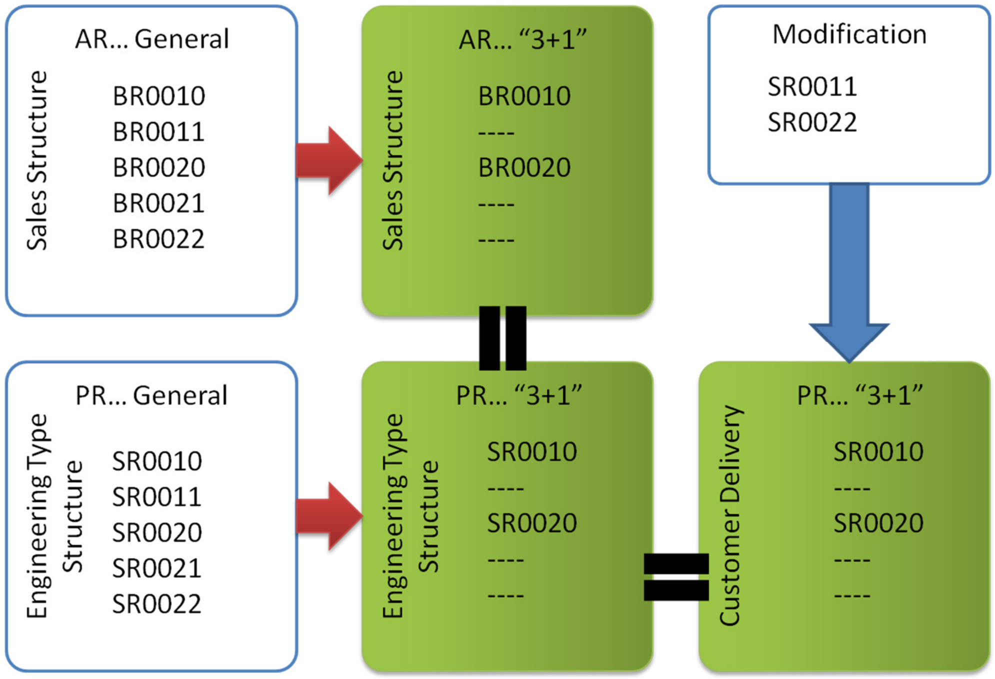

Figure 16. Component engineering and sales structures for the short delivery time offer. (Case company 2015 Memo)

This new model presented in Figure 16 above is based on the existing component engineering and the sales structures; but from the sales and engineering type structures certain options have been removed. This makes it possible to complete the customer engineering task by applying the copy-paste approach. By using this model, much more flexibility can be achieved to the customer engineering because the person who transfers the component structures to the customer project basically do not have to have any knowledge of the component. This model would also make the live for suppliers much easier; therefore with that new process, the case company is able to offer the fixed manufacturing documentation and the suppliers do not have to every time study the hole documentation before they can start the manufacturing. If the customer has asked for some modification or customization, these would be offered and completed outside the 12 weeks time window.

5.6 Manufacturing Lead Times and Supplier Engagement

As mentioned earlier in this thesis, the case company has already some time ago outsourced all its component manufacturing for multiple suppliers. Originally, these suppliers were located mostly in Finland but in order to further cut manufacturing costs, manufacturing has been transferred to lower cost countries, mostly inside Europe.

In the new short delivery time offer, these suppliers will have an important role because the manufacturing lead time makes the biggest part of the whole process. If the suppliers chosen for this process are not able to keep their schedules in order, it makes a huge problem for the case company and also for the whole process. For this reason, it is important for the case company to start building strong relationship with it suppliers.

In the workshop, the case company made an initial decision about which components will be given for which supplier. Table 11 presents the initial list of the suppliers and the components.

Table 11. Components and suppliers chosen for the short delivery time project.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
SUPPLIERS	
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As seen from the Table 12 above, there are two suppliers who are quite heavily involved in this project by having multiple components on their responsibility. Performance of these suppliers is essential for the case company, therefore it is important that company relationship with these suppliers is in a good shape.

For building suppliers engagement to this project supplier commitment process was created. This supplier commitment process is consisted of nine steps which are described in Table 12.

