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Improving the Requested On-Time Delivery by Analyzing the Data

The case company X

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ABSTRACT

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In Autumn 2019, the case company utilized the global data mining tool, Celonis, to measure the Requested on-Time Delivery, ROTD. The tool measures how well the organization is able to meet the customer requested delivery date, and it is taking the data directly from company's ERP- system. The difference between the requested delivery date and the actual delivery date is notable. Hence, the goal of this thesis is to analyse the data from the Celonis tool, and to find out the gaps affecting the ROTD. The aim is also to find the improvement areas to better meet the customer requested delivery time, and to increase the ROTD. There is a globally indicated target for ROTD%, which this thesis is aiming to support also.

This study was carried out by building a theoretical understanding of the order-to-delivery process, the delivery performance measurement and, in addition; a small portion of the continuous improvement. Later, all these topics were combined into the theoretical framework, which was supporting the empirical part of the study. This case study focused only on the case company's data analyse, and the case study used both quantitative and qualitative methods. The secondary data was first analyzed to find out the reasons to the current ROTD level, and with the help of interviews, the primary data was collected to have a deeper understanding of the entirety and propose some improvement ideas.

The secondary data analysis shows that the reason for ROTD gaps varies a lot between customers, so customer specific improvement actions must be implemented. Based on the results of primary data analyses, the correct system data at Local Sales Units (LSU's) and Regional Distribution Centres (RDC's) plays a significant role in ordering sub-process, and on the other hand, strong cooperation and clear instructions would be the key to improve also the biggest gaps in ROTD.

Keywords	supply chains, measuring methods, improvement, customer satisfaction

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TIIVISTELMÄ

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Syksyllä 2019 organisaatiossa otettiin käyttöön globaali työkalu, Celonis, asiakkaan pyytämän toimitusajan mittaamiseen. Työkalu mittaa asiakkaan pyytämän toimituspäivän toteutumista, ja se lukee tiedon suoraan organisaation käyttämästä toiminnanohjaus- järjestelmästä. Organisaation vahvistaman ja asiakkaan pyytämän toimitusajan välillä on huomattu olevan eroavaisuuksia. Siitä syystä tämän tutkimuksen tavoitteena on työkalun dataa analysoimalla löytää kehityskohteita, joiden avulla pystytään paremmin vastaamaan asiakkaan pyytämään toimitusaikaan, ja näin ollen parantamaan myös ROTD%: a. Mittarille on globaalisti määritellyt tavoitteet, jota tämä opinnäytetyö pyrkii tukemaan.

Tapaustutkimus toteutettiin luomalla ensin teoreettinen ymmärrys tilaustoimitusprosessista, sekä toimituskyvyn mittaamisesta. Lisäksi myös jatkuvan parantamisen teoriaa sivuttiin, jonka jälkeen muodostettiin näistä kolmesta osa-alueesta teoreettinen viitekehys empirian tueksi. Tapaustutkimus kohdentuu ainoastaan case- yrityksen tiedon analysointiin, ja tutkimuksessa käytetään sekä kvantitatiivista että kvalitatiivista menetelmää. Olemassa olevaa Celonis- työkalun sekundääridataa analysoimalla löydettiin juurisyitä nykyiseen ROTD tasoon, ja haastattelujen avulla kerätty tieto syvensi ymmärrystä kokonaisuudesta, sekä antoi kehitysajatuksia.

Datan analysointi osoitti, että ROTD kuilujen syyt saattavat vaihdella asiakkaittain paljonkin, joten myös kehitystoimien täytyy olla asiakaskohtaisesti räätälöityjä. Tutkimus osoitti, että paikallisten myyntiyhtiöiden ja jakelukeskusten järjestelmätiedot vaikuttavat suuresti tilausprosessiin, ja toisaalta vahva yhteistyö ja selkeä ohjeistus ovat avainasemassa, kun halutaan pienentää kuiluja ROTD:n ja oikean lähtöpäivän välistä kuilua.

Avainsanat toimitusketjut, mittaamismenetelmät, parantaminen, asiakastyytyväisyys

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1 INTRODUCTION

1.1 Background and aim of the study

An order-to-delivery process is considered as the core flow when goods are delivered according to customer needs. Therefore, it is important to track the flow and measure the performance to be able to remove the possible gaps, and hence to improve the customer satisfaction. Hines (2004, preface) referred to Webster's statement, that in the future, a successful organization is customer-oriented rather than product or technology focused, and it brings the voice of the customer to all the organization's value-delivery processes.

One of the priorities in the case organization's business in 2019 was "passion for customers". Over the past three years, the Net Promoter Score (NPS) has been telling that the Business needs to be better in the area of on-time delivery, as 15% of the NPS red cards received from customers have been related to on-time delivery performance (Ref. Appendix 1, 1). As a consequence of the result, a global on-time delivery project, which deployed the Celonis tool, was carried out. Celonis is a transparent big data source to show how factories are performing through the value chain. Like in any multinational organization, a common challenge is the transparency of the processes, as a high variety of systems and applications challenges the transparency and ease of analyzing the data. This data mining database was globally deployed to help finding improvement opportunities related to on-time delivery to customers.

Over the past years, the Confirmed On-Time Delivery (COTD) has been the main metric to measure the operational order-to-delivery performance in the case company. However, this Key Performance Indicator (KPI) is based on the factory confirmation of the delivery time rather than purely the customer requested delivery time. In Celonis, the customer Requested on-Time Delivery (ROTD) is the only metric to be followed, and it challenges the base of the common processes that the organization has used to manage the value chain. Therefore, it is now important to analyze the big data visualized in Celonis and find out the root causes for inefficiencies and improve the ROTD to customers.

The research questions in this study are the following;

1. What are the factors affecting the current level of ROTD% from customer and factory point of view?
2. How should the customer modify the ordering process so that the gap between the actual delivery date and the customer requested delivery date would decrease?
3. What actions should be done in the order-to-delivery process to better meet the requested delivery time?

When combining all these three research questions into one common research problem the question is:

- Why does the customer requested delivery date and actual delivery date differ from each other and how could the ROTD be improved?

With the help of these research questions, this study is analyzing the root causes of the current ROTD of the later defined Local Sales Units (LSU's) and Regional Distribution Centers (RDC's) as well as investigating the possible improvement actions to the order-to-delivery process, all only from the case company's point of view. In addition, the aim of the study is to create needed solutions to increase the ROTD%, The case company is a feeder factory in Finland, and it belongs to the global technology group. The factory is delivering mainly to internal customers, LSU's and RDC's, inside the case group. They are stocking some of the products at their locations, and some products are ordered on end customer request. Standard lead-times are agreed and in use for the sales between LSU's/RDC's and the factory. Each factory's ROTD% improvement is followed globally on high priority, and the ROTD% of 85% has been set as a common target for all the factories in year 2020.

1.2 Focus and limitations of the study

The Celonis tool is gathering all the data, even the minor ones, so the mass is huge. For some customers, the ROTD target of 85%, has been reached already. In addition, the amount of item lines per customer differs, and the customers with the highest amount of orders lines have the biggest impact to the overall ROTD%. Therefore, the target is to select customers which have not yet reached the 85% of ROTD, but with a high amount of item lines. The order lines will be analyzed as a mass to find possible common themes, but in addition as per customer to find out customer specific reasons for the ROTD%. The Celonis data is based on the Lean methodology's DMAIC process, where the Define and Measure phases are done in the tool, but it is the factory's responsibility to analyze the result and make the needed changes to improve the ROTD.

The ROTD% consists of two main aspects; how the customer is ordering and how the factory can meet the requested delivery time. According to the case company's current order-to-delivery process, the fixed delivery date is confirmed. It means, that the customer requested delivery time will be respected if it is according to the lead-time defined for a certain quantity, but also considering correct shipping dates and transportation methods. The case company, as a feeder factory, can make small short-term actions quite fast but changing the customers' inaccurate ordering habits might be difficult as the value chain is usually very long. This study will mainly analyze the selected customers' data thoroughly, which can be shared and communicated with the customers, and secondly, it will concentrate on the concrete actions that can be done from the factory's point of view to improve the ROTD%.

As a conclusion, this study will focus on:

1. Analyzing the root causes of big variation and hence bad performance in requested on-time delivery from the case company's point of view.
2. Finding out the improvement needs in the order-to-delivery process from both the case company's as well as from the customers' point of view

1.3 Approach and research methods

The type of the case study is both quantitative and qualitative. The case study is a good research approach when the aim is to deeply understand the improvement need and possibly to generate new improvement suggestions. Hence, a case study is answering the questions "why" and "how" (Oppariapu 2020). Many times, the analysis phase in a qualitative study is the most challenging part (Eskola & Suoranta 2005, 137) but in this study, the quantitative part consists of secondary data which already exists in the Celonis tool, and it is pre-analyzed big data from the case company's EPR system. This helps to better define the reasonable scope to concentrate on in the qualitative part of the study, as the data is well visualized and partly categorized already. The qualitative research is traditionally regarded more as understanding research whereas the quantitative is explanatory research. Combining the quantitative and qualitative research has been argued both for and against, but many methodology books also justify the combination. (Sarajärvi & Tuomi, 2017, Chapter 2.3.). In this study, the secondary data analysis is explaining the result of the ROTD% whereas with the help of qualitative methodologies, the aim is to understand the reasons behind the current ROTD% state more deeply, so the combination fits well in this case.

The secondary data will be analyzed by thematizing, to be able to highlight the main construction of the ROTD%. At the same time, the data is quantified, as the themes will be visualized in percent to see the division of the themes. After having the clear picture of the ROTD% division for each customer, the findings will be discussed in a group interview in the customer support team to deepen the understanding towards different customers' ROTD%. The group interview is divided into two smaller groups with three persons in each group. The aim is to verify that each person has enough time and space to articulate own thoughts and with two group interviews, it is easier to compare the results and see if they are alike.

Especially in qualitative research, the researcher role is remarkable and there are always some pre-assumptions and rationalization done by the researcher (Eskola et al. 2005, 20). In this study there were also some pre-assumptions of the reasons behind the ROTD% due to the long working history with the customers, but on the other hand, as the data was gathered and pre-analyzed already in the Celonis tool, the pre-assumptions should not affect too much on the study.

1.4 The construction of the study

This study is divided into eight main chapters including the introduction. The background and aim of the study and the defined focus and limitations are presented shortly in the introduction. In addition, the construction of the study is described, and the research approach and methods used are presented. The theoretical background is focusing on the order-to-delivery delivery process description and definition in the second chapter, then continuing to the third chapter creating the overall picture of the delivery performance measurement. The fourth chapter is shortly presenting the frame of continuous improvement, which is also the approach in ROTD improvement actions. In the fifth chapter, the theoretical framework is introduced, and the empirical part of the study is presented in the sixth chapter, where the Celonis tool is engrossed shortly to create a bit of understanding of the used data source. In the seventh chapter, the result is presented, whereas the eighth chapter is bringing together the conclusions of the data analysis as well as introducing the improvement needs to be conducted in the next step. The overall content of the study is pictured in Figure 1.

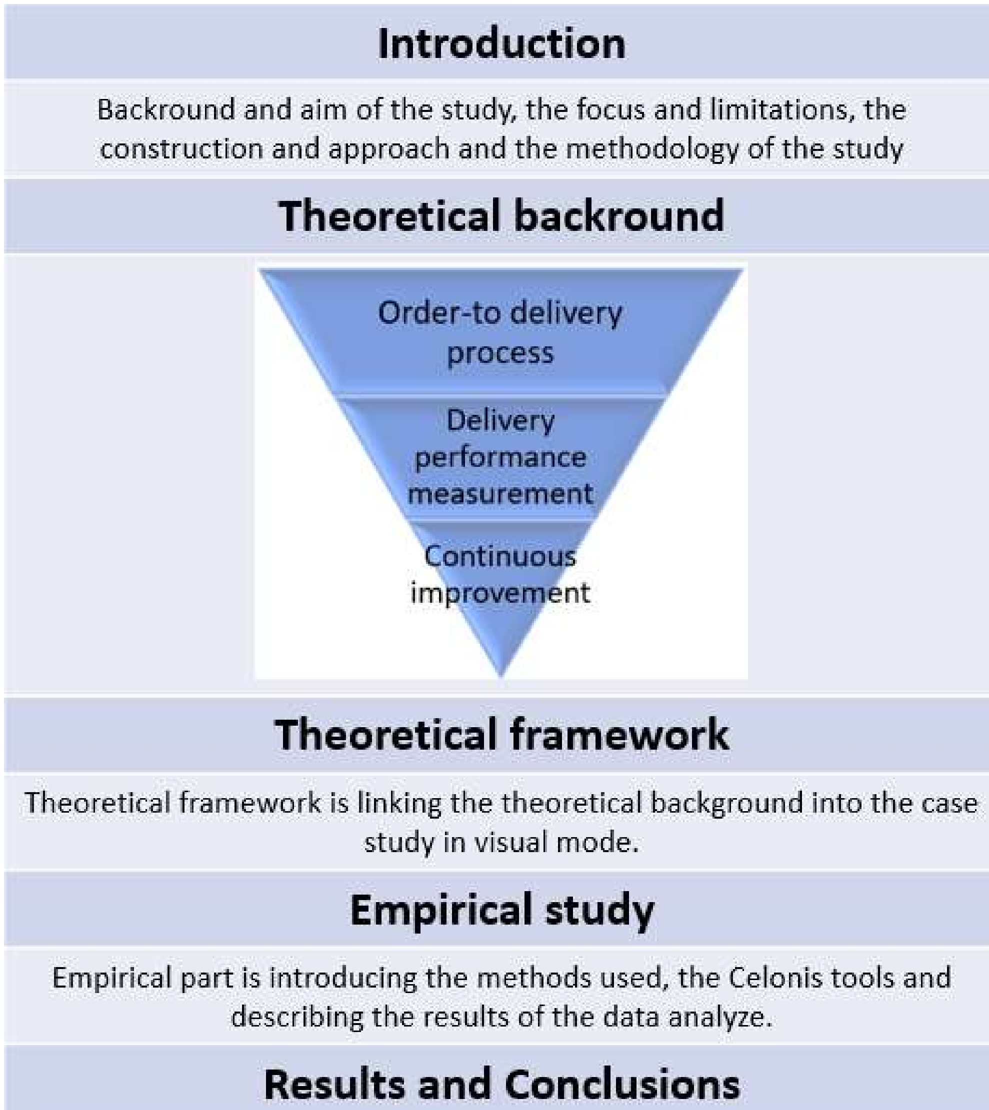

Figure 1. The content of the study.

2 ORDER-TO-DELIVERY PROCESS

2.1 Supply chain management

Supply chain and management of a supply chain is a wide subject and can be viewed from many different aspects. As the order-to-delivery process is essential part of the supply chain, the whole supply chain concept needs to be described first.

Obtaining good quality products delivered to customers fast and reliably is not a competitive advantage anymore, it is more of a requirement to even exist in the market. Products are consistently requested to be delivered faster, exactly on-time and intact, and this requires close coordination between many different parties. (Mentzer, DeWitt, Keebler, Min, Nix & Smith & Zacharia, 2001, 2). In 1994, La Londe and Masters proposed that a supply chain is "*set of firms that pass materials forward*". In 1992, Christopher defined the supply chain to be "*the network of organizations that are involved, through upstream* (suppliers) *and downstream* (customers) *linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer*" (Mentzer et al., 2001, 3). Estampe, (2014, Introduction) defines, that supply chain management is *"the integration of key operational processes from the end user to the original suppliers of products, services and information, which bring added value to customers and other stakeholders*".

All the definitions above agree that a supply chain consists of separate processes, which are linked to common information and/or physical product flow. La Londe and Masters have proposed that if all the members in supply chain would have the same goal and focus on serving customers, would succeed. Also, Fleischmann & Meyr (2004, 298) states, that customer satisfaction is the main objective of supply chain management. Many authors have stated that supply chain management needs the integration of many different processes and partners all the way from sourcing to production, then continuing to distribution across the supply chain (Mentzer et al., 2001, 9-10). On the other hand, supply chain management is not a one-way flow, but it contains also the information flow like customer requirements and orders and payment flow from customer. Taylor & Brunt has stated in 2001 that supply chain management and lean management are in close interaction with each other, as lean management is aiming to prune the waste within the company and supply chain management aims to avoid the waste all along the value chain (Knolmayer, Mertens & Zeier, 2002, 1).

In Figure 2 it is described the simple supply chain flow including the supply chain management. This is probably the most traditional way of picturing the flow from the raw material refining into the value-adding goods delivered to customers, but as Mentzer et al. (2001, 5) continues, the supply chain management can be categorized either as a management philosophy, an implementation of it or a set of management processes. There has also been discussion about the difference of supply chain management and logistics, and in 1998, the Council of Logistics Management defined, that logistics is a subset of supply chain management. Logistics is part of the supply chain plans, it implements and controls the efficient flow and storage of goods, services and related information from the origin until consumption in order to meet customers' requirements. Supply chain management is focusing on both operational and strategic aspect and should be viewed as a single entity rather than separate segments. (Knolmayer et al., 2002, 2).

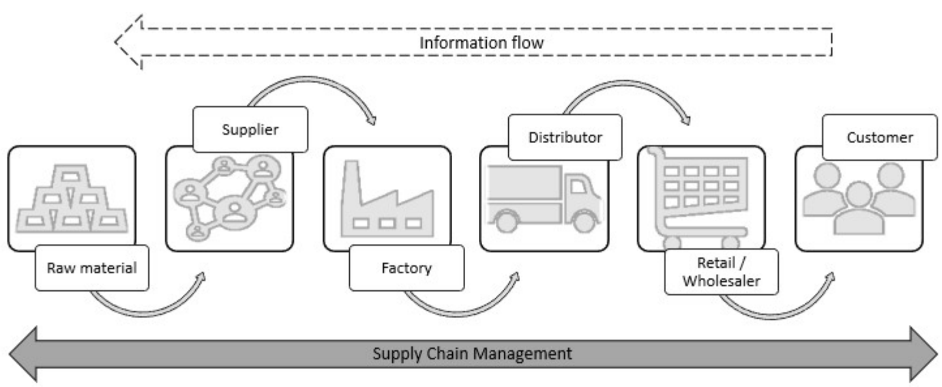

Figure 2. The Supply Chain flow.

