Improvement of an order-to-cash business process by deploying lean six sigma tools: a case study

Emilia Kääriä and Ahm Shamsuzzoha
University of Vaasa, Vaasa, Finland

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Abstract

Purpose – This study is focused to support an ongoing development project of the case company's current state and the challenges of the order-to-cash (O2C) process. The O2C process is the most visible process to the customer, and therefore, its punctual and fluent order management is vital. It is observed that the high degree of manual work in the O2C process causes mistakes, delays and rework in the process. The purpose of this article is therefore to analyze the case company's current state of the O2C process as well as to identify the areas of development in this process by deploying the means of Lean Six Sigma tools such as value stream mapping (VSM).

Design/methodology/approach – The study was conducted as a mix of quantitative and qualitative analysis. Based on both the quantitative and qualitative data, a workshop on VSM was organized to analyze the current state of the O2C process of a case company, engaged in the energy and environment sector in Finland.

Findings – The results found that excessive manual work was highly connected to inadequate or incorrect data in pricing and invoicing activities, which resulted in canceled invoices. Canceled invoices are visible to the customer and have a negative impact on the customer experience. This study found that by improving the performance of the O2C process activities and improving communication among the internal and external stakeholders, the whole O2C process can perform more effectively and provide better customer value.

Originality/value – The O2C process is the most visible process to the customer and therefore its punctual and fluent order management is vital. To ensure that the O2C process is operating as desired, suitable process performance metrics need to be aligned and followed. The results gathered from the case company's data, questionnaire interviews, and the VSM workshop are all highlighted in this study. The main practical and managerial implications were to understand the real-time O2C process performance, which is necessary to ensure strong performance and enhance continuous improvement of the O2C process that leads to operational excellence and commercial competitiveness of the studied case company.

Keywords Order-to-cash (O2C), Business process improvement, Lean six sigma, Process performance metrics, Value stream mapping, Case study

Paper type Research paper

1. Introduction

The objective of this study is to improve the order-to-cash (O2C) business process of a case company through the implementation of Lean Six Sigma tools. The study was conducted in a case company in Finland, working in the energy and environment sector. The case company has an ongoing development project of assessing the current business processes and their maturity, thus O2C is one of these processes that need to be developed. To develop the processes, a comprehensive study and assessment of the current processes are required and this study aims to support the case company to achieve that goal. Manual work and a large number of changes throughout the processes are recognized issues but their effect on the process performance is unknown. Currently, there are limited performance metrics for the

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O2C process in the case company, and has identified a need to gain a further understanding of whether the process is efficient or not. This study therefore would be beneficial for the case company to understand the amount of waste, its effect on the customer, and the real-time process performance.

At present, the case company's current O2C system is mainly done by the Allegro system (Allegro, 2023), which is unreliable and requires manual controlling and checking that results in canceled invoices. These canceled invoices are visible to the customer and harm the customer experience. The large amounts of manual work cause mistakes, delays, and rework. Manual pricing and invoicing actions have become the new normal for the process. However, this was never intended as the systems should be reliable. As the process is split into different functions that are interdependent, the importance of communication and accurate information is vital for a well-functioning value chain. The current process creates waste internally and externally in the credit invoice actions. The credit invoice rate is at a high level of 46% meaning that this is a crucial area of improvement in increasing value for the stakeholders. Additionally, repairing the Allegro system functionality would decrease the amount of manual work for the pricing and invoicing team.

To improve the current O2C process in the case company, the use of Lean Six Sigma tools, such as process mining, root cause analysis, and daily continuous improvement activities are used. Additionally, key process performance metrics such as touchless rate, credit invoice rate, and the number of manual field changes could be created in the process mining software such as Celonis can be put into service, to understand the real-time O2C process performance. Celonis provides detailed information from SAP transactions to reveal the process performance. It generates event actions for each phase of the process identifying the person performing the activity, the duration of the activity, and the variation of the activities. Celonis also enables the definition of key performance indicators.

Process mining provides a data-based view of process performance, which enables management to recognize performance problems and make decisions based on the data. This research studies the current state of the O2C process to gain an understanding of the challenges and root causes of the arising problems. The theoretical frameworks and findings from data provide comprehensive knowledge to determine recommendations for the case company. The main aim of this research work is, therefore, to study and analyze the current O2C process and give recommendations for the case company to act on. The O2C process is the most visible process for the customer. Therefore, it is a vital business process to be managed. By optimizing the O2C process activities there is more time left for additional sales activities and thus incoming revenue. To fulfill the identified challenges of the case company, this study identified two research questions (RQ), which are stated as follows:

RQ1. What are the challenges of the case company's current O2C process and what methods can be used to improve the process performance?

RQ2. What are the best metrics to measure the O2C process performance of the case company to provide value for the relevant stakeholders?

The rest of the article is outlined as follows: Section 2 covers the theoretical frameworks based on the O2C process, and Lean Six Sigma, while Section 3 reviews the methodology and describes the implementation of the empirical study. The description of the case company is outlined in Section 4. Study results are presented in Section 5. Overall, research outcomes are discussed in Section 6, whereas, Section 7 concludes the results that are reflected in recommendations for the case company followed by the study limitation and future studies.

2. Literature review

2.1 Concept of lean six sigma and lean manufacturing

The *Six Sigma* methodology was formed around the quality aspect of operations and the value provided to the customer (Oakland, 2014, Cherrafi *et al.*, 2016, Kregel and Coners, 2018, Sánchez-Rebull *et al.*, 2020). As competitiveness rises, businesses need to focus on correct activities along with high-quality management. The manufacturing industry was the first to introduce Six Sigma as maintaining a high standard of quality was a crucial element for survival in the industry (Malik *et al.*, 2012, Prior, 2016, Singh and Rathi, 2019, Improta *et al.*, 2019, Singh *et al.*, 2021). This was the starting point of total quality management (TQM). To succeed in Six Sigma, quality management systems have to be implemented in all systems. The adoption of quality tools and methods along with the improvement and involvement of the team will result in improved business process performance and better business planning (Trent, 2008, Brun, 2011, Subira *et al.*, 2019).