Table 12. Supplier commitment program.

	STEP	WHAT
1.	Creating commitment to the project.	Discussion with supplier about supplier commitment to this project. Managerial level discussions involved to build trust.
2.	Investigation of manufacturing lead times and cost.	Suppliers selected to the project perform investigation in which they sort out the current manufacturing lead times of the components they will be responsible of.
3.	Investigation of purchased parts lead times and cost.	Suppliers selected to the project perform investigation in which they sort out the delivery times and cost of the OEM parts used in the components. For example motors, gearboxes etc.
4.	Plan for shortening and reaching needed lead times.	For the component which manufacturing lead time is found to be more than 10 weeks supplier and case company together make a plan to shorten and reach the needed manufacturing lead time.
5.	Plan for needed storage for reaching needed lead times.	Components which manufacturing lead time are extensive and there is not found good plan to shorten its manufacturing time possible plan for possible storage is created.
6.	Budget planning and process creation.	
7.	Agreement and “contract” signature.	Agreement with suppliers and case company about the binding delivery times for predefined component structures.
8.	Process and readiness audit.	
9.	Ready for 10 weeks delivery time.	Agreement with the suppliers that everything has been

As described above in Table 12, the supplier commitment program is a nine step program which is meant to reinforce the suppliers' commitment. The main idea of this program is to share information between the case company and supplier. During this program, the component manufacturing lead times will be also studied and possible problems found are then solved in co-operation with the case company and the supplier. By this process, trust between the case company and the supplier should became stronger. During the final steps, after all the problems are solved, the suppliers should be able to give fixed manufacturing lead times for the components.

The next section discusses the validation of these proposals and after the validation final proposals are discussed.

6 Validation of the Proposal

This section discusses the feedback received from the initial OTD process proposal. By using the feedback received from the discussion, this section builds the final proposal of the OTD process. Finally, this section gives some instructions for the case company about the next steps which should be taken for ensuring the performance of the new OTD process.

6.1 Findings of Data Collection 3

For validating the initial proposal, a discussion was held with the case company manager who is responsible for the short delivery time based offer project. This section describes the feedback (Data 3) received from the validation discussion. Memo of this discussion is presented in Appendix 6.

6.1.1 OTD Process Timing Model and Component ERP System Type Structures

At the validation phase, the proposed timing model was discussed and evaluated. By using the initial proposal as a template, a general component timing model was created to the case company ERP-system. Figure 17 below presents the final proposed component timing model as it is in the ERP system of the case company.

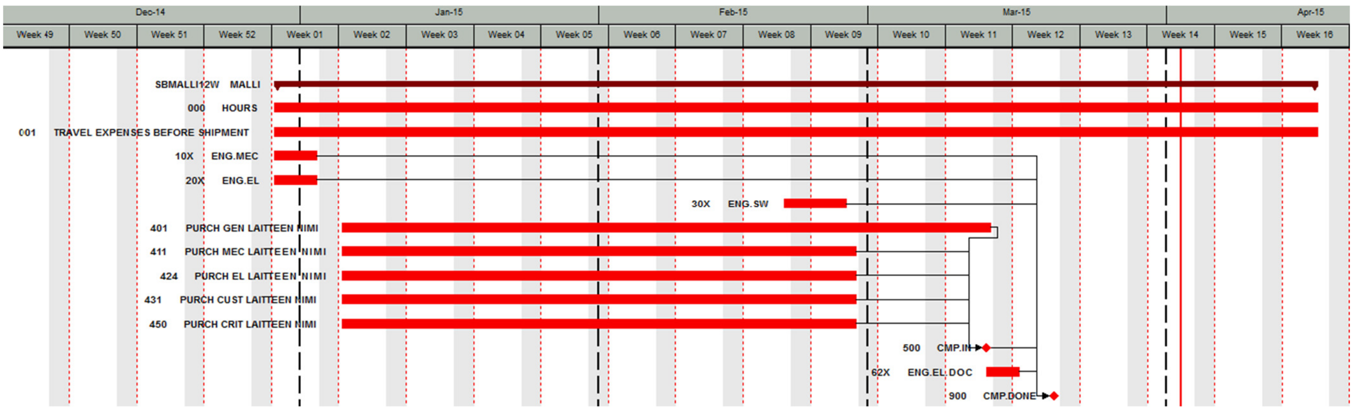

Figure 17. Final proposed component timing model. (Case company 2015 Memo)

As it can be seen from Figure 17, week 01 has been reserved for customer engineering activities. From the start of week 02, the manufacturing activities by the suppliers begin.