In this study, the supply chain management is considered as how Estampe described it to be above; the integration of key processes starting from raw material supply until the finished good creating value to customers but taking more operative than strategic aspect. The aim is reactive problem solving but also proactively develop the ordering process to minimize the gap in the future. In addition this study analyzes only the order-to-delivery process reaching the order handling, production and dispatching. The sourcing is only on the operational level considering the products which are purchased to order or stocked, but not including the component supply to production so the raw material supply is out of scope. Even though the transportation of the goods to customer may have a major effect on the on-time delivery performance, it will not be in the scope of the study as the Celonis ROTD% is only based on how well the factory is able to dispatch according to requested delivery date.

2.2 Process definition

A process is a series of tasks and decisions which are delivering value to customers or any stakeholders. It is a way of doing things, and the aim is to fulfill the internal and/or external customer or any other sub-groups' needs. Processes can be divided into four main groups; core processes, supporting processes, management processes and key processes. The core processes are the ones where the customer satisfaction is created, and those processes begins from the customer, like for example an order, as well as ends to the customer as for example delivery. Supporting processes are, as named, supporting the core processes, and those are for example material management, IT management or financial management. Management processes are for example strategic and operative planning. Key processes are especially important to the business success, and which are selected to improvement objects. (Tuominen, 2010, 9-10).

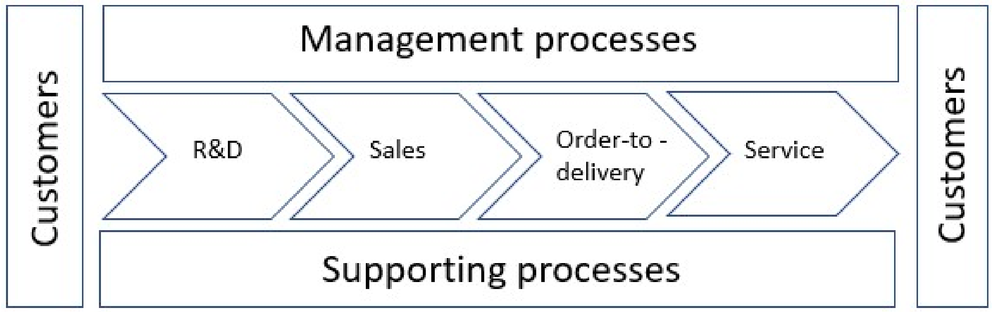

Figure 3. Process groups (Tuominen, 2010, 10).

Processes are functioning on three levels; process, sub- process and task. As an example, the order-to-delivery process contains many sub-processes like order handling, component production, assembly, packing and delivery. In addition, each sub-process is divided into tasks, which one or more persons are executing. (Tuominen 2010, 12).

2.3 Order-to-delivery process

Order-to-delivery process, or like some sources call it "order-to-cash", is traditionally related to automotive companies where it is critical to deliver the right product to the right place at the right time (Capgemini, 2020). The order-to-delivery process consists of at least three actors; a customer, a supplier and a logistics service provider, and all these three actors affect the order-to-delivery process performance. Therefore, the performance management of this process should include the triad aspect. However, only few have empirically studied triads including the logistic service provider's aspect to supply chain performance, and few studies include the performance management involving both supplier and customer aspects. Considering the overall order-to-delivery process, each sub-process is dependent on the other sub-processes, so there is a need to explore what dimensions are the most important to measure and manage. (Forslund et al., 2009, 42). In this study, the aspect taken is dyads, i.e. the performance between the factory and the customer, as the analyzed data and the key performance indicator in use is excluding the logistics service provider's performance.

Forslund et al (2009, 43) defines that there are different kind of order-to-delivery process configurations used. On-time delivery, highlighted by e.g. Forslund and Jonsson, and flexibility, highlighted by e.g. Supply-chain Council, are the most prevalent performance dimensions, which are used in the order-by-order environments, where the orders are coming in intermittently. An order-to-delivery process in this kind of environment starts with the identification of a need to order and ends when the goods are delivered and available for use. It starts and ends at the customer, and four different sub-processes can be recognized:

- the ordering sub-process at customer, starting from the need to order until the purchase order reaches the supplier
- the delivery sub-process at supplier, starting from the receipt of the order until the goods are available to dispatch
- the transportation sub-process, starting when the goods are available to pick-up until unloaded at customer reception
- the goods receipt sub-process, starting when the goods are received until those are available for use.

Figure 4 is picturing the four sub-processes in the order-to-delivery process, and letters A, B and C indicating the interfaces. (Forslund et al., 2009, 43).

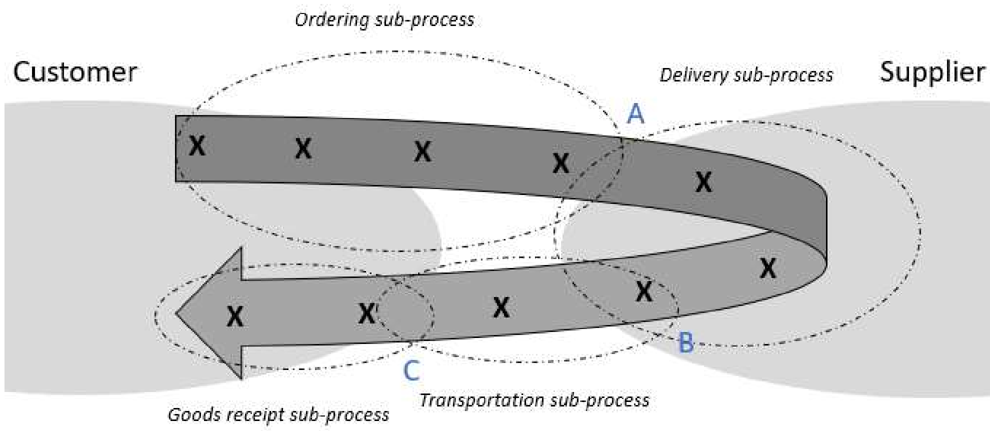

Figure 4. Order-to-delivery process' four sub-processes (adapted from Forslund et al (2009, 44).

Like defined earlier, this study is concentrating only to the ordering sub-process and the delivery sub-process. The customers are the the case company's Local Sales Units (LSU's) or Regional Distribution Centers (RDC's). However, it is important to understand that this is the only part of the ordering sub-process, as there might be a long chain already before the order reaches out the factory. The LSU or RDC may deliver to wholesaler, who delivers to panel builder who delivers to customer X, who delivers to customer Y. And the chain might be even longer. Therefore, it is important that the requested delivery time could be fulfilled so that the whole chain is flowing smoothly all the way to the end customer. However, the the case company can only affect the delivery-sub process and also steer the ordering sub-process to consider all the needed aspects, so that it would be possible to meet the requested delivery time.

2.4 Possible gaps in order-to-delivery process

McLean (2017, 21-28) has defined six reasons in the order-to-delivery process why companies are not able to deliver as requested by the customers. The first reason is that customers cannot forecast accurately as they might not be able to anticipate and forecast the future demand or there might be other factors beyond their control impacting the demand. The second reason is that lead-times are long. When considering each step in order-to-delivery process like sourcing the material, transporting the material from supplier, manufacturing the goods, packing and shipping the goods and finally delivering to the customer, the total lead-time might be even months. The third reason is big batches and big shipment quantities. According to McLean, the big production batches might be efficient, but on the other hand takes longer time to run and to consume those from inventory. Big batch sizes can also increase volatility in the supply chain affecting more on shortages and of longer duration. The fourth reason is material shortages as those are often the main cause of production delays and late deliveries. However, the root cause for the material shortages are usually found in the business itself and not at the supplier. The fifth reason is the poor factory performance, and usually the problems are compounded with the material shortages and constant schedule changes due to the demand volatility. The sixth reason is the poor warehouse and logistics practices. This means that the company might not be able to deliver according to customer request, because of the inaccurate stock recording or the insufficient inventory levels.

When considering these reasons into the case company's context, the missing forecast can sometimes create issues. The majority of the order flow is stable because of the LSU's and RDC's refilling stock orders. However, considering some big project orders, it would be reasonable to have a forecast, to be able to prepare the components from supplier and plan the possible changes in the production. As all the order flow comes through the LSU's and RDC's, the end customer forecast might be difficult to obtain due to the reasons McLean mentioned above. Sometimes lead-times might also be long, for example, in cases when all the stock is sold out and the next batch arriving from supplier takes a long time for some reason. Or due to the production capacity or missing material, some production lines might be closed for a short time period. The lead-time might be longer than the customers expect because the ordered quantity is bigger and therefore, the longer lead-times should be used.

Big batches are not usually an issue as the lead-times are defined according to smaller and big quantities. Sometimes they may cause issues when the production is running the stock-refilling order, as big refilling batches might have less priority compared to direct customer orders. There, smaller stock refilling quantities could be the solution. The material shortages are causing issues to production as well as direct customer orders, but the reasons are so diverse, that they will not be specified here. Poor factory performance or poor warehouse and logistics practices are sometimes causing the delivery performance gaps but as those are not considered to be the target of this study, no further analysis will be done.

2.5 Lead-time aspect in order-to-delivery -process

In order-to-delivery process, the performance related to lead-time is central. According to Forslund et al. (2009, 42), many researches have discussed about the lead-time reduction in light of business process reengineering or lean and agile methodology. However, it has been discovered that the lead-time length is not usually considered the most important dimension in order-to-delivery performance. Hence, the other dimensions like on-time delivery are valuated as being more important. Accordingly, Ramachandran & Neelakrishnan argue that requested on-time delivery is one of the top industrial metrics (2017, 109). Also McLean (2017, 32) describes the Delivery In-Full On-Time (DIFOT) is the ultimate measure of the supply chain performance. Hines (2004, 38-39) defines the speed of delivery and the delivery reliability as part of the key competitive dimensions. Already in 1970's, a paradigm of Just-In-Time (JIT) in manufacturing industries was raised. This paradigm aims at customer service enhancement, in addition to logistics cost reduction. The core of JIT is to deliver at right time the right quantities to the right location with the right quality, and in JIT, the transportation and the logistics management plays a significant role. (Cheng, 2011, 275).

From logistics' point of view, the lead-time is traditionally defined as the elapsed time between the identification of the need to order until the goods receipt. On-time delivery is the extent of how well the delivery date and the delivered quantity corresponds to what has been confirmed based on the lead-time. Overall, the lead-time performance contains many different dimensions like the lead-time length and the on-time delivery, but also the adaptability and flexibility of the lead-time. Some previous studies show, that even though customers call for on-time delivery and flexibility, the experienced performance might still be low. (Forslund et al., 2009, 42-43). McLean (2017, 33) also defines, that the most important lead-time is the expected lead-time by the customer. It means the time, that the customer is prepared to wait from placing the order until receiving the products. This time can vary a lot; depending on the product and its customization degree, the way of distribution, the customer's location or market expectations, i.e. what competitors do. All in all, the most important determinant for the acceptable lead-time is the customer need. (McLean, 2017, 33).

In 2004, Mattson defined five phases in order-to-delivery process performance: before order, at order, from order to delivery, at delivery and after delivery. Lead-time in 'before order' phase refers to estimated but not necessarily committed lead-time, which is typically maintained in customers ERP system. (Forslund et al., 2009, 44). In the case company, the lead-times are revised and distributed either once or twice per year to each customer. Short and long lead-times, as well as the quantity limits, have been defined for most of the products. The same lead-times and limits are also maintained in the case company's EPR system, but usually the customers do not have the possibility to maintain many different lead-times in their system, but only one for each product.

Forslund et al (2009, 44) continues, that the lead-time 'at order' refers to the date that is valid at the time when the order is received, and which is confirmed by the supplier. In the case company, standard lead-times can only be revised maximum two times per year and typically those are not changing a lot. Sometimes, there are temporarily longer lead-times in use for the separately specified products or product groups, if there is e.g. lack of components, production capacity issue or quality related issue. In those cases, the case company aims to define the duration of the deviation and communicate it to customers. Ramachandran et al. (2017, 109) states that the material on-time receipt from supplier or sub-contractor is an essential factor affecting the on-time delivery. If the lead-time 'before order' does not correspond reasonably to the lead-time "at order", knowing it in advance has minor importance (Forslund et al. 2009, 44), but in the case company's business, it is very essential that the customers have and maintain the correct standard lead-times in their systems, as the production delivery process scheduling is based on the defined standard lead-times. McLean (2017, 33) argues, that if a company needs to determine whether it can meet the customer lead-time consistently, it needs to calculate the order fulfilment lead-time, i.e., the lead-time 'from order to delivery' until 'at delivery'. However, McLean also recognizes, that this is a complicated way of measuring due to possible delays of receiving at customer side.

If a customer is repeatedly ordering the same product and the lead-time varies, the difference between the separate orders is called lead-time variability (Forslund et al. 2009,44). Also, Coyle, Langley, Gibson, Novack & Bardi (2008, 283) have defined, that even the absolute length of the delivery time is important, the variability is even more important. In the case company, the lead-time variability can be wide due to several reasons; the customers are ordering different quantities with short or longer lead-times, they are ordering with longer lead-times than the standard lead-time is, different customers have different dispatch dates per week, which might add some extra days to the lead-time, or there are temporarily longer lead-times in use. Variation may also be related to the time addition of the weekends. Sometimes the standard lead-time might be too long for whatever reason, and the customer needs the delivery within a shorter time frame. The more the supplier is able to adapt the standard lead-time to the customer requested lead-time, is called lead-time adaptability, according to Forslund et al. (2009,44). In the case company, the production delivery process scheduling is automated in ERP, i.e., it schedules the confirmed delivery date based on the standard lead-time and the quantity, taking also into account the customer's correct dispatch date and transportation method. Therefore, the lead-time adaptability is done manually by checking with production or purchasing if it is possible to meet the customer request, and then changing it manually on the order.

Lead-times can also be viewed in light of flexibility. It can be considered from many aspects like product-, mix-, volume-, or delivery flexibility (Forslund et al. 2009, 44), but in the case company, only the volume and the delivery flexibility are the most relevant. As already described, there have been defined different lead-times for different quantities, i.e. small quantities can be delivered within shorter lead-times, but bigger quantities need more time to be produced at supplier or sub-supplier. However, even a bigger quantity can be produced earlier depending on the production capacity at that time.

Figure 5 shows the relationship between lead-time variability, adaptability and flexibility. In addition to these relationships, there is also lead-time accuracy, or on other words, on-time delivery. It means the relationship between the confirmed the lead-time versus actual lead-time. (Forslund et al., 2009, 45). In the case company the most essential lead-time dimension is the delivery accuracy, so how well confirmed lead-time and actual lead-time coincide. The relationship between confirmed and adapted lead-time, thus how well the case company is able to adapt the confirmed lead-time based on the customer request, is becoming more essential as it is the only performance measured in the Celonis tool as well.

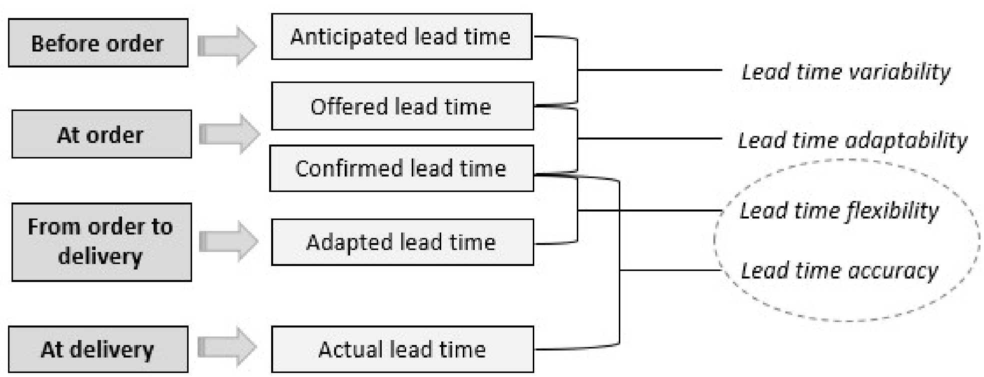

Figure 5. The relationship between lead-times (adapted from Forslund et al. 2009, 45).

To be able to assess the performance of the order-to-delivery process as a whole or some sub-process, a performance metrics need to be defined and applied. (Forslund et al., 2009, 45). In the case company, the object to measure is the delivery accuracy, i.e. how well the delivery date and total quantity corresponds to the confirmed date by the percentage of confirmed order lines delivered on-time. Furthermore, the assessed on-time delivery in the Celonis tool is measuring on how well the case company is able to meet the customer requested delivery time, so it is taking both flexibility and accuracy into consideration.

3 DELIVERY PERFORMANCE MEASUREMENT

3.1 KPI as a performance management tool

Harold S. Geneen has cited that "*It is immutable law in business that words are words, explanations are explanations, promises are promises, but only performance is reality*". (Barwise & Meehan, 2004, 145). Performance is revealing the responsiveness on the customer needs, but many authors have also recognized that you need to measure the performance what you want to manage. On James Harrington words, *"Measurement is the first step that leads to control and eventually improvement. If you can't measure something, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it."* (Kaydos, 1998, 3).

Each organization needs to set goals to quide the efforts and focus on all actions done in the organization. Goals should be defined on SMART way, which means that those should be Specific, Measurable, Attainable, Realistic and Time-sensitive. KPI's are then set to measure the actual performance of the defined goals. (Mahbod & Shahin 2006, 227). Kaplan (2009, 5) defined that performance measurement aims to determine the effectiveness of a strategy or the efficiency of operating processes. Hence, measuring the performance means that the organization is pursuing to positive results and improvement. Also Paramenter (2015, xxiv-XXV) argues, that performance measurement can steer the organization towards targeted goals and also to create wider ownership for employees to see more clearly the progress. The author also argues that performance measurement increases visibility and improves the overall understanding to help of decision making. Figure 6 is visualizing the core target of the performance measurement; it should guide different teams towards a common strategic direction.

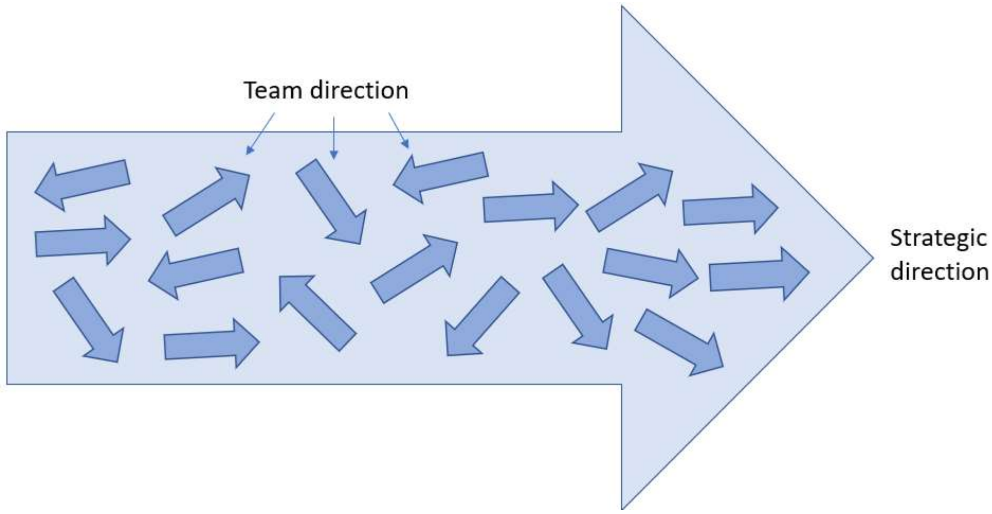

Figure 6. Discord between the team direction and the organization's strategy (Paramenter 2019, Xvii).

Like Kaydos wrote already in 1998, you are not able to understand how the process works if you don't measure it. Understanding how the whole process works, means knowing what factors are affecting to performance and how it will develop if something changes in the process, but it also reveals what the process is capable of. (Kaydos, 1998, 3). He continues (1998, 6), that if quality needs to be improved, the following measurements are needed:

- The gap size between what customers want versus what they are getting (determines the size of the performance problem)
- The measurement of the process (provides the understanding of the process)
- The performance gap size after the changes have been made (indicates whether the attempt to improve performance worked)

Implementing a performance measure may already improve the performance itself, because the measure defines what is important and focus attention towards those issues. Measures also help to establish and communicate the standards that are not probably understood by everyone, and as the performance becomes visible, no one wants to look bad in relation other companies. (Kaydos, 1998, 7). Kaplan (2009, 7) argues, that there are many different kinds of metrics to use for each business activity, and for operative processes, the number of items shipped on-time is one of the main metrics.

3.2 On-time delivery measurement

On-time delivery metric provides visibility on how well the business can meet the customer expectations by fulfilling the orders. In addition, the on-time delivery performance reveals the effectiveness and efficiency of the internal processes throughout the supply chain. (Marr, 2012, chapter 42). The core purpose of a supply chain is to deliver the products that customer need in the quantity they need and when they need them (McLean, 2017, 32). It has been stated that from logistic point of view the order-to-delivery process is one of the most essential processes to manage ((Forslund et al., 2009, 41).

On-time delivery or Delivery In-Full On-Time (DIFOT) can be simply calculated by comparing the number of units delivered in full on-time versus total units shipped. (Marr, 2012, chapter 42).

$$\textbf{OTD} = \frac{\text{Number of order lines delivered on-time (in full)}}{\text{Total number of order lines}} \times \frac{100\%}{1}$$

Figure 7. The formula for on-time delivery calculation.

Many different definitions define the On-Time Performance (OTP) in addition to DIFOT, like for example Shipped On-Time (SOT) and On-Time In-Full (OTIF). The DIFOT and OTIF KPI’s are quite much identical as those consists of two parts; “on-time” and “in full”, and the KPI is measuring the efficiency and accuracy. Organizations can define the reachable time, which can refer for example, to requested delivery date, production cycle or agreed response time. (QPR, 2020). McLean (2017, 32) argues that there have been a lot of debates on how to measure DIFOT correctly. According to McLean, if customer orders the product with shorter lead-time than the company is able to achieve, or what has been agreed with customer, the company can measure the on-time delivery compared to the confirmed date, so called ‘first agreed date’, at the time of the order. Some would call this DIFOT failure already, but McLean is not concerned about this way of measuring. However, in case of further changes in agreed delivery time, that should be considered as DIFOT failure. Even simpler way of measuring DIFOT is to measure against the standard lead-time, and this is as justifiable if the company defines it to be the correct KPI. Many companies are likely to measure actually *shipped* on-time in full rather than delivered as there might be many variables to which the company is not able to affect, like the goods receipt- process at customer. Whichever is the way of measuring the DIFOT, the most essential is that the measurement reflects the actual performance from the customer point of view. (McLean, 2017, 32)

"On-time" criteria mean that the delivery should not be late, but neither too early, because there are some mismatches in the process if either of those happens. Delivered "in-full" is the synonym of customer getting exactly the amount they have ordered. (QPR, 2020). On the other hand, Paramenter (2019, Xxi) highlights that delivery performance measurement in DIFOT for all deliveries can also sometimes lead to a situation where the concentration is on minor important deliveries first and putting major and more complex deliveries at risk.

There are different aspects to be considered when calculating the on-time performance; whether it is calculated considering the confirmed delivery date from the supplier or either it can consider the supplier ability to respond the customer requested delivery time. The case company has been measuring the confirmed on-time delivery performance for many years already, but the measurement is based on the confirmed on-time rather than purely customer requested on-time. It is based on the standard lead-times which are defined for each product and for certain quantities. The lead-time can be for example, 4 days for the quantity under 30 pieces and 8 days for quantity of 30 pieces or more but maximum 100 pieces. Customers should order accordingly, and for high runners, they should update their databases with correct lead-times. Depending on the contract, the transportation-time may be included into the confirmed delivery time, but for some customers the delivery time given is the shipping date from the factory. This should be considered as well from customers side. Lead-times and transportation-times are always working days and not calendar days.

For some customers there are deliveries every day, but for some customers, mainly for longer destination or lower volume customers, there are few the most optimal shipping dates defined per week. As an example, for one customer there are Monday, Wednesday and Thursday as shipping dates via air freight and Tuesday via sea freight. Few customers have also some special limitations from their side, like for example only complete deliveries are allowed or some special inspection or payment must be conducted before the shipment can be done. In these cases, customers should order accordingly with the lead-time that the request can be realistically completed. In some cases, the case company is not able to send the total quantity at once due to lack of components or huge quantity ordered. If partial delivery is shipped, the last partial delivery that completes the order line is considered in the ROTD% calculation. On other words, even though there are for example 3 out of 4 shipments delivered on-time from one order line, if the last shipment is delivered later than requested, the shipment is considered as late.

If the customer is ordering with longer lead-time considering all the above mentioned limitations, the case company's ERP system is scheduling the order lines based on the customer request, on the next possible dispatch date, but if the customer requested date is earlier than the limitations allow, then the order is confirmed to the next possible shipping date after factory scheduling rules. In Figure 8, there is a list of definitions on how the orders are scheduled.

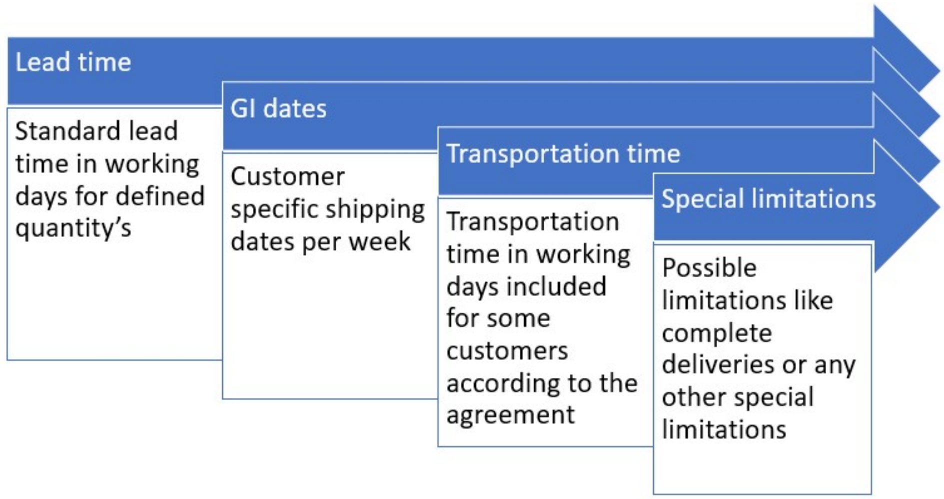

Figure 8. Definition of how the orders are scheduled.

3.3 Customer requested on-time delivery measurement

Along with the Celonis process mining tool implementation, the focus is now more on the ROTD overall. According to Godsell and Hoek (2009, 172), too often the OTIF is measured against the promised date by supplier rather than the customer requested date. The authors argue that very often the delivery performance against promise date exceeds the common target of 98 percentages, whereas the delivery performance compared against the customer request date reveals that on average, 99.7% of the scope order lines were late on average 16 days. This way the customer service performance may look more favourable than it is. Therefore, it would be reasonable to realign the customer service metrics to measure the actual customer need. (Godsell et al., 2009, 172).

In the case company, the customer satisfaction was the main driver to implement the data mining and the ROTD measurement. Like Godsell et al. (2009, 172) describes, this is a better way to focus on the customer service management to obtain better customer satisfaction, as well as to reveal and understand the failures behind the poor performance. It is easy to agree with this perspective, as measuring the promised date has nothing to do with customer perspective, hence, it mainly measures the targets defined by supplier. However, in the scheduling production managed in the ERP system, the standard lead-times play a significant role in the capacity planning. Therefore, the earlier mentioned rules are important in order-to-delivery process, as automatic scheduling does not allow to schedule the orders according to customer requests if it differs from the requisition. In any way, the ROTD measurement reveals the bottlenecks to improve better than the COTD measurement. With the help of the Celonis tool and the ROTD measurement, it is easier to see the gap size between the requested and confirmed delivery date i.e. the size of performance problem. The measurement itself provides better understanding of the problem, and it is easy to follow the performance gap size progress after the improvement actions have been made. Figure 9 visualizes simplified example of the possible conflict if the requested lead-time is shorter than the standard lead-time is. The gap is even bigger, if the transportation-time is included in the confirmed date, but it is not considered in requested date.

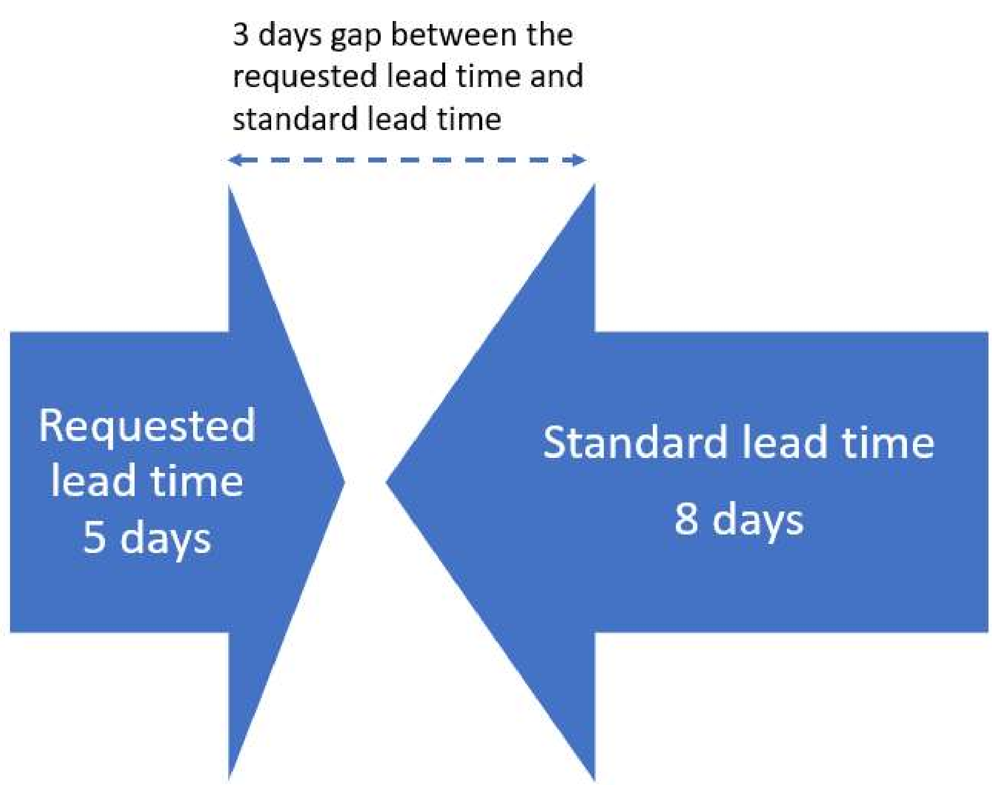

Figure 9. The gap between the requested and the standard lead-time.

4 CONTINUOUS IMPROVEMENT

Hines (2004, 259) described the world-class organizations to be customer focused, flexible and responsive, supported by technology and continuously improving. The continuous improvement is a wide concept and it is the base of Lean philosophy. It can be viewed from many different aspects and it can also be very abstract if it is out of touch of the specific context. (Kanbanize, 2020). Continuous Improvement (CI) philosophy was described by Deming to consist of improvement initiatives that reduce failures and increases success. In addition, it can be defined as a never-ending process throughout the company focusing on the continuous increasing improvement. In general, its' target is to eliminate waste in each of the processes in the organisation. One of the core thoughts of continuous improvement is to involve everyone working together for improvement by small incremental improvements or bigger radical change. However, usually major improvements come over time as a result of minor incremental improvements done. (Baghel & Bhuiyan, 2005, 761).

4.1 The voice of the customer

All what matters is the customer perception of the performance, not the actual performance. In Figure 10 is defined the two aspects of customer focus in Hoshin Kanri, which is a strategic management method; whether to improve customer satisfaction with existing products or services by identifying the root causes for dissatisfaction. This can be done with numerous tools developed for continuous improvement. Or, by launching new products or services tailored to meet the customer need from the beginning. (Hutchins, 2016, 108).

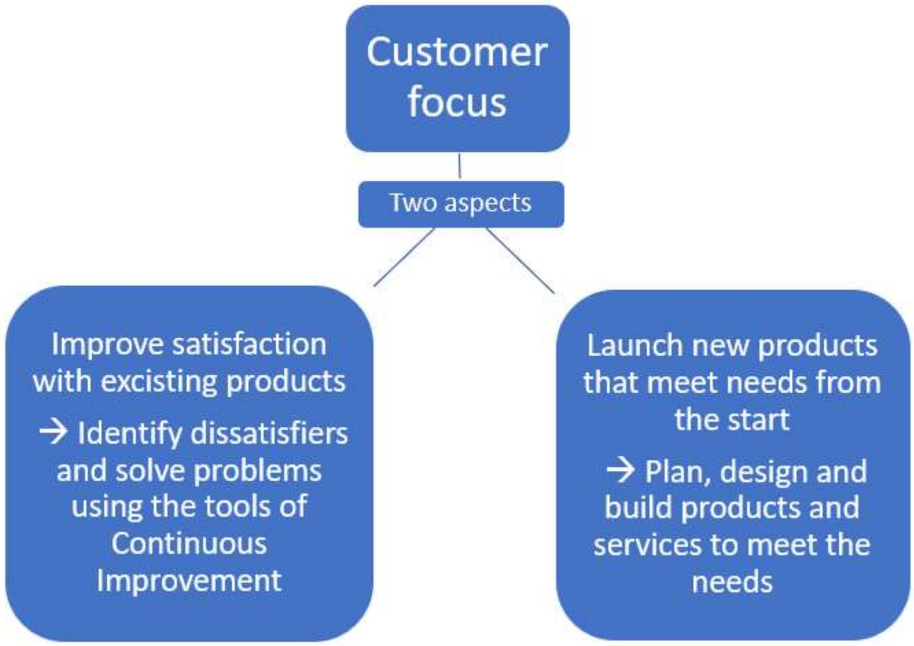

Figure 10. Two aspects of customer focus (adapted from Hutchins, 2016, 108).

In Hoshin Kanri is argued that if the customer perceives the performance to be poor even though it has been good, it is not reasonable to make any improvement, but to change the perception (Hutchins, 2016, 108). On other words, it is important that the perception is realistic and attainable, as it is not reasonable to change a fluent process where the customer perception might differ from the reality. Like emphasized earlier, there is a gap between the ROTD% and the target level visualized in the Celonis tool, and the case company has identified already earlier some mismatches in ordering processes which causes the gap. Some customers are requesting delivery date to the same date than the order is placed, or they might not consider the transportation time which means that the order might even be requested to the past. In these cases, changing the delivery process is not the first option, as it would not solve the root cause. However, the issue has not been this visible, so the ROTD% measurement reveals the perceptions that customers have, and then there are better possibilities to improve the actions that need to be improved or change the perceptions if those are unrealistic.

Nowadays, it is already self-evident, that without customer there is no business. According to Hutchins (2016, 110), there is still common ignorance regarding the critical importance of ensuring that the customer satisfaction is achieved. Hence, it is very essential to obtain and analyze customer-related statistics bearing in mind that customer satisfaction is a dynamic situation which requires constant monitoring and adjustments. In the case company, the customers are internal LSU's and RDC's, however, there is always the end customer behind each order, so it is equally important to embrace the customer satisfaction.

4.2 Continuous improvement- methods

Continuous improvement is not a static but dynamic process with no target dates, it can never be considered complete. There are several continuous improvement tools and methods to improve the processes in different stages. Continuous improvement should always be based on facts, and seven basic tools of quality are graphical techniques used mainly in troubleshooting. The tools are cause-and-effect diagram, check sheet, control chart, histogram, pareto chart, scatter diagram and flow chart. Lean thinking and later combined Lean Six Sigma concentrate mainly on quality improvement, adding efficiency, minimizing the waste and maximizing the flow. Lean embraces many concepts, theories and tools, like 5S, Kaizen, Kanban and Poka Yoke, but the core is in the way of thinking and culture. (Six Sigma, 2020). One continuous improvement method can also be benchmarking. It is useful to adapt solutions, which are discovered to be functional at somewhere else. It can also be considered that continuous improvement requires learning from the best, but it must be able to fit the solutions correct way to own operations.