For the activity *401 PURCH GEN,* the time of ten weeks has been reserved. PURCH GEN is the activity which is used when the component is delivered as completely manufactured by the supplier. This means that component is also delivered as a fully functioning unit. Other activities below the *401 PURCH GEN activity,* which have 2 weeks less time, are the activities for electrical cabinets and mechanical components, mostly OEM. For these components, it was decided that it is good to have some time for testing.

The proposed model for creating the new component engineering and sales structures was also accepted well by the case company management. The proposed model requires that, for all the components included to the short delivery time offer, the new component engineering and sales structures must be created. It was highlighted that this general component timing model can then be copied to the new component type structures which will be created for the components included in the short delivery time offer.

6.1.2 Manufacturing Lead Times and Supplier Engagement

The supplier commitment program was accepted by the case company management and it has already been started. The management thought that it is a good idea to start engaging the suppliers early during the process. Especially the idea that the case company and supplier together should solve out the possible problems was thought to be good.

6.1.3 OTD Process

The initial proposed OTD process was approved by the case company management; they also expressed a wish that the OTD process flowchart should be made more detailed. By using the initial model as a base a new OTD process, the flow chart was created. This OTD process flow chart is presented in Figure 18 on the next page. As it can be seen from Figure 18, the new OTD process flowchart shows all the steps that should be done in the process, and it also show that which part of the organization is responsible for each step. The flow chart can be later filled with names of the persons who are made responsible for each step.