One of the most common continuous improvement methods is Deming cycle PDCA or also known PDSA (Plan, Do, Check/Study, Act). The Deming's cycle (Figure 11) is a management model which calls for making controlled decisions based on hard facts. It reminds to focus on what is really important and start small. In the 'Plan'- phase, the target is to define what is aimed to improve, and also forecast the predicted result. In 'Do'- phase, the plan is executed with small steps in controlled circumstances. In ‘Check/Study’- phase it is compared the actual result to the predicted result defined in ‘Plan’- phase and in ‘Act’- phase, it is meant to take actions to standardize or improve the process, but also to abandon the change if noticed to be wrong direction. (Quality Knowhow Karjalainen Oy, 2020).

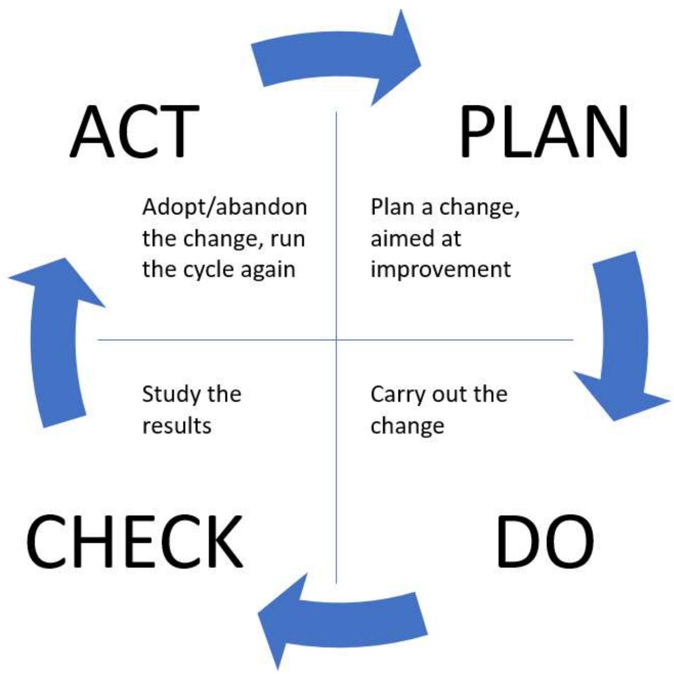

Figure 11. Deming cycle PDCA.

In this case study, the facts are analyzed and based on the Celonis data, and based on the results, the improvement actions will be planned with the help of PDCA.

5 THEORETICAL FRAMEWORK

As described in the theoretical background, the main task is to focus on the order-to-delivery process, whose performance is measured in the Celonis tool. As the ROTD% is not yet on target level, there need to be improvement actions done to meet the target. Therefore, this study is focusing on analysing the root causes of big variation and gaps of the ROTD% as well as discovering the improvement needs in the order-to-delivery process.

In the theoretical background, there was visualized the four sub-processes which belongs to order-to-delivery process. Those are the ordering sub-process, the delivery sub-process the transportation sub-process and the goods receipt sub-process. Below Figure 12 is a copy of the Figure 6 presented earlier in chapter 2.

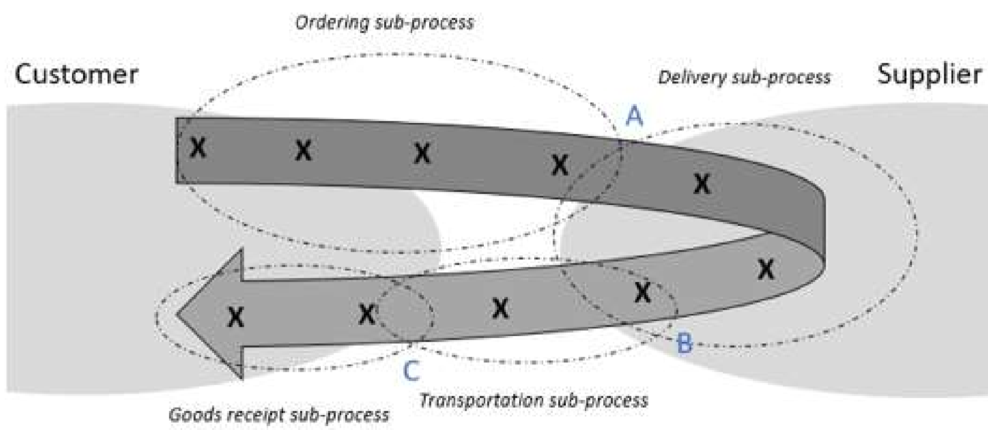

Figure 12. Copy of the Figure 6, page 20.

From the picture it can be seen which are customer's sub-processes and which are supplier's sub-processes, but there are also areas where the sub-processes coincide, visualized with letters A, B and C. Considering the fact, that the ROTD% measurement in the Celonis tool is purely focusing on the ordering sub-process, the delivery sub-process and the interface between these two sub-processes, the focus area for this study is visualized in Figure 13.

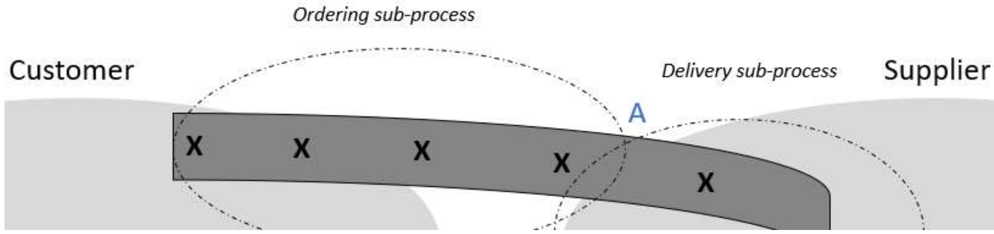

Figure 13. The ordering sub-process and the delivery sub-process.

Like described earlier, the ordering sub-process at the customer is starting from the need to order until the purchase order reaches the supplier, whereas the delivery sub-process at supplier is starting from the receipt of the order until the goods are available to dispatch. However, the interface between these two sub-processes is obvious and these strongly affect each other.

Grönroos & Voima (2011, 31) are also describing the value co-creation with the same kind of picture, showing that there is always the joint sphere where the value is created in interaction between both parties (Figure 14).

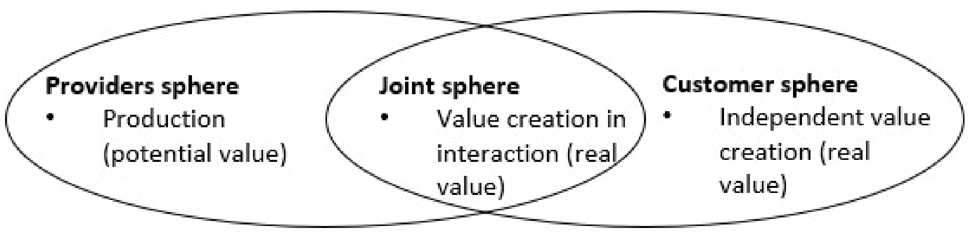

Figure 14. Value creation spheres by Grönroos & Voima (2011, 31).

By combining the core of both pictures, the theoretical framework of this study looks as following in Figure 15. It shows that the ordering process starts from the customer, but also showing the interaction between the customer and the supplier sub-processes. The two-way arrow is visualizing the whole order-to-delivery process where the "x" is visualizing all the sub-processes inside the process. The ordering sub-process may contain for example the order from the end customer, price or offer requests from the supplier or the order placement to the supplier. Like Tuominen described (2010, 12), the delivery sub-process contains for example order-handling, component production, assembly, packing and delivery.

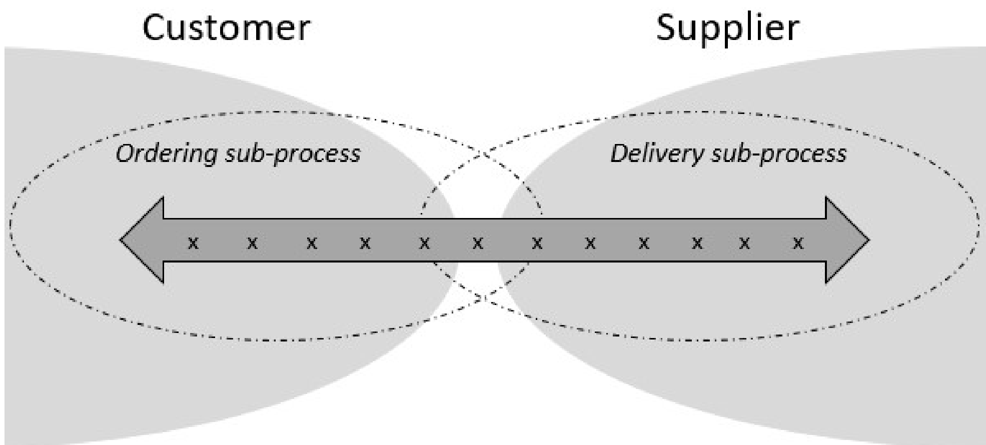

Figure 15. The ordering sub process and the delivery sub-processes in interaction.

Going forward, the 2020 target for the ROTD% measurement in the Celonis tool is 85% or above. The year to date average ROTD% for year 2020 has been 76%, so there is a 9 %-point gap between the actual ROTD% and the target. Some improvement actions need to be done to reach out the target. The key to reach out the target is to analyze the reasons behind the current ROTD% and implementing improvement actions to increase the ROTD%. Like described in the theoretical background, continuous improvement is the base of Lean philosophy and it can be viewed from many different aspects but mainly as a never-ending process throughout the company focusing on the continuous improvements. In this study the continuous improvement with small steps is considered to be a rational way to improve the ROTD%. The Figure 16 is showing the final theoretical framework of the study.

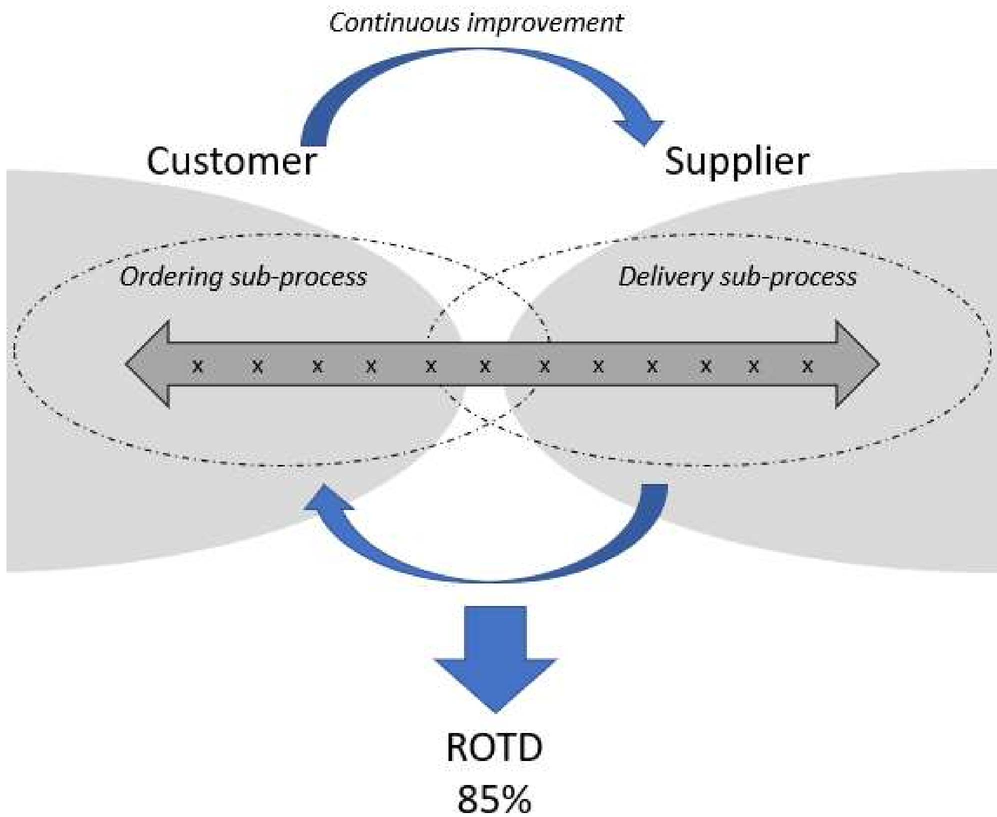

Figure 16. The continuous improvement of the order-to-delivery process.

6 EMPIRICAL STUDY

It was already 1965, when Rose and Peterson cited, that facts must be dug up from the ongoing reality, those must be monitored and measured precisely with the help of methods. The overall purpose of doing research is diversified; its aim is to describe, explain, understand, and analyze as well as criticize and foresee the existing data or knowledge. (Ghauri & Gronhaug, 2010, 3, 11).

6.1 Methodology of the study

The chosen methodology of this study is a comparative case study. A case study is investigating a comparative phenomenon in real-life context, which means that the object or the environment of the study is not manipulated, but real. There can be only one single case, or a small number of cases called comparative case study. (Dul & Hak, 2008, 4). This study is conducted for the case company X, and the analyzed cases are the selected customers, whose ROTD% is investigated. The study is utilizing both quantitative and qualitative methods. Even though many researchers emphasize either a quantitative or qualitative method, Ghauri et. al. (2010, 105) argues, that both of those can be well combined in the same study. Also Hirsjärvi, Remes & Sajavaara (2009, 160-161) agree that both quantitative and qualitative information is needed. Ghauri et al. continues, that qualitative research is more explorative, intuitive and rational where the emphasis is on understanding, whereas quantitative research is focusing on facts, logical and controlled measurement with result-oriented view (2010, 105).

Quantitative research is usually answering questions like what, where, how much or how often, and it is describing the phenomenon based on the numeric facts. In this study, the quantitative part is analysing the already existing secondary data from the Celonis tool. This data is pre-analyzed and sorted but further analyses is needed. With the help of secondary data analysis, the main reasons affecting the ROTD% for each customer will be revealed, so which are the main gaps that are preventing that the ROTD% is reached. Like Ghauri et. al. (2010, 90-91) describes, the secondary data can provide benchmarking measures or other findings which can be compared with the results of the study, and in this study, it creates the base for deeper investigation via qualitative methods.

The secondary data reliability needs to be considered as well, and in this study the secondary data is considered reliable; it is taken directly from the company's ERP system for the ROTD% measurement purpose and sorted with the common rules. Understanding the secondary data and ability to analyze it, requires skills and previous experience from the researcher to understand the reasons behind different customers, and this is covered with many years working experience with the same customers.

The advantage of the primary data is, that it is collected for the particular case at hand, and it gives more in-depth and precise information of the research problem (Ghauri et al., 2010, 14). Qualitative research is answering questions like why and/or how, and the aim is to understand the phenomenon with the help of soft knowledge (Hirsjärvi et al. 2009, 164). According to authors, the methods used in the qualitative study should bring up the view and voice of the participants, and good methods are for example theme interview, group interview, committed observation or discursive analysis. Even though the secondary data provides quite wide aspects already, to gain deeper understanding of the research problem, this study continues by collecting qualitative primary data by interviewing persons in the customer support team focusing on the previous data analysing results. All the interviewees have their own responsibility areas among the customers, and they are already familiar with Celonis data analysis and secondary data gaps. The benefit of interviewing the customer support representatives is, that they have customers with different kind of gaps affecting the ROTD. This way it is possible to gain a wider view that interviewing few LSU/RDC representatives.

After the data collection instrument is selected, the next step is to select the elements from which the information is collected. Depending on the study, it is possible to collect the information from each member of the population or a portion of the population by taking a sample from the larger group. For quantitative studies, the sampling is extremely important to get the trustworthy answer for the research problem.

(Ghauri et al., 2010, 138). In this study, the qualitative sampling is defined among all the customers based on the biggest items line quantity and the ROTD%, this is better explained in chapter 6.3. This is called judgement sample, where the aim is to select units which are representative of the population. In primary data, the sample can be described to be a convenience sample, as for the interview the customer support persons are selected persons; they are found to be convenient because of their expertise among their responsibility area.

6.2 The Celonis tool as big data source

There has been an explosion of data in the era we are living now, and some researchers has argued that big data has true potential to revolutionize many fields. There are several varieties and large volumes of data that can be processed on high velocity by the help of big data analysis (Fosso Wamba, Gunasekaran, Papadopoulos & Ngai, 2018, 478). Holmes (2018, preface) also argues, that new data analysing techniques are transforming the extensive mass of data into useful insights. However, many steps precede before the data is well visualized and applicable; the data must be retrieved from the selected source, then select a suitable subset to work with, decide the appropriate sampling strategy as well as clean the data. After several phases of pre-processed data, the data mining phase fits models and extracts patterns i.e. visualizes and, in some cases, consolidates it with the existing knowledge. Shortly, data mining transfers the data into understandable processed knowledge. (Sumathi & Sivanandam, 2006, 187).

The Celonis is a process mining software using process mining technology to transform business processes into visual mode and helps organizations to remove operational friction. With the help of process mining technologies, the process optimization is more automatic, fast and intelligent, as it pulls data from the organizations operational systems to reveal how processes are flowing within the company. It enables companies to discover, enhance and monitor in the path of process improvement. (Celonis, 2020). In the case company, the ERP- system processes a mass of data all over the world, but still there has not been a powerful tool earlier to analyze the data especially in sales or delivery processes. The Celonis has a very organized insight into the case company's processes, and the tool can process and analyze a large amount of data in no time at all.

The baseline in continuous improvement before the Celonis was taken into use, was that the analytic data was produced manually from various sources, the data processing was inconsistent and there was not a common platform to share real-time best practices. What was primarily measured were end results, not necessarily the process performance. Hence, there was a need for real-time analytics automatically from source systems and a need for root cause analysis and more efficient continuous improvement of processes and data. Since every activity in the system has a time stamp, it can be tracked on how the process is managed, and whether there is space to improve. The Celonis transfers the time stamps into physical representations of the process flow and as reports of business performance during selected time period. (Ref. Appendix 1, 2). In the case company, the Celonis is utilized on wider scope but this study will concentrate on analysing the on-time-delivery data, in more precisely; the ROTD performance. The data is taken directly from the case company's ERP system and then visualized in the Celonis tool. In the Celonis, it is possible to compare the results of the other factories globally, and the ROTD% is one of the KPI's when comparing the factories overall.

6.3 Secondary data analysis

Secondary data of the study is already available and pre-analyzed in the Celonis tool. However, further analysis is needed to understand more deeply the causes in the case company's context. In the secondary data analysis, defined classification visualized in simple bar charts was used, so it is not the aim to create deeper statistical analysis. The time period chosen for analysis is rolling six months backwards, as this is the time scale for the target 85% of the ROTD. During that time scale, there were in total 76 042 sales item lines. In this study, the aim is to concentrate on customers where the ROTD % is under 85%, but also with highest amount of sales item lines as those have the biggest effect on the overall ROTD %. The total amount for chosen customers was 36 651 sales items lines, which is 48 % of the total sales item lines during the chosen period. Considering the customers who had more than 1.000 sales item lines and the ROTD under 85 %, 13 customers were chosen for the analysis. The customers are labelled in alphabets (Table 1.), and the reference to real customer numbers is visible in Appendix 2.

Table 1. Chosen customers for secondary data analysis.

Customer	Delivery Items	ROTD %
A	7390	79
B	5573	76
C	4086	58
D	3197	80
E	2912	61
F	2137	73
G	1973	81
H	1966	74
I	1801	75
J	1635	82
K	1413	75
L	1365	53
M	1129	81

The secondary data was first uploaded from the Celonis tool to excel file for time period March 1st, 2020 to August 31st, 2020. If the ROTD% was 100% the item line is marked as 'On-time', and if both COTD% and ROTD% were 0%, the item line was marked as 'Delayed'. The next items analyzed were the items lines which may have been 'Requested to the past' or 'Requested to the weekend', as for these, there has not been a possibility to meet the requested delivery date. Even though the ROTD% is purely measuring how the factory can meet the customer requested delivery time, the factory scheduling system is based on the standard lead-times. Therefore, the next point of the analysis was to investigate if the requested lead-times are according to short lead-time, and if the quantity was bigger, it was then compared to the longer lead-time. If the customer had requested with shorter lead-time than standard lead-time is, it was marked with 'RDD<SLT' (Requested Delivery Date < Standard Lead-time). Like described earlier, some customers have deliveries each working day, but others have only few dispatch dates per week due to the volumes or long-distance location. If customer had requested the delivery date to some other day than what is the correct dispatch date, the item line was marked as ‘Requested to wrong GI date’. If none of the above mentioned analyze descriptions fit, the item line ROTD 0% was considered to originate to production or sub-supplier. The priority order is visualized in Table 2.

Table 2. The priority of the analysis description.

Priority	Analyze descriptions
1	On time
2	Delayed
3	Requested to the past
4	Requested to the weekend
5	RDD<SLT
6	Requested to wrong GI date
7	Production or Sub-Supplier

Afterwards all item lines are analyzed and marked with the closest analysis description, and the distribution of the result is presented in waterfall chart in Figure 17.

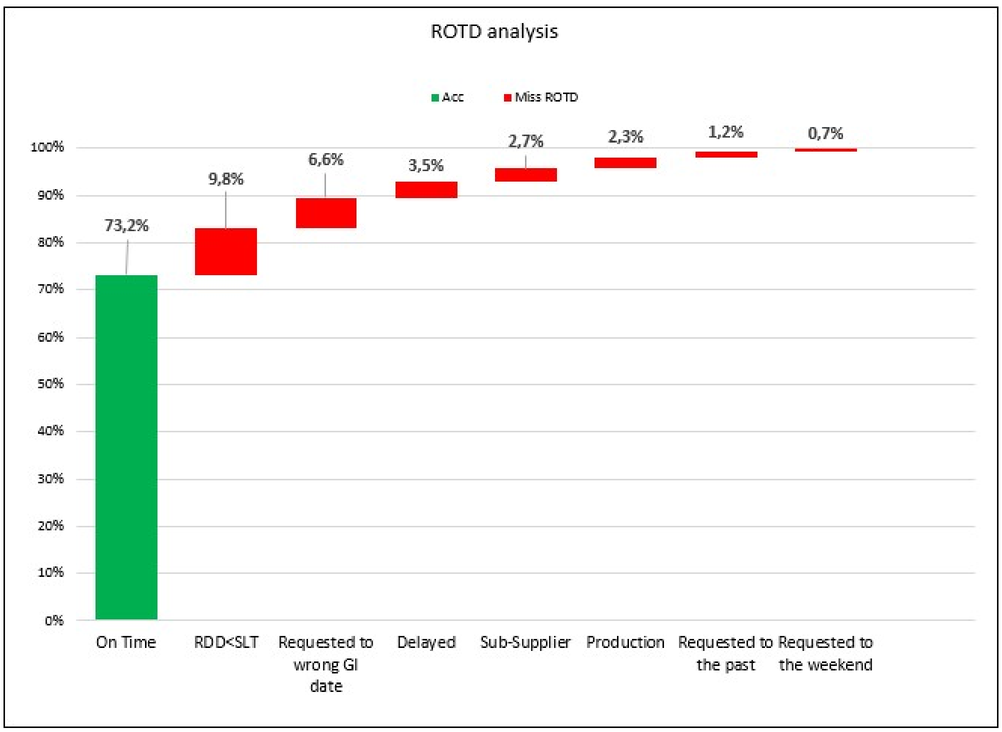

Figure 17. Overall analysis of the Celonis data.

The analysis shows that for the selected customers, the average ROTD was 73,2%. Among the selected customers, 9,8% of the ordered item lines were ordered with shorter lead-time than what the standard lead-time is. 6,6% were requested to wrong GI date, and 3,5% of the ordered item lines were delayed also from the confirmed delivery date. 2,7% were not confirmed on customer request because of the sub-supplier originated issues and 2,3% because of the production originate issues. 1,2% of the order lines were requested to the past and 0,7% were requested to the weekends. The overall analyzis shows that there is 11,8% gap for the target ROTD 85%.

Considering the on-time distribution (Figure 18), customers D, G, J and M are above 80% in ROTD, whereas customers B, F, H, I and K are between 73%-76%. The lowest ROTD% of the selected customer were for C, E and L between 58%-61%.

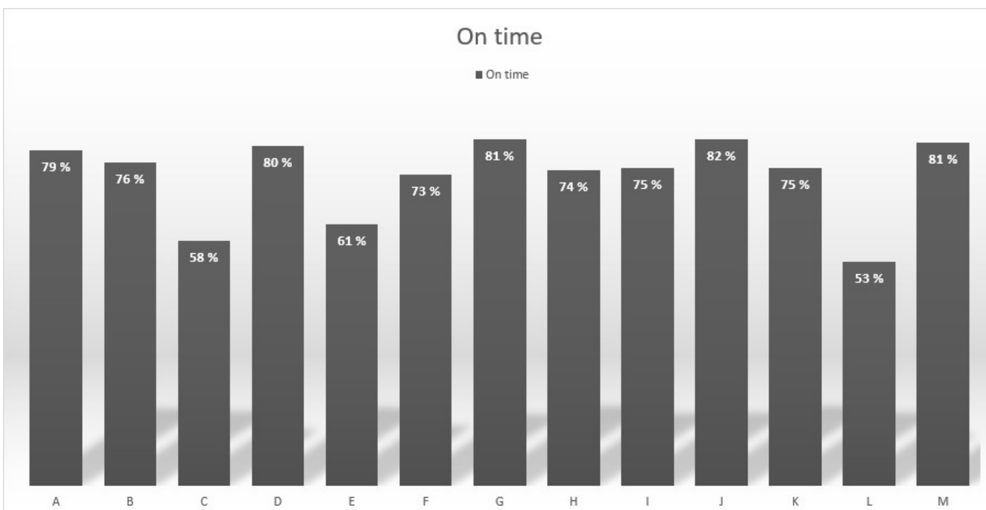

Figure 18. Requested on-time by customers.

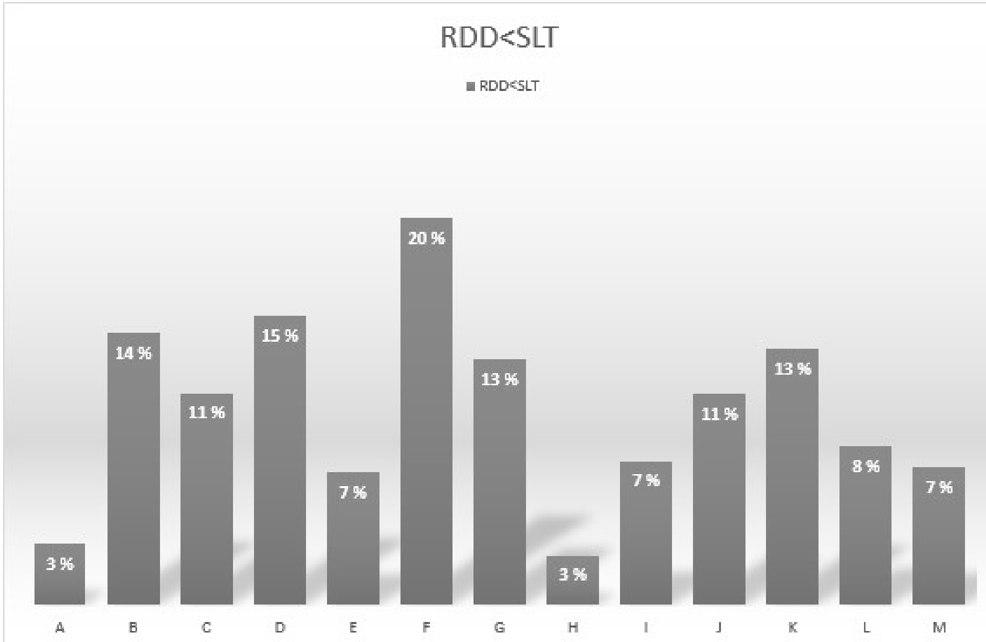

Figure 19. RDD<SLT- gap by customers.

The overall analyzis in Figure 17 shows that the highest gap reaching out the target ROTD% is due to the requested delivery date is shorter than the standard lead-time is. The Figure 19 visualizes, that customer F has requested the delivery date with shorter lead-time than the standard lead-time is for 20% of the order lines. Customers B, C, D, G, J and K have requested with shorter delivery date for 11%-15% of the all order lines, whereas customers A, E, H, I, L and M have the RDD<SLT under 10%, customer H having only 3% of the order lines requested with shorter lead-time.

After investigating the data further, it was found that there were products for which the requested delivery date was shorter than short lead-time, and on the other hand products, where the longer lead-time should have been used because of the quantity ordered, but the item line was requested with shorter lead-time. 73% of the products which were ordered with shorter lead-time than the standard lead-time, were ‘make to order’- products from own production, 15% of the stocked items and 12% of the individually purchased items. Usually stocked items are sold with 3 days lead-time, but the majority were requested with 0-2 days lead-time. For some products small quantities are sold from stock but the bigger quantities made to order or purchased individually.

Figure 20 shows that not all the customers have requested to wrong GI date, but the reason is that these customers B, D and F have shipping dates each day. Customer M does not have shipping date every workday, but they are able to manage correct factory shipping dates in their system. Customers C and L has the biggest discrepancy in requested GI dates with 19% and 29% of item lines requested to wrong GI date. Customer C is a long-distance country with three shipping dates for air and one shipping date for sea. Mainly the sea freight- orders were requested to wrong GI date as 81% of this category gap is caused by sea freight orders. For customer L, there is only one shipping date per week, so that is causing the big gap in this category. Customer A, E, G and I have 5%-10% item lines requested to wrong GI date and customers J and K only 2%. All these customers have 2-3 shipping dates per week. Customer H has only 12 item lines out of 1966 items lines requested to wrong GI date, even though they also have two shipping days per week.

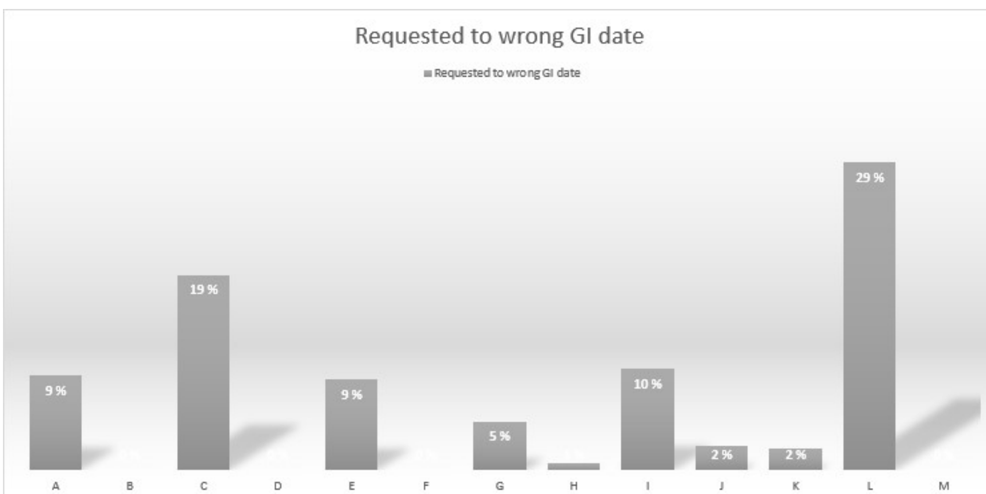

Figure 20. Requested to wrong GI date- gap by customers.

The Figure 21 visualizes the distribution of delayed order lines per customer. It means that the factory has not been able to meet the requested nor the confirmed delivery date. Customers C, I, K and M have the highest quantity of delayed order lines compared to total item lines per customer. All the other customers have under

5% of delayed item lines and customers G and H having only 1% delayed item lines. A little over half, i.e. 53% of all delayed items were sold from stock, 26% of the items are made to order and 21% are individually purchased items.

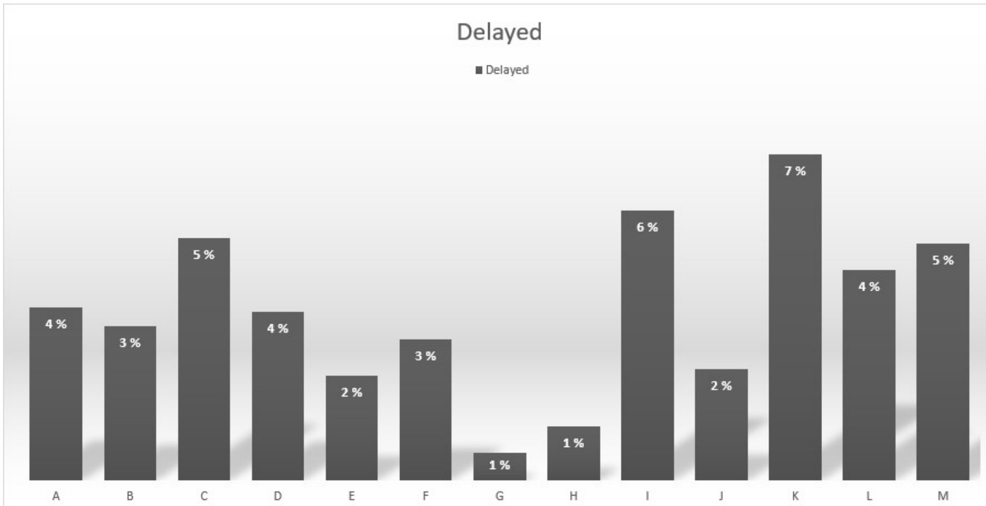

Figure 21. Delayed- gap by customers.

The fourth biggest gap is caused by production issues (Figure 22). Customer E has 8% of the item lines ROTD 0% because of the production originated issues. For customers A, B, L and M the gap is 2%-5%, and all for the rest the gap is 1% or less. After further investigation, the gap for customer E is not necessarily based on production issues, but it originates at some weeks in springtime when the COVID-19 pandemic was at its most hectic pace, so there were reduced shipping dates in place for this customer. In reality, there was not such a big gap for this customer, but it was not able to categorize the mass of items other way. It would have been possible to investigate even more deeply for example how big variation there was between requested and actual delivery date for products and products groups, but that is not the scope at this point as it was more essential to have overall view of the gaps.

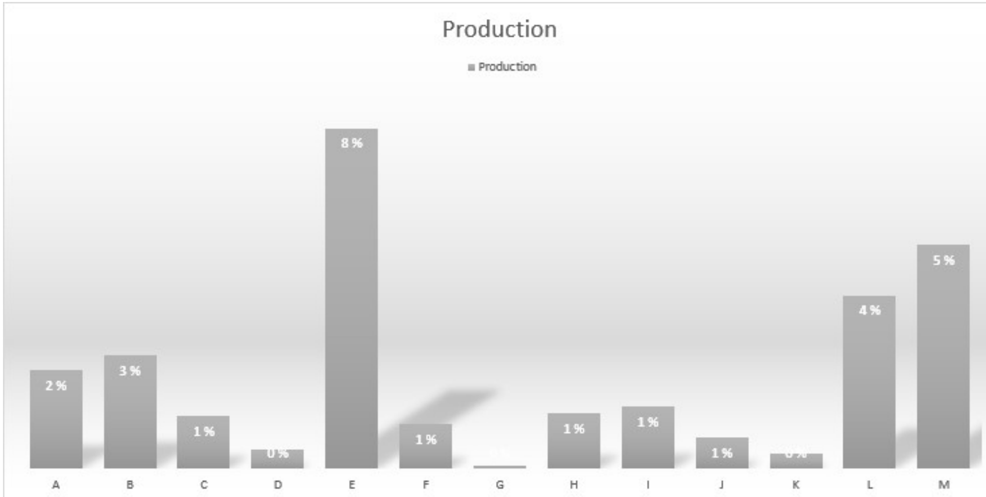

Figure 22. Production- gap by customers.

The Figure 23 illustrates that for customer E, there has been a significantly higher gap in sub-supplier originate issues, whereas for customers A, B, K and M the gap is 2%-3%, and all the rest 1% or less. The reason for customer E's big gap is the same as in production gap; for this customer there was only one shipping day per week for some weeks' time period during COVID-19 pandemic, but normally the customer E has three shipping dates per week. In reality, there is not such a gap in this category for customer E, but it is difficult to categorize this any other way.