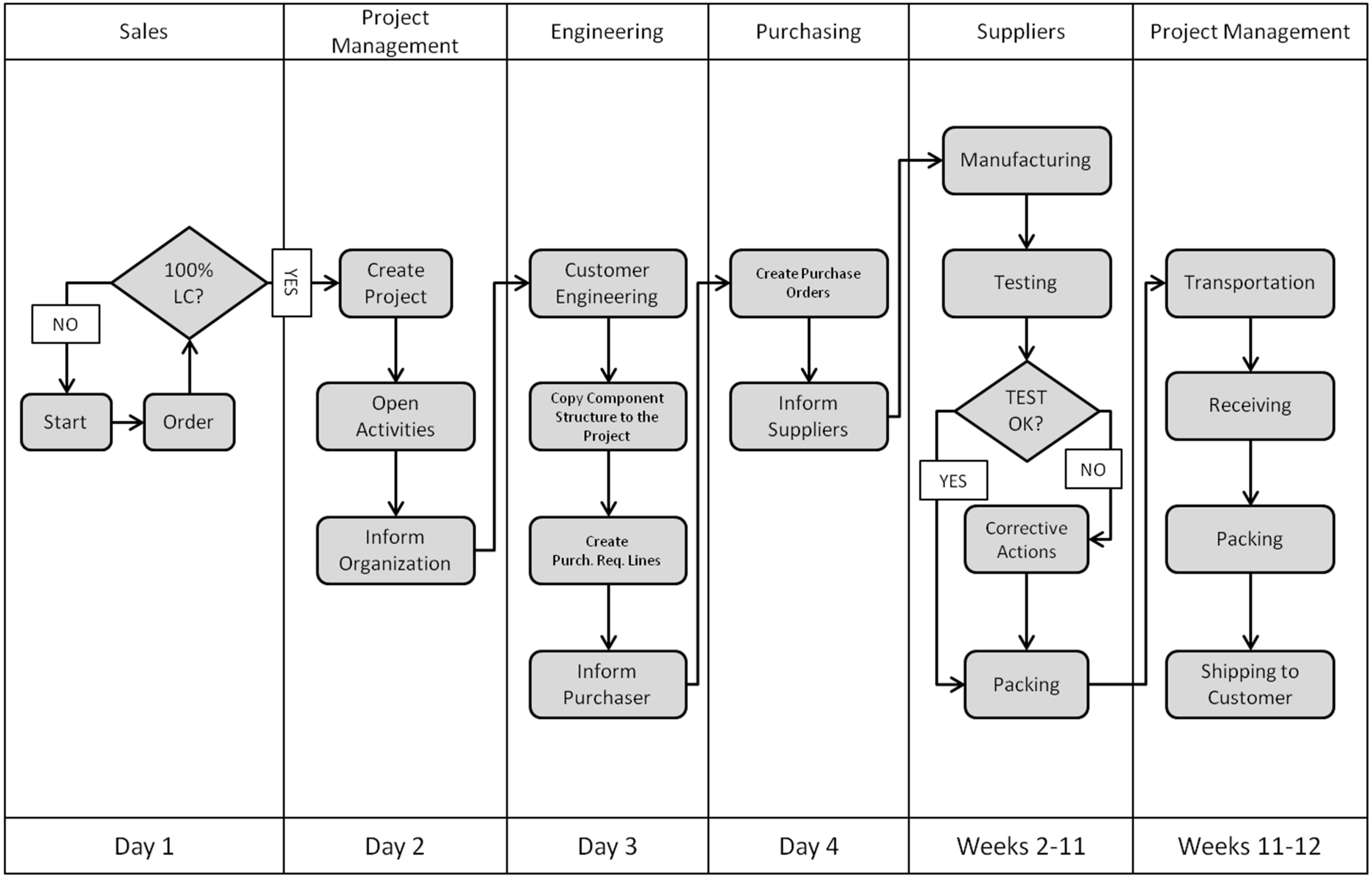

Figure 18. Final proposed OTD process.

7 Discussion and Conclusions

This section contains the discussion and conclusions of this thesis. First, this section discusses the summary and then secondly, practical and managerial implications. Thirdly, it evaluates the outcome and objective of this thesis. Finally, the reliability and validity of this thesis are evaluated.

7.1 Summary

This thesis concentrated on developing a new OTD process for the case company. The objective of this thesis was to create a proposal of new OTD process by which case company could reduce the lead time of the current OTD process by 50%. This new shorter OTD process is needed by the case company because it has planned to launch a new short delivery time based offer for a certain line type. This short delivery time offer is part of the company competitive differentiation strategy.

This study proposes a new OTD process by which the case company could be able to reduce the delivery time of the OTD process by 50%. In the new OTD process, the focus is placed on reducing the lead times for: (1) the process related issues, (2) the case company supplier related issues, and (3) the issues which are related to the components which are included in the selected line composition delivery. These issues were revealed by the current state analysis which was conducted by interviewing the stakeholders and by studying the company internal documents and data in the case company ERP-system. The findings from the current state analysis led to the development of three proposals by which the case company would be able to tackle the issues related to: (1) the OTD process, (2) the suppliers, and (3) the components. These proposals were then evaluated by the company management and the final proposal of OTD process was created.

In the validation of the proposals, the case company management evaluated and accepted the initial proposals quite well. Only small improvements were suggested to the final proposed models; as a result, the final proposed OTD process was made more detailed and precise. The initial proposed component timing model was used as a basis for creating the final component timing model which was then introduced into the case company ERP system. The proposal for committing suppliers to the new process was not changed from the initial proposed model. Additionally, the initial proposal for the component sales and engineering structures was kept as it was proposed initially.

7.2 Recommendations / Action Plan

Before the case company should start offering the new short delivery time offer, it is necessary for the company to consider taking the following step. First, to verify performance of the new proposed OTD process. Process verification can be done in multiple steps but it is important that all parts of the new OTD process are tested and/ or simulated before taking them into practice. Table 13 below presents other steps that should be taken in order to ensure the performance of the new OTD process.

Table 13. Action plan for establishing the new OTD process.