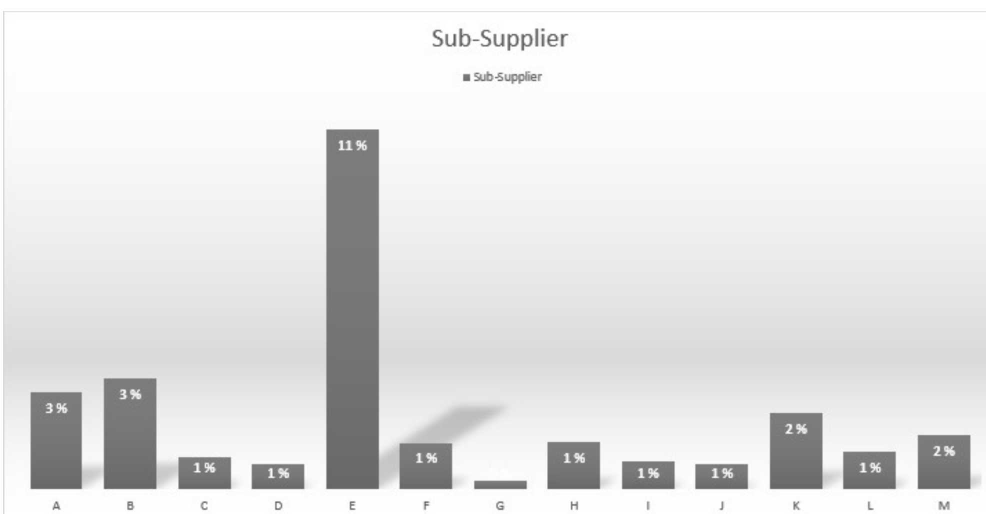

Figure 23. Sub-Supplier- gap by customers.

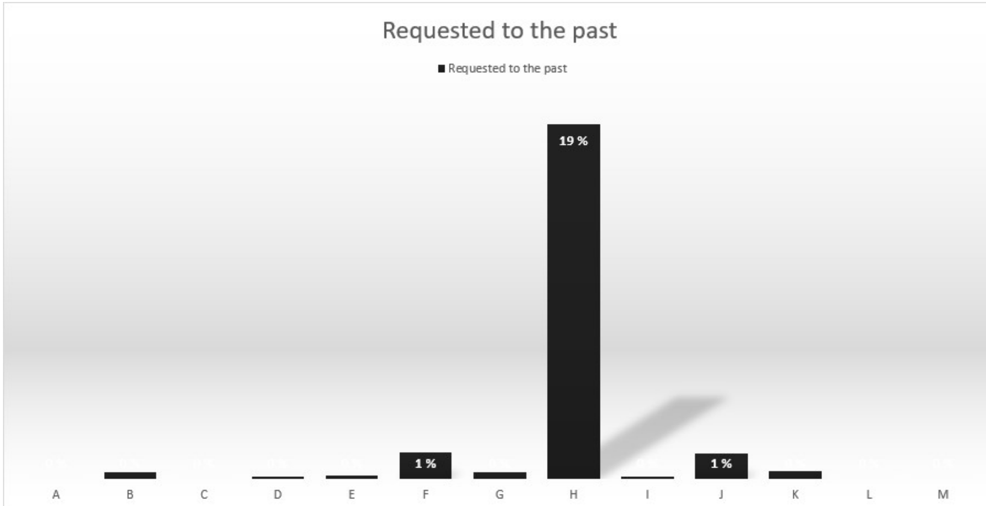

Figure 24. Requested to the past- gap by customers.

In Figure 24, the gap in requested to the past item lines affecting to the ROTD% is visualized. It shows that customer H has 19% of the item lines requested to the past, whereas all the other customers have 1% or less item lines requested to the past. After further investigation of customer H secondary data, it was revealed that customer H should include 10 days transportation-time to their requested delivery date, but it is missing in many cases. On the other hand, it seems that these item lines' requested date does not match the standard lead-time either.

Figure 25 illustrates that only customers C and E have requested delivery date to the weekend, customer C having 5% and customer E having 2% of the order lines requested to the weekends. Both customers are long distance countries, and there was no explanation found from the data. The products requested to the weekend were various, but none of them stand out specifically.

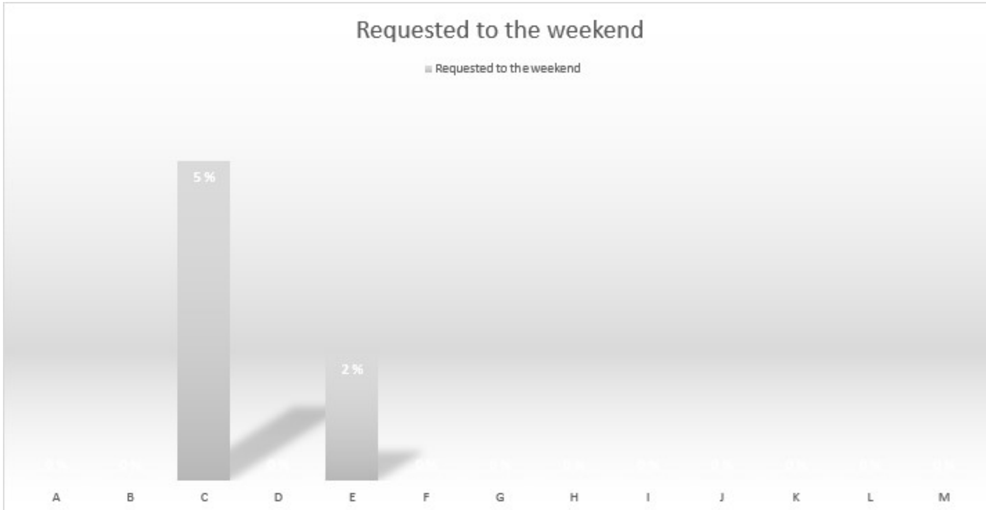

Figure 25. Requested to the weekend- gap by customers.

As a summary, most of the customers have the biggest gap in RDD<SLT. Only customer H has the biggest gap in ‘Requested to the past’, whereas customer L has biggest gap in ‘Requested to wrong GI date’. However, for customer L the gap in ‘RDD<SLT’ is quite equal to ‘Requested to wrong GI date’. In overall statistics, the ‘Requested to wrong GI’ date was the second biggest gap, but for three customers only, this was leveled in their figures. From the third to the seventh biggest gaps it varies depending on the customer. for many customers the third biggest gap is ‘Delayed’ items, whereas for few customers the third gap is originated to ‘Production’. The distribution is shown in Figure 26. However, it is important to note, that this distribution is only valid for the analyzed period of time. Therefore, it is essential to analyze the data continuously to get the most current view of the ROTD and gaps.

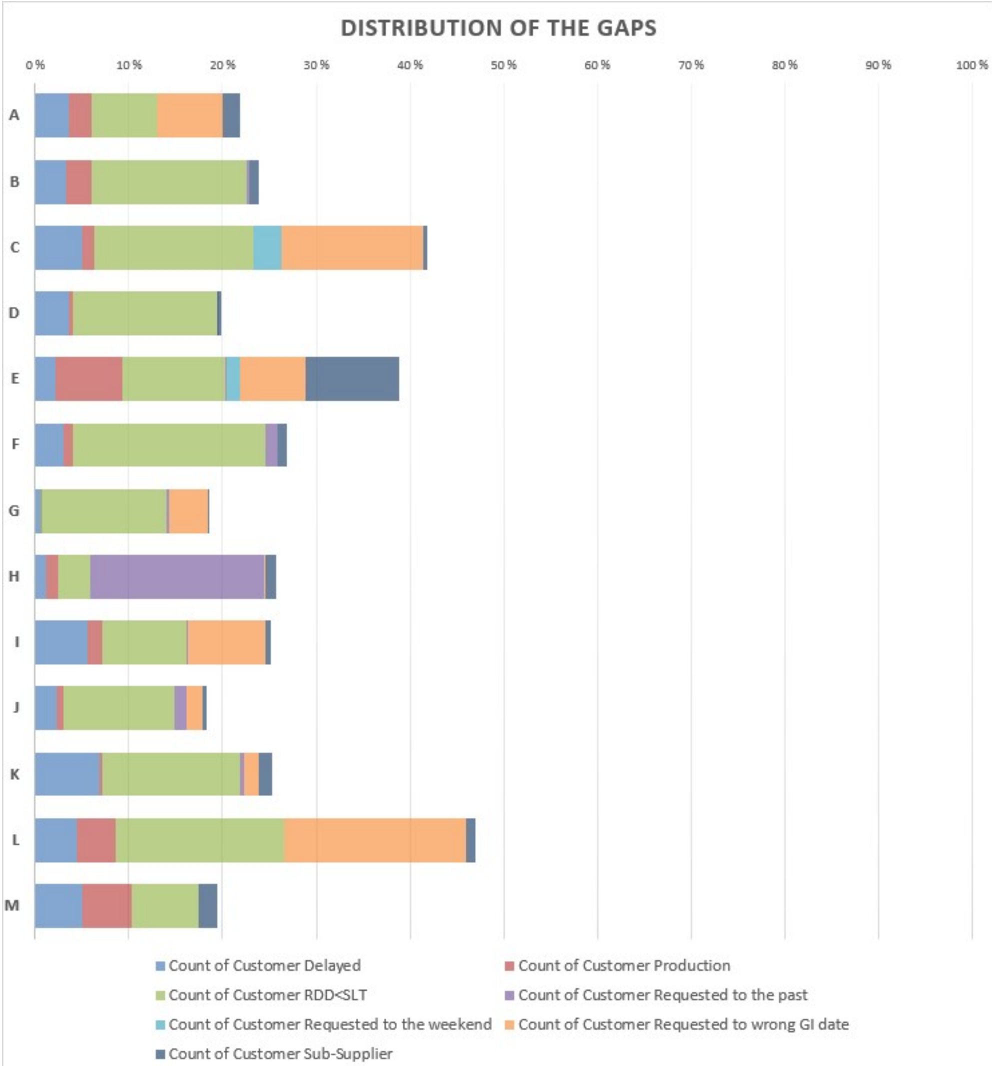

Figure 26. Distribution of the gaps.

6.4 Primary data analysis

The primary data was collected with group interviews to gain deeper understanding of the research problem. The means of the interview was theme interview, and Hirsjärvi et al. (2009, 208) describes this interview type to be a mixture of structured interview and open interview, where the themes are known but there is no precise form and order for the questions. The interviews were conducted as group interviews, as it is a good way to share ideas and process those further together. The team was divided into two groups of three persons in both groups (Appendix 3). This way it is easier to activate each person to bring up the ideas and thoughts, and also Hirsjärvi et al. (2009, 211) agrees that the group of two to three persons works best in group interviews.

The questions were divided into two theme sections. The first questions were based mainly on question ‘why’, to investigate the reasons of the gaps, and the next sections concentrating on question ‘how’ to reduce the gaps. The interview questions are shown in Appendix 4. In the first part of the interview, a fishbone diagram was used as a visualizing tool to find the possible root causes for the ROTD gaps. The fishbone- or cause-and-effect- diagram is commonly used as a helping tool in teamwork and finding out the possible causes for problems (QK-Karjalainen, 2020). It is a visual way of presenting grouped topics and documenting the brainstorming results, and the cause-and-effect diagram was filled afterwards with the reduced sentences from the both interviews to collect all the different answers together (Appendix 5). In the second part of the interview, the 8 x 8 idea creation method was applied to bring up the improvement ideas. This method is similar to a mind map, but more disciplined where the problem is written down in the middle, and eight topics related to the problem, and then to create 8 ideas for each topic (Lavonen & Meisalo). The completed 8x8 idea creation sheet was also filled afterwards with the reduced sentences to collect all the ideas together (Appendix 6). There were not found 8 ideas for each area, but the main target was more to collect the ideas in some visual and easy way knowing that there would not be as many ideas for each area.

Both interviews were recorded to ease out the transcribe afterwards. The interviews were held on subsequent days in Microsoft Teams- platform where the recording was also easy to do. For both interviews, two hours were reserved, but the recordings took 59 minutes and 57 minutes and only the actual interviews were recorded. After the interviews, those were transcribed word-by-word in Microsoft Excel during the same day the interview was conducted under the discussed topics and questions. The interview was held in Finnish and the recording was first transcribed into Finnish. All the filler words and topics outside the asked question were left out when translating the full sentences into English. The questions in the interview were already categorized based on the secondary data gaps, and the analyzed units were complete sentences, which answered the questions regarding the categorized gaps.

One of the key characteristics in the analysis is to divide up or break down the data mass. The aim of the analysis is to dissect, reduce, sort and reconstitute the data, and through this kind of analysis, the researcher manipulates the data to gain understanding, clarify problems or test hypotheses. (Ghauri et al., 2010, 199). The reduction and categorization are the critical points in data analysis because the researcher is deciding which expressions belongs to the same category, and it affects to the further analysis and conclusions of the study. After categorization, the analysis is continuing by combining the different subclasses under upper classes. Depending on the richness of the data, the classification into upper, top and main classes can be continued as far as it is considered to be meaningful. (Tuomi & Sarajärvi, 2018, 114)

In this study, the questions were already based on the specific themes, so the first categorization was done already. In the next step, the sentences were reduced to simplify the expressions. An example of this kind of reduction is in Figure 27. After the reduction, the data is clustered into subclasses (Figure 28), so that the same kind of meanings are combined into one subclass. Ghauri et al. (2010, 200) describes, that the aim of the categorization into subclasses is to find some more general phenomenon. The clustering continues by combining the subclasses into upper classes (Figure 29), the upper classes can be combined into top classes and finally there can be created one all unifying main class (Figure 30).

In this study, the subclasses were combined into upper classes, which were driven from the fact, that the defined upper class is primarily affecting the subclass. The upper classes were *end customer*, *LSU/RDC*, *factory/supplier* and *customer support*. Then, the upper classes were classified into top classes depending on whether the upper class definition is routed to *ordering sub-process* or *delivery sub-process*. The main class was defined to be the *ROTD,* which was the starting point of the whole study.

Original phrase	Reduced phrase
"End customer needs it with shorter lead time."	End customer need
"Usually they try to order according to the standard lead times, but the individually purchased items which they don't stock, they request or the end customer request just comes trough (in the order)."	Non-stock item at customer
"Could it be so that the order has been pending for approval for a while (at LSU/RDC side)."	Pending approval
"If the order goes to error list, so there might be more handling time."	Data missing
"For some customers we confirm the delivery time which includes the transportation time, but I am not sure if they take it into account. So they only order with lead time."	Transportation time not considered
"They (customers) are not taking into account the shipping dates, like for example some customer have only shipping date on Tuesday, but they request for each day."	Correct shipping dates not considered
"For my customers the challenge is the transportation time which they might not consider.."	Transportation time not considered
".. And also that they only have certain shipping dates per week."	Correct shipping dates not considered
"I am not sure if customers are able to manage the lead times in their system, especially as we have two lead times for certain quantitys."	Ability to manage two lead times
"Are customers able to utilize all the information we share?"	Ability to utilize the information
"One reason can also be that they (customers) just don't know, or just don't see the importance."	Lack of knowledge
"..or don't have recourses ."	Lack of recources
"Somebody can think that the urgency is more visible if they request faster than the lead time is."	Urgency is more visible
"Customer might not consider that if they order bigger amount, it will need more time to produce than a smaller quantity."	Lack of knowledge
"Customer is in a hurry, and even if they know the standard lead time, they are in a hurry and they will request with shorter lead time. They could request with standard lead time and then expedite, but sometimes it is one way to show that the item is urgent."	Urgency is more visible
"Customer might not have defined the standard lead times correctly into their system or does not update those."	Incorrect lead time data in the system
"They (customer) order a stock item with standard lead time, but then the stock is empty and for some products the lead time is really long if we run out of stock. Customer trust that for stocked items the lead time should be 3 days, they have it right, but we are not able to deliver accordingly."	Out of stock
"Customer does not update the batch sizes or delivery times into their system."	Incorrect lead time data in their system
"The personnel at customer is changing a lot, the reason might be that they just don't know."	Lack of knowledge

Figure 27. An example of reduced data.

Reduced phrase	Subclass
End customer need	Need or urgency
Non-stock item at customer	
Urgency is more visible	
Pending approval	Order management
Lack of recources	
Transportation time not considered	
Ability to manage two lead times	
Delay in order processing	
Ability to utilize the information	Lack of knowledge
Lack of knowledge	
Longer lead times not used	
Personnel changes	
Data missing	Incorrect system data
Incorrect lead time data in the system	
Wrong quantity	
Cancelled order line	
Out of stock	Ability to deliver
Quality issue	
Supplier	
Unclear/missing instructions	Instructions and communication

Figure 28. An example of grouping the reduced phrases into subclasses.

Subclass	Upper class
Need or urgency	End customer
Order management	LSU/RDC
Lack of knowledge	
Incorrect system data	
Ability to deliver	Factory/Supplier
Instructions and communication	Customer Support

Figure 29. An example of grouping the subclasses into upper classes.

<table>
<tr><th>Upper class</th><th>Top class</th><th>Main class</th></tr>
<tr><td>End customer</td><td rowspan="2">Ordering sub-process</td><td rowspan="4">ROTD</td></tr>
<tr><td>LSU/RDC</td></tr>
<tr><td>Factory/Supplier</td><td rowspan="2">Delivery sub-process</td></tr>
<tr><td>Customer Support</td></tr>
</table>

Figure 30. An example of the division of Upper class, Top class and Main class

7 THE RESULT OF THE STUDY

The study is not ready when the result is analyzed, but those should be also explained and construed. It means, that the researcher is reflecting on the result of the study and makes own conclusions accordingly. It is important to consider how the researcher articulation may have affected in different stages of the data collection and how the researcher may have been able to understand interviewees. Notable also is, that the reader of the study is also making own interpretations of the study while reading. Therefore, it is essential to keep in mind the complexity and multilaterality of the interpretation. (Hirsjärvi et al. 2009, 229)

7.1 The result of the study

This study was conducted with the help of secondary and primary data. The secondary data was already available and pre-analyzed in the Celonis tool but needed further analysis to obtain deeper understanding of the issue. The primary data was collected in the group interviews, where the frame was driven from the main areas which appeared in secondary data analyzes. The aim of the study was first to analyze the root causes of big variation and hence the poor performance in some cases related to requested on-time delivery. Secondly, the aim was to find out the improvement areas in order-to-delivery process.

The main class was considered to be the ROTD; it is the target and result of the performance. Like the theoretical framework described, the main sub-processes affecting the ROTD in the Celonis tool are *ordering sub-process* and *delivery sub-process*, and these were considered the top classes of the interview results. Further, the issues and/or possibilities can be routed according to upper classes, on other words; who are the main responsible of the subclasses found (Figure 31).

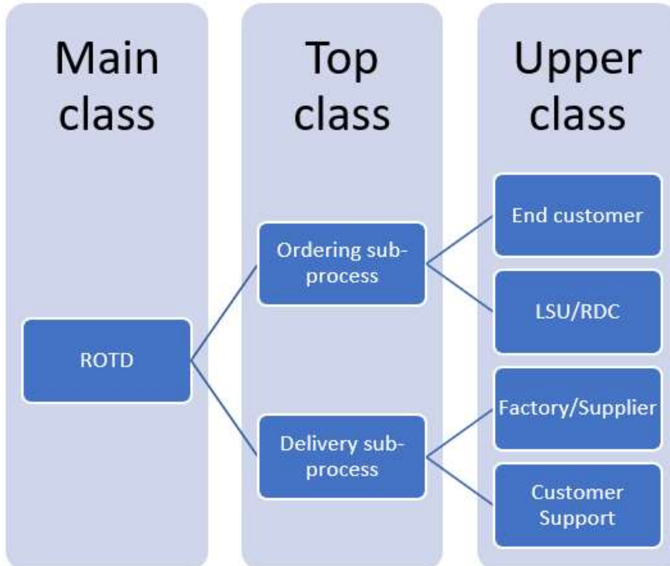

Figure 31. The top- and upper classes of the study.

The result of the analysis consists of the two top classes, the ordering sub-process and delivering sub process, so which are the reasons affecting the ROTD in these classes. Later, the improvement areas were separately analyzed based on the same classes.

7.1.1 Ordering sub-process gaps

In the ordering sub-process, two upper classes were identified; end customer and LSU/RDC (Figure 32). Obviously, the end customer is behind the whole ordering process, and one of the issues, which may cause the shorter requested lead-times, was the end customer *need of urgency*. The end customer may purely have an urgent need, and if the product is non-stocked item at LSU/RDC, the order comes through with the lead-time the end customer has requested it. This issue has come up also in earlier discussions with LSU's/RDC's as well; they are not able to change the requested delivery date that the end customer has asked if the product is a non-stock item. One point that came up during the interviews, was that the end customer need might be more visible if ordered with very short lead-time.

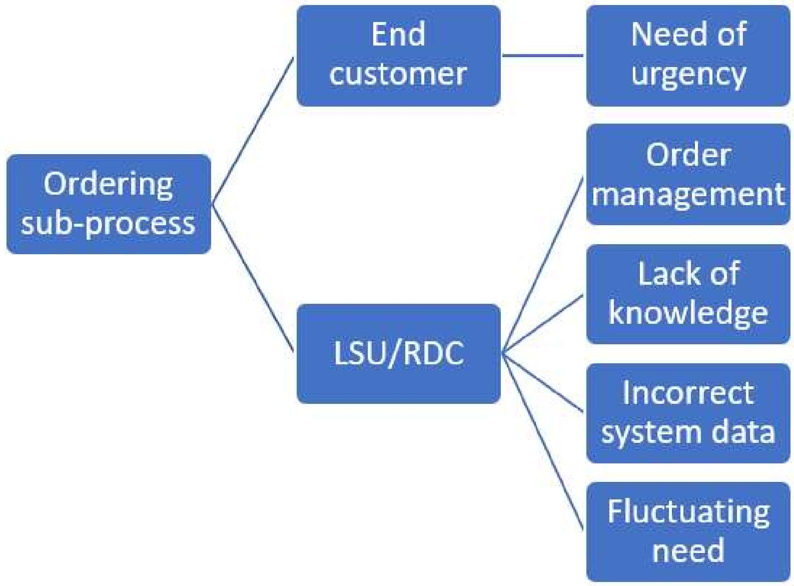

Figure 32. Order sub-process top- and subclasses.

One of the biggest gaps, that came up during the interviews was the LSU/RDC *order management*. It was discussed that LSU's/RDC's do not necessarily consider the transportation time in the requested delivery time, even though for some customer it should be considered depending on the incoterm agreement. Also, they may not be able to manage short and longer lead-times in their system, but they order only with the short lead-time even though the ordered quantity would need the longer lead-time. Some LSU's/RDC's may have an internal approval process, which causes that when they place the order to factory, the requested lead-time is not anymore according to standard or is already passed it. Delay in order processing at LSU/RDC side can cause that the order is requested with too short lead-time or requested to the past, and one of the interviewees brought up that they might not even be able to modify the original requested dates.

When considering the requests to wrong goods issue date, the issues that came up during the interview was, that the transportation-time is not considered, or the correct customer specific shipping dates are not considered. They might not even be able to manage the correct GI dates in their system, or, for some customers it is manual work that they do. One gap found in secondary data analyze was the customer requests for the weekends, and in the interview, this was also considered both order management and incorrect system data issue. LSU's/RDC's may only consider the lead-time and if they have a different working calendar or have not blocked the weekends in their databases, it is causing requests for the weekends. During the first interview, it was recognized one new gap which was not considered earlier, and it was named as *customer specific issues*. Sometimes customer have closing periods at their side, and they request the factory to amend the orders and not to deliver at certain period of time. However, they might not have closed the same period in their system, or they have not changed the orders accordingly in their own system, and this causes mismatches in the ROTD.

The *lack of knowledge* was recognized to affect also many gaps. Even though the lead-times are provided to LSU's/RDC's at least twice a year or on request, there still seems to be unclarities and lack of knowledge on how to use especially the longer lead-times. It was jointly agreed in the interviews that customers are only able to update one lead-time in their system, but only few customers have also updated the longer lead-times permanently for high runners. Personnel changes at LSU/RDC side can also cause lack of knowledge, and the reason might also be that the personnel who are processing the orders, does not necessarily have the lead-time information or does not know how to use it. Also, the requested to wrong GI date or requested to the past can be caused by the lack of knowledge. Either they do not know the correct shipping dates, or they are not able to manage those in their system. Sometimes this might even be person driven or purely a human mistake.

The *incorrect system data* can appear in too short lead-times, wrong GI dates or request in the past/weekend. The LSU/RDC system data can be incorrect in many ways; it has not been updated, contains wrong data (like wrong quantity or lead-time) or the longer lead-times/transportation-times/correct GI dates are not considered in the system. Also, if the weekends are not blocked in their system, it allows them to order for weekends as well.

Sometimes the reason for the gap can also be *fluctuating need*. Especially end customer projects may generate huge order peaks for some products, and if the

LSU/RDC only have the short lead-times in their system, they order the big quantities with short lead-time. Huge order peaks can also empty the stocks at the factory, as the big quantities are ordered with short lead-time. This is considered to be included to the ordering sub-process, as the factory is not able to be prepared for order peaks without proper forecast from LSU/RDC side.

7.1.2 Delivering sub-process gaps

In the delivering sub-process, two upper classes were recognized; factory/supplier and customer support (Figure 33). All the causes in factory/supplier areas were categorized as ability to deliver, whereas order management or instructions and communication were considered the upper classes for customer support.

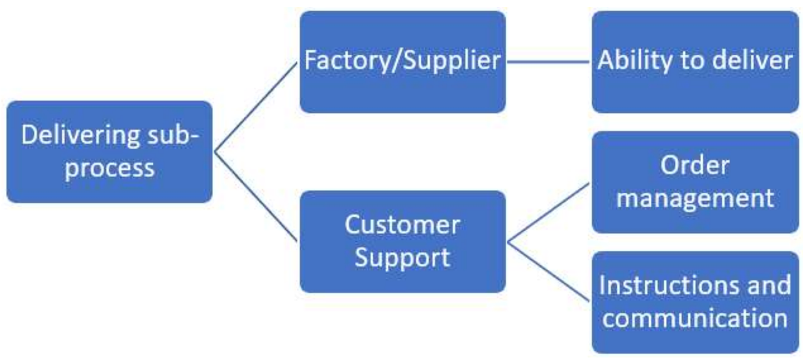

Figure 33. Delivering sub-process top and subclasses.

The *ability to deliver* rose the main and only topic when considering the factory/supplier impact on the ROTD and the reasons are various. Sometimes, even though the stock levels are continuously followed, the factory might run out of stock for some products. It is either the huge order peaks or the factory/supplier ability to fill in the stocks, or there might be some quality related issues. For stocks but also for production and supplier deliveries, the impact of missing components, quality issues and broken tool or machine is obvious. Sometimes, due to the production capacity, few or more dates are closed in production calendar. It means that new orders cannot be scheduled to those dates anymore, and the scheduling process ignores those dates. In these cases, the lead-time is longer than the standard lead-time, and the impact is greater if more dates are continuously closed. Supplier capacity can affect also the lead-time due to delayed deliveries or longer lead-times confirmed. One way to manage either the capacity or the lack of components at factory is to update temporarily longer lead-times for certain products in factory database. The longer the period is, and the quantity of products affected, the greater the impact to the ROTD also is.

The subjects were discussed a lot during the interviews, but there were also some individually raised topics like maintenance and inventory sometimes affecting the ability to deliver according to request. On the other hand, there might be supplier changes every now and then, where some component production is moved from one supplier to another, and if not planned well or some challenges arise, it affects the ability to deliver. Sometimes rarely sold items might have longer lead-time if some components are missing and for some reason those needs longer time to deliver than what factory have considered as standard lead-time. For some purchased products, quality inspections have been defined when receipt to verify the quality, and it may add some lead-time if there is for example, a capacity issue at that moment. The capacity issue may rise also in sending department if there are a lot of delivered item lines scheduled for one day or due to personnel capacity overall. These are quite rare, and not impacting a lot but still considerable.

For customer support, one subclass identified was the *instruction and communication.* One reason why LSU’s/RDC’s are ordering with shorter lead-time than the standard lead-time, might be the unclear or missing instruction regarding the short and longer lead-times and the quantity limits for those. Earlier, the lead-times were shared with LSU’s/RDC’s with the file which included only the short lead-time even though there were also longer lead-times in use for bigger quantities. In autumn 2019 the new file was implemented, where both short and longer lead-times, and quantity levels for both were shown. However, the instructions for using the new file were probably insufficient, and not many customers are utilizing both lead-times.

Other dimension affecting the delays or longer lead-times is when LSU/RDC is ordering rarely sold items. During the interview, there was a discussion about these kinds of cases where rarely sold items were delayed because the special products were not recognized, and information about some components taking longer time to be received was given afterwards. However, it was agreed that customer support is not able to check item lines if rarely sold or not, but the lead-time itself should be on correct level. Also, sometimes longer order processing time can add some extra days, and the customer requested delivery time cannot be met because of that.

7.1.3 ROTD improvement possibilities

In addition to analyzing what the gaps affecting ROTD are, the actions to improve the ROTD figures were also discussed. Like in the gaps, also in the improvement actions the responsibility area is even more indeterminate. Therefore, it is not necessarily essential to consider the ordering sub-process and delivery sub-process separately, but more as the main responsibility areas like described in Figure 34.

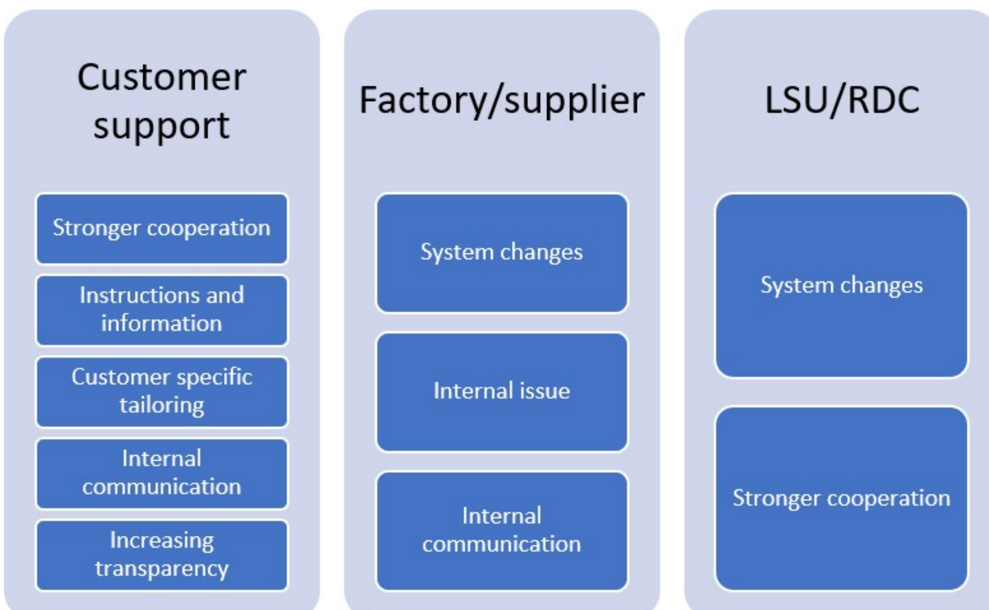

Figure 34. ROTD improvement responsibility areas.

During the interview, there were found a lot of tasks that customer support could do to support the ROTD improvement. It was agreed, that in many cases the *stronger cooperation* as well as *instructions and information* could help improving the ROTD. Stronger cooperation is visible when considering many different gaps.

For lead-times, customer support should catch the item lines ordered with too short lead-time immediately when those arise, and with the help of cooperation, investigate what the reasons behind those are. It should be ensured that LSU/RDC update the corrects data in their system. Stronger cooperation is also the key to correct the item lines which are requested to the past or to the weekend, or if customers have closing periods. Customer support should dig into the data together with LSU/RDC and ensure that the transportation-time is included and inform if they should request the shipping date or the arrival date based on the incoterm agreement.

In regard to lead-times, it would help that customer support could provide clearer instructions on how to read the short and longer lead-times from the file, as it has been a bit difficult for them also to understand for example, the limits. These instructions were already made and shared in a recently established SharePoint- site directed for LSU's/RDC's. This site should now be used for better information sharing, and as the site was opened, many new contact persons were interested on joining. It was also discussed that customer support should ensure that correct persons at LSU's/RDC's receive the needed data, as sometimes they have noticed that the persons who are ordering, do not necessarily have the lead-time information. In the SharePoint, the master file of all the lead-times could also be shared to help LSU's/RDC's to check some lead-times which they might not have yet. Customer support could also inform customers every time the extended lead-times are in use, because this way it could be ensured, that LSU's/RDC's have the up-to-date information in use. In addition to extended lead-times, customer support could give more information to LSU/RDC about the other possible challenges, which may affect to the deliveries.

Other area where customer support could somehow affect the ROTD is the *customer specific tailoring.* One important thing, which has been discussed a lot, is adding some extra days to the lead-time for those customers that only have few shipping dates per week. This could help the current factory scheduling system to schedule the orders to the previous possible and correct shipping date if customers have only few shipping dates per week. Customer support could also analyze the high runners together with main LSU/RDC to make sure that longer lead-times are permanently in use for those products they order the most. For some LSU's/RDC's, it would be good to analyze also the challenging products, for example, products where the lead-time differs a lot if stock is sold out. Together with LSU/RDC, it would be good to consider updating longer lead-times if it is seen that bigger batches are always ordered for those products.

During the interview, one separate topic related to *internal communication* was also raised. Customer support should actively bring up the voice of the customer, as it should be the core in each action. Sometimes the decisions are easily made considering only ease of doing things, like closing too many factory days one after the other if it is not properly considered how it affects the requested lead-times. Other separate topic discussed was *increasing transparency*. It has been discussed already earlier that factory should provide the stock availability in the web tool to increase transparency. This has been investigated already but is not necessarily easy to implement due to the complexity of the ERP system but would surely help LSU's/RDC's to see what the stock situation at factory is, and it will be further investigated.

From factory/supplier point of view, there were identified *system changes*, *internal issues* and *internal communication* as the areas that could help to improve the ROTD. There were suggestions given in the interview, like raising stock values, reducing lead-times and adding some stock for high runners. Lead-times should be checked twice a year and needs for changes could be found. However, the stock values are quite optimized already, but one possibility would be to align LSU/RDC stock items and factory stock items so that the same product is not stocked by many locations. There were also other suggestions, like adding shipping dates for each LSU/RDC every day, or to uniform the incoterms so, that only the shipping date without transportation-time would be confirmed. Internal communication was important topic, and there was discussion about the big projects and those affecting to factory performance. There was highlighted the Product Management responsibility to communicate the possible incoming project orders well in advance and cooperate with purchasing and factory to ensure the material flow.

When discussing about the possibilities to reduce the delayed item lines, there were not many ideas of improvement, and the delayed item lines are always caused by missing components, capacity or quality issues. However, it was agreed that enough resources should be guaranteed, and factory and purchasing should proactively follow-up the order flow to see possible issues well in advance. Also prioritizing the orders can have some impact on the delayed item lines, as in general, production orders, which are opened for customer ordered are prioritized, and the items which produced for stock, might be delayed. In these cases, the small order lines which are sold from stock, might then be delayed. This is affecting to the ROTD, but on the other hand, one aim is also to have as low delay in the invoicing value as possible. Internal communication holds a significant role in reduction of delayed order lines or longer lead-times. Also, the new SAP transaction in purchasing side and new additions to production work queue where they can see the customer requested shipping date, are considered to be helpful in regard to reducing delayed order lines as well as to better meet the requested delivery date. One improvement task would be to actively follow updates in the actual producing dates and receipt dates for purchased goods, so that the dates in the system would hold better true.