STEP	WHAT	RESPONSIBLE
1.	Start project for creating new component engineering and sales structures to the company ERP system.	Director of Engineering
2.	Start the supplier commitment program to ensure the supplier engagement to the project. Solve possible component manufacturing lead-time related issues.	Director of Operations
3.	Establish the team who is responsible for the short delivery time offer projects. Share responsibilities for different actions and simulate process in the ERP system.	Director of Engineering Engineering Managers
4.	Check that everything is ready?	Director of Operations Director of Engineering
5.	Simulate the whole process. If possible simulate the whole process by actually ordering all the components.	Director of Operations Director of Engineering

Simulating and testing the whole process is essential, and by doing it, the case company would be able to reduce the risk of any possible failure during the first actual customer delivery. After the testing, the results should be analyzed and possible weaknesses corrected.

7.3 Evaluation of the Thesis

This thesis proposed a new OTD process by which the case company should be able to reduce the delivery time of the current OTD process by 50%. The new model included actions which considered three different aspects of the OTD process: (1) process, (2) suppliers, and (3) components. For the case company, it is important to implement the whole proposed OTD process because all those three different areas have their own effect to the performance of the process, and all these three factors are affecting each other.

Even though this study made a suggestion of a new OTD process, it is yet impossible to say if the case company is able to reach the goal of three months OTD process lead time, without trying it in practice. To verify and prepare for this, the case company has to simulate and test the new OTD process in real life.

7.3.1 Outcome vs. Objective

The objective of this study was to create a new OTD process by which the case company should be able to reduce the delivery time of the current OTD process by 50%. The results of this study gave the case company a number of improvement suggestions which will all make an effect on the different part of the OTD process performance. So it can be considered that the result of this study did meet the objective, although the real business impact for the case company can only be evaluated after testing the new suggested OTD process in a real life situation. After testing it would be possible to make the final evaluation of the performance of the suggested OTD process.

7.3.2 Reliability and Validity

Validity and reliability of this study were ensured by taking multiple steps. To improve validity of this thesis, all the data collection were described in detail. Each interview was also documented by tape recording it and also by making field notes. The recorded material was then used to verify the correctness of the field notes. The related questionnaire used in the interviews is made available in the appendix of this study. The conclusions made during the study were based on multiple sources which makes also improves the validity of this study.

The reliability of this study was ensured by: (1) using multiple sources of data, (2) by conducting 3 rounds of data collection, and (3) by applying established theory. Multiple data sources included interviews, company internal documents and data from the case company ERP system. Data for the study was also collected at different points in time. First, Data collection 1 was conducted during the current state analysis; second, Data collection 2 was done when the initial proposal was build, and the final Data collection 3 was collected when the initial proposal was validated by the case company management. The theory in this study was based on exploring the existing knowledge and literature published of the relevant topics.

7.4 Closing Words

As the competition in most of the business and industries is getting ever more fierce, it is important for companies to continuously improve their performance to be able to win against their competitors. As this study has shown, when designing a new process to improve the old one, it is important to carefully analyze the whole process in order to find the issues which are affecting the total performance. Improving just one of these issues may not create significant results because the issues might be linked together. But when all the issues are captured and improved together, as part of a holistic process, the result can surprise positively.

References

Anderson, J.C. and Narus, J.A. (1990), A Model of Distributor Firm and Manufacturer Firm Working Partnerships. *Journal of Marketing,* Vol. 54 No. 1, pp. 42-58.

Armistead, C. et Machin, S. (1997). Implications of Business Process Management for Operations Management. *International Journal of Operations & Production Management.* Vol. 17, No. 9, pp. 886-898.

Davis, S. M. (1987). Future Perfect. *Addison-Wesley Publishing, Reading, MA.*

Day, M. et al. (2013). Trust and Relational Embeddedness: Exploring a Paradox of Trust Pattern Development in Key Supplier Relationships. *Industrial Marketing Management.* Vol. 42, Iss. 2, February, pp. 152-165.

Dyer, J.H. et al. (1998). Strategic Supplier Segmentation: The Next "Best Practice" in Supply Chain Management. *California Management Review.* Vol. 40, No. 2, pp. 57-77.

Elzinga, D.J. et al. (1995). Business Process Management: *Survey and Methodology. IEEE Transactions on Engineering Management*, 42(2), pp. 119-128.

Forslund, H. et al. (2008). Order-to-delivery Process Performance in Delivery Scheduling Environments", *International Journal of Productivity and Performance Management*, Vol.58 Iss 1 pp. 41 – 53.