One of the biggest improvement areas for LSU's/RDC's, was concerning the system changes. Like already brought up in gaps, they do not necessarily have the correct data in their system. The lead-times should be correct, and somehow, they should be able to manage at least the transportation-time in their system. In addition, it would be good to manage the correct shipping dates in their system, as it is likely possible for at least some LSU's/RDC's. There was also one new gap recognized during the interview, which was related to customers closing periods, and these should be also updated in LSU/RDC system so that no orders would be requested on that period of time. As it was already described in customer support area, the strong cooperation between customer support and LSU/RDC plays a significant role, and the LSU/RDC should analyze also the high runners from their point of view and update the short or longer lead-times accordingly. They should also examine the stocking levels and probably add some stocks for high runners or special products that they only order and are not stocked at the factory.

8 CONCLUSIONS

8.1 Answers to research questions

Going back to the beginning of the study, the research questions were asking:

- What are the factors affecting the current level of ROTD% from customer and factory point of view?
- How should the customer modify the ordering process so that the gap between actual delivery date and the customer requested delivery date would decrease?
- What actions should be done in the order-to-delivery process to better meet the requested delivery time?

These research questions were combined into one main question asking; *Why does the customer requested delivery date and actual delivery date differ from each other and how could the ROTD be improved?*

The secondary data analysis was bringing up the factors affecting the current ROTD% level, and that gave the starting point for primary data collection. The interview questions were therefore constructed around the secondary data findings asking the questions *why* and *how* to find out the root causes for the gaps and also find out the improvement need in the order-to-delivery process.

The gaps have been recognized already earlier when analyzing the data from the Celonis tool. However, the division between different customers can differ a great deal as it was shown in secondary data analysis. Some customers have only minor item lines requested with shorter lead-time than standard one, but then the same customer might have huge quantities requested to the past. On the other hand, only few customers were requesting the shipping date to the weekend, so other customers are apparently able to manage this in their system. As a conclusion, each customer data needs to be analyzed separately and plan actions accordingly. All the customers can of course be analyzed together, but no unifying conclusions can be made, because there are always customer specific reasons behind the results.

The primary data collected in the interviews deepened the understanding of the root causes behind the gaps. There were gaps found related both to the sub-process as well as to the delivery sub-process. The main gaps in the ordering sub-process were related to order management, lack of knowledge and incorrect system data whereas in the delivery process, the biggest gaps are caused by the factory ability to deliver due to various reasons.

The interview result shows clearly that the strong cooperation and clear instructions are the key to affect the ROTD. It is also notable, that even though the customer support had minor impact on the gaps, they still have big impact on improving the ROTD by cooperating and communicating with LSU's/RDC's. We need to continue to strengthen the cooperation between LSU/RDC and the customer support, as well as increase the internal communication at the factory. These topics were raised in many different contexts and should be considered in continuous improvement actions.

The theoretical background was supporting the empirical study well and can be linked together. The theory of the order-to-delivery process was describing the core of the whole study. There, it was identified the two main sub-processes, the ordering sub-process and the delivering sub-process, to be further investigated. The delivery performance measurement illuminated a little bit of the importance, but also the complexity of performance measurement. The continuous improvement continued by highlighting especially the customer focus on all actions and introduced some methods and tools for further continuous improvement actions. All these different chapters were combined in the theoretical framework, which helped to define the final focus of the study.

8.2 Reliability and validity of the research

In the study, the aim is to avoid any mistakes and therefore, it is important to evaluate the reliability and validity of the study. Reliability means the repeatability of the study result, on other words; it does not give coincidental results. This can be authenticated in many ways, and if for example two appraisers ends up to same result, the result can be considered reliable. In quantitative researches, there are also many different statistical ways to evaluate the reliability (Hirsjärvi et al. 2009, 231). In this study, the secondary data itself can be considered reliable, it is driven from the ERP system, and the Celonis data is created with common rules by third party platform ensuring that each factory is evaluated according the same rules. If following the same analyze description priority, the result of the categories would be the same. The gap categories have been in use already from autumn 2019, so those are familiar, and analysis have been done a monthly basis, based on these categories. However, it is notable to understand that if analyzed in another order, it would affect the result. An item line can have many gaps, but the priority order defines which of the gaps shows first. So, one item line can be requested to wrong GI date as well as too short lead-time at the same time.

The primary data can be considered reliable, so if the same interview had been conducted by someone else, the answers would have been quite much the same, and if the interview would be repeated with the same interviewees, there would not most likely arise any new or only singular topics. However, if interviewing customers or production or purchasing representatives at factory, the result would be divided in another way and some new topics would emerge. As a conclusion, in this context and approach, the result is reliable.

Another concept is validity when evaluating the research. Validity means the ability for metric or the research method to measure exactly what was ment to measure. (Hirsjärvi et al. 2009, 231). Like in reliability, also the validity of the secondary data can be considered valid. The aim was to define the gaps affecting the ROTD% and the Celonis metric is already pre-analyzed data, so for example the requested on-time lines are already categorized in the data. With the help of analysis description priority, it is easy to define the categories, but needs manual work as the pre-analyzed data is not revealing the gaps correctly. The interview was conducted in the team, where members know the topic and know each's other very well. The research problem is asking 'why' and 'how', and the interview questions were formed in that way. The questions in the interview were tied with the secondary data categories, so the topics were familiar and there are very few probabilities that the questions would have been misunderstood. Also, the precise description of the research may improve the validity. Therefore, the study can also be considered rather valid.

8.3 Recommendations and development plan

Considering the gaps and improvement ideas found during this study, it is essential to put the improvement ideas into action. As defined in the theoretical background, the Deming- cycle is one of the continuous improvement tools, and it would be good to utilize it in further actions as well. The continuous improvement is good to implement in small steps and in the area that one could affect for real, so the following improvement action plan was defined for customer support (Figure 35).

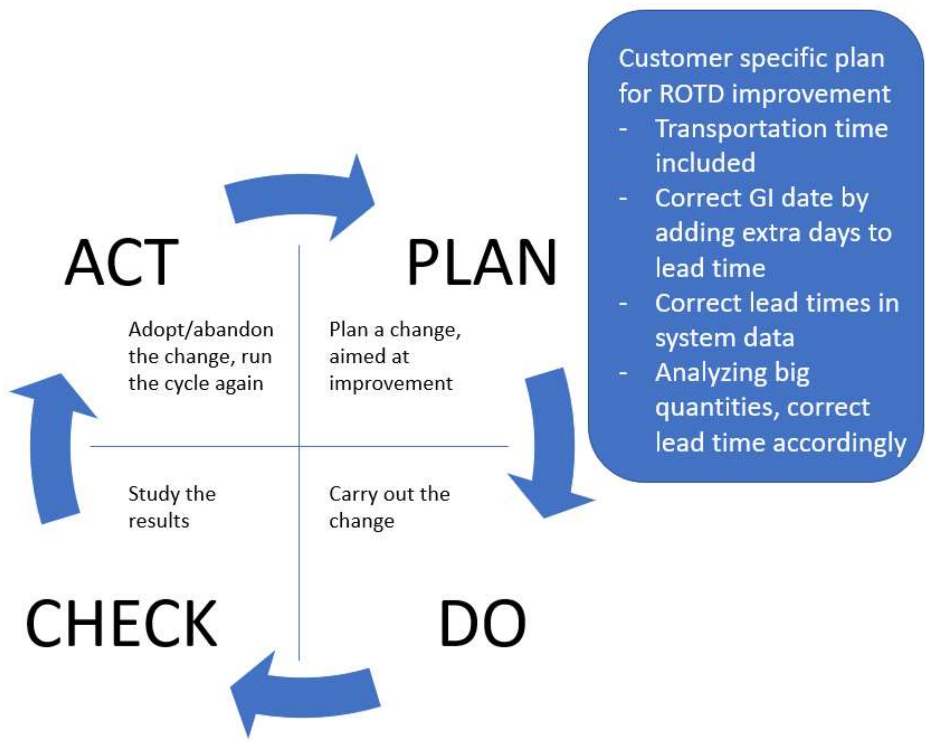

Figure 35. Improvement plan for customer support area.

As described in the results, the strong cooperation is one of the essential things to maintain and improve, and the continuous improvement plan is embracing this view. The plan for customer support is to start the customer specific improvement actions by ensuring, within own responsibility area, that the transportation-time is included in the requested delivery time if incoterm agreement requires so. It is necessary to examine how many extra dates should be added on top of the lead-time for the customers who have only few shipping dates per week, so that we can better match the requested delivery date with actual delivery date. On the other hand, it would be good to investigate also if there would be a need to add some more shipping dates if the volumes have increased. Lastly, there is a need to analyze the big quantities and high runners ordered and to ensure that LSU/RDC have updated the longer lead-time for those items that they are ordering in big quantities. As referred to earlier in chapter 4, it is important that the perception is realistic and attainable, so it is not reasonable to change the fluent process if customer perception differs from reality. All in all, the customer support target is to ensure in the best possible way that LSU's and RDC's have all data correct in their system.

One continuous improvement tool was benchmarking, and as it was revealed in the secondary data analysis in Figure 19. the customer M was able to manage correct GI dates in their system even though they do not have shipping dates every day. For example, the sea freight GI date was changed from Friday to Tuesday in autumn 2019 and they were able to manage and change the new date in their system so that the sea freight orders are requested to correct shipping date. This could be one benchmarking idea to investigate with the customer how this is managed in their system and instruct other customers as well about the possibility. Of course, it must be considered that not all the customers have the same system in use and for some it is just not possible to manage.

Another idea, which came after the interviews, was to utilize the Microsoft Teams for better customer specific communication as well. During the interviews, the topic related to lack of knowledge was addressed in many different contexts, and in MS Teams, it would be easy to collect all the needed data that should be considered in the ordering sub-process. This would help also new persons at LSU/RDC to learn the practices better.

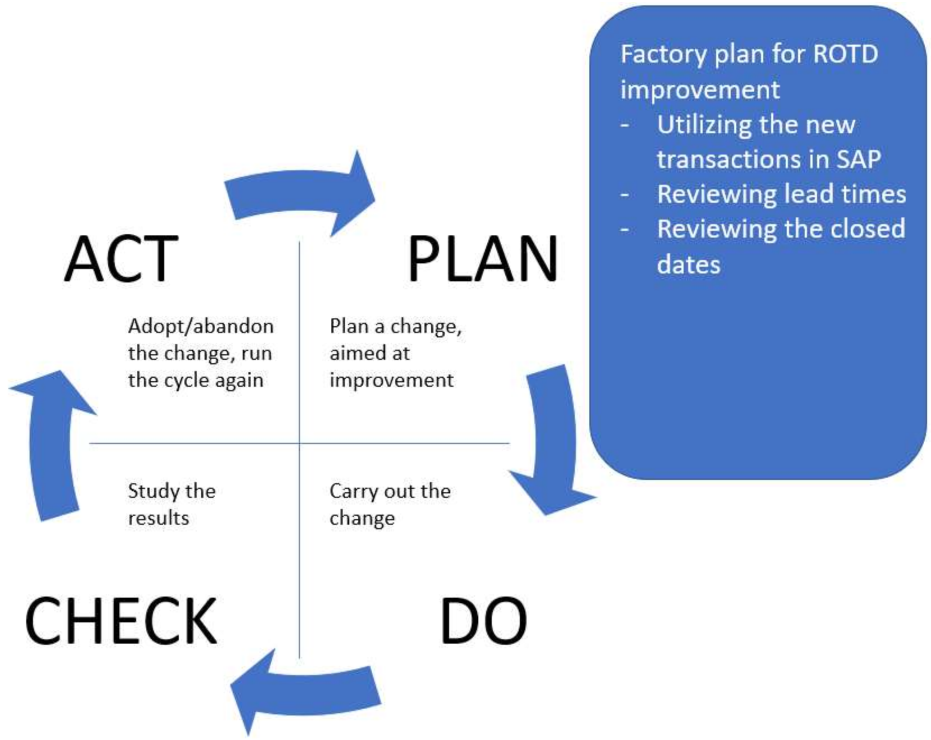

Figure 36. Improvement plan for factory area.

The main tasks for the factory to improve the ROTD (Figure 36) are to utilize the new functions in work queue and purchasing transaction where the customer requested delivery date is visible. As the factory's scheduling system is not able to consider purely the customer request, it is good that they are still able to see the requested delivery date, and produce goods according to customer request if possible, on capacity or component point of view. On the other hand, the interview addressed some mismatches in system data, so it would be good to go through and ensure that we have correct lead-times in the database, and to verify if something needs to be changed. Lastly, it is essential to remember how the closed dates affect ROTD and consider possible other actions to implement.

8.4 Proposals for further development and research

The Celonis tool and ROTD calculation based on the Celonis data have been running now from the year 2019. The ROTD% has been improving step by step and the year 2020 target is quite close already. However, there are many things to improve as the target will not remain at the same level for good. Therefore, there is obviously room for continuous improvement actions in the future as well. Proposals for further development could be various; it would be interesting to analyze the same kind of study after few years to see how the gaps have been developing. Like already discussed in chapter 3, if something needs to be improved, it is necessary to measure the gap size after the changes have been made to indicate whether the attempt to improve the performance worked or not.

In addition, it could be possible to dig into specific product groups ROTD in the light of lead-time improvement or investigate more deeply one customer progress and conducting precise improvement project using for example Lean Six Sigma DMAIC- method. On the other hand, this study was made by interviewing the internal customer support, but another point of view would also be to interview purely persons at LSU/RDC to understand how the processes are at their side. This study will be processed further in Lean Six Sigma Green Belt project concentrating more deeply on the highest gaps and concrete improvement actions described earlier. Therefore, this has given a great starting point for further continuous improvement!

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APPENDIX 1 - CONFIDENTIAL
Confidential references

This appendix is confidential.

APPENDIX 2 - CONFIDENTIAL
Customers in secondary data analyze.

This appendix is confidential.

APPENDIX 3 - CONFIDENTIAL
Participants of the interview

This appendix is confidential.

APPENDIX 4
Interview questions

Part I

Why the requested delivery time is shorter than the standard lead-time?

How the sub-supplier challenges affect the ROTD?

How the production challenges affect the ROTD?

Why some of the order lines are delayed?

Why the customers requests to the past?

Why the customers requests to the weekend?

What other issues could affect the ROTD?

Part II

How we can reduce the gap between requested and confirmed lead-time?

How we could reduce the gap when customers requests to the wrong GI dates?

How we could reduce the delayed item lines?

How we reduce the gaps caused by production?

How we can reduce the gaps caused by sub-supplier?

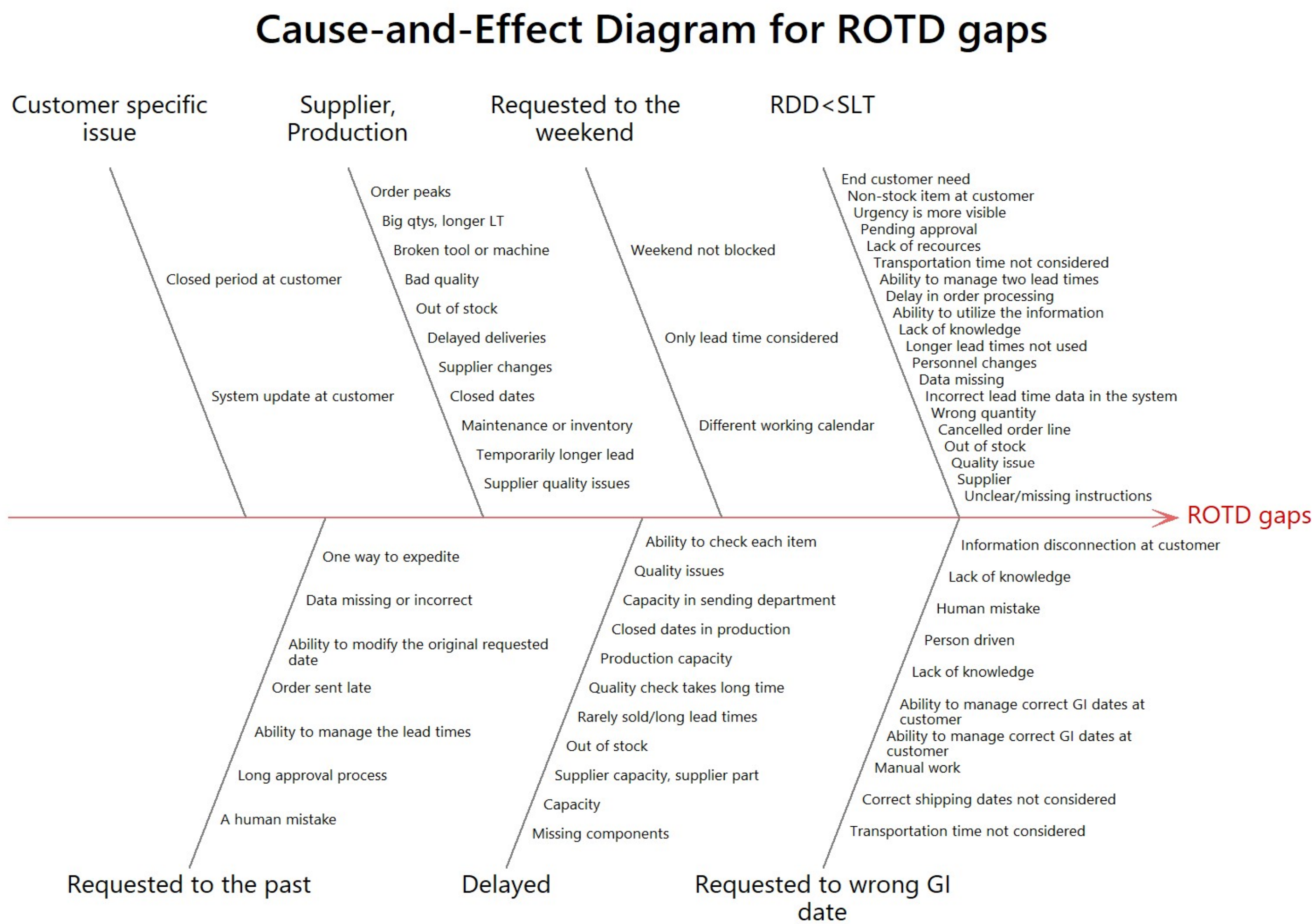
How we could reduce the item lines which are requested to the past?

How we can reduce the item lines requested to the weekend?

What special features comes up with your customers which can affect the ROTD?

APPENDIX 5

Cause-and-Effect diagram for ROTD gaps



APPENDIX 6

8x8 idea creation method