Frohlich, M. T. and Westbrook, R. (2001). Arcs of Integration: An International Study of Supply Chain Strategies. *Journal of Operation Management.* Vol. 19. 185-200.

Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report*. Vol. 8 No. 4, 2003, pp. 597-607.

Hales, M. et al. (2011). Time to Tell Your CPOs to Collaborate with Suppliers: How to Create Value by Collaborating Inside and Outside the Organization. *A.T. Kearney.*

Harland, C.M (1997). Supply Chain Operational Roles*. Integrated Management Systems,* Vol. 8 (2), 6-14.

Hinterhuber, H.H. (1995). Business Process Management: *The European Approach. Business Change & Re-engineering.* Vol. 2, No. 4, pp 63-73.

Ivens, B. S. et al. (2013). Managing and Developing Key Supplier Relationships: An Introduction to the Special Issue, Discussion and Implications. Industrial marketing management. Vol. 42, Iss.2 pp.135-145.

Jack, E. P. et Powers, T.L. (2015). Managing Strategic Supplier Relationships: Antecedents and Outcomes. *Journal of Business & Industrial Marketing,* Vol. 30 No. 2, pp. 129 – 138.

Lamber, D. M. et Knemeyer, A. M. (2004) We´re in This Together. *Harvard Business Review.* December, pp. 2-9.

Lee, R.G. et Dale, B.G. (1998). Business Process Management: A Review and Evaluation. *Business Process Management Journal.* Vol. 4, No. 3, pp.214-225.

Liker, J. K. et Choi, T. Y. (2004). Building Deep Supplier Relationships. *Harvard Business review.* Vol. 82, No. 12, pp. 104-113.

Maxwell, J. (1996). Qualitative Research Design: An Interactive Approach. Thousand Oaks, CA: SAGE Publications Ltd.

Pritchard, J-P. et Armistead, C. (1999). Business Process Management – Lesson From European Business. *Business Process Management Journal,* Vol. 5, No. 1, pp. 10-32.

Quinton, S. and Smallbone, T. (2006). Postgraduate Research in Business: A Critical Guide. London: Sage Publications.

Sarkis, J. et Talluri, S (2002). A Model for Strategic Supplier Selection. *Journal of Supply Chain management.* Winter 2002, Vol. 38, No, 1, pp 18-28.

Saunders, M., Lewis, P. and Thornhill, A. (2007). Research Methods for Business Students, 4th edition.

Silveira, G. D. et al. (2001). Mass Customization: Literature Review and Research Directions. *International Journal of Production Economics,* Vol. 72, pp.1-13.

Smith, H. et Fingar, P. (2003). Business Process Management – The Third Wave, (Meghan-Kiffer Press: Tampa, FL).

Tan, K. C. et al. (2002). Supply Chain Management: a Strategic Perspective. *International Journal of Operations & Production Management,* Vol. 22, No. 6, pp. 614-631.

Tersine, R. J. et Hummingbird, E. A. (1995). Lead-time Reduction: The Search for Competitive Advantage. *International Journal of Operations & Production Management,* Vol. 15, Iss. 2, pp. 8-18.

Wikner, J. et Rudberg, M. (2005). Integrating Production and Engineering Perspectives on the Customer Order Decoupling Point. *International Journal of Operations & Production Management,* Vol. 25, Iss. 7, pp. 623-641.

Yin, R.K. (2009). *Case Study Research – Design and Methods*. 3rd ed. Thousand Oaks, CA: Sage Publications.

Zairi, M. (1997). Business process management: A Boundaryless Approach to Modern Competitiveness. *Business Process Management Journal,* Vol. 3, No. 1, pp. 64-80.

REMOVED

Questions for the current state analysis

Date:

Duration:

Interviewee: Position:

1. How are you involved in our current order-to-delivery process?
2. How do you see our current order-to-delivery process?
3. Do you think that the part of process that you are responsible of is working effectively?
4. Are you able to finish all tasks in given time limits?
5. If there would be need for cutting the lead time of this process what could/should be done?
6. Do you think that there is place for general improvements in the process?
7. How could the company avoid the problems or decrease the number of problems?

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