The term lean manufacturing (LM) was first coined by Japanese automaker Toyota in the 1950s under the name Toyota Production System (TPS). The basic idea to deploy this principle was to increase productivity and cut costs by getting rid of wasteful or non-value-added activities (Womack *et al.*, 2008). Due to rising Japanese imports in the 1980s, Western manufacturers showed a strong interest in using LM (Holweg, 2007). Additionally, due to its global excellence in terms of cost, quality, flexibility, and quick reaction, the concept of LM was subsequently spread throughout nations and sectors (Schonberger, 2007). Numerous scholars have revealed that for companies to be competitive in the global market using lower cost, faster delivery, and higher-quality products, the LM strategy should be implemented (Zahree, 2016).

Businesses nowadays must contend with problems and complexity as a result of the fast-changing business environment. Any company, whether manufacturing- or service-focused, may ultimately rely on its capacity to consistently and methodically react to these changes to increase the value of the output to survive. Lean manufacturing system implementation is thus becoming a key capability for any type of firm to sustain, as value-adding processes are required to reach this excellence. The majority of research focuses on just one lean element, with very few studies focusing on multiple lean elements. However, for lean implementation to be successful, an organization must focus on all the elements, including value stream mapping (VSM), cellular manufacturing (CM), U-line system, line balancing, inventory control, kanban, pull system, single-minute exchange of dies (SMED), production leveling, etc. (Sundar *et al.*, 2014). To help the organization implement the lean manufacturing system, an effort has been made to construct a lean road map (Zahraee *et al.*, 2014).

2.2 Various lean methods and tools in manufacturing industries

The core activity of the lean method in business process management is to identify the value for the customer and to identify the waste of resources, cost and time in the process (Pal *et al.*, 2014, Ramos *et al.*, 2018, Singh *et al.*, 2019, Sreedharan *et al.*, 2020, Mabrouka *et al.*, 2021). By identifying waste, the bottlenecks of the process can be resolved by improving the process. A lean process should react to the initiative from the customer (e.g. a sales forecast or a customer order). To sustain lean business process management, a strategic plan that supports the goals of the company and aims for continuous improvement should be created (Sreedharan and Sunder, 2018, Antony and Sunder, 2019, Sánchez-Rebull *et al.*, 2020, Rodgers *et al.*, 2021). By updating this plan, management can determine, influence and oversee strategic areas of improvement.

The performance of manufacturing systems, port container terminals, supply chain management, construction management, banking systems and building systems can all be improved using a variety of techniques and strategies, including computer simulation,

statistical analysis and lean manufacturing approaches, all of which are difficult to model. Lean manufacturing and thinking, which has been widely implemented in various businesses, is one of these. Table 1 displays a basic summary of the numerous lean strategies and techniques that are available in various literature.

2.3 Order-to-cash

Managing the O2C process is relevant to an organization's success (Korotina *et al.*, 2015). By analyzing the order management process, managers can understand the process performance and the customer perspective in the order processing (Shapiro *et al.*, 2004, Sfaxi and Ben Aissa., 2021). Critical people working with a joint effort to fulfill the customer order (Shapiro *et al.*, 2004) perform the order processing. The O2C process is the handling of a customer order and it includes the activities starting from the order to the stage of finally receiving the money from the sale (Parravicini, 2015, Muraya, 2020). The O2C process's key features are to collect customer orders, deliver the goods to the customer's desired place on time, and finally receive the payment from the customer. In addition to delivering the goods, the quality of goods must be up as agreed and the relevant delivery documentation must be provided.

The O2C process has a clear cycle consisting of several key activities such as preparation, customer order and its implementation, delivery of the goods, invoicing the customer and getting the payment of the order (Guo and Liu, 2020). If the O2C process is efficient and the activities of the process have been accomplished correctly, providing good customer service will be a competitive advantage for the company (Parravicini, 2015, Markovic *et al.*, 2020). To ensure that the O2C process is performed in the best way possible, it is crucial to make sure that in the preparation stage of the process, everything is available in the database and the Enterprise resource planning (ERP) system correctly to avoid mistakes. In addition to having a strong performance of these actions, Parravicini (2015) highlights that having clear customer communication is important. Moreover, any errors in the process should lead to corrective actions.

3. Study methodology

This research study was conducted in a case company that operates in the field of energy and environment sector and is a leading corporation in sustainable business. The study adopted a mix of quantitative and qualitative methods with the view to gaining a more comprehensive overview of the case company. Based on the data collected through the dataset, interviews and workshop, this study discovered the reasons for certain bottlenecks or errors occurring in the case company's routine business processes. Each of the study steps is explained in the following subsections.

3.1 Quantitative data

The quantitative analysis was based on data received from the studied case company's ERP system during the timeline of the research from the 1st of April 2018 to the 30th of September 2019. The case company uses SAP and a process-mining tool called Celonis, which visualizes its business processes and performance. By limiting the dataset to all spot sales delivered by vessel with the CIF (cost, insurance and freight) incoterms, the dataset consisted of 249 cases. The quantitative analysis has been conducted by finding the bottlenecks and defects of the process followed by a comparison to the ideal process flow. The defects and bottlenecks were analyzed by assessing long lead times and repeating activities that lead to rework or additional work. The main challenges found from the data were assessed in closer detail and brought up during the interviews.

Lean method	Lean technique	Case sector	Author
Cellular manufacturing	It is a systemized technique for a specific product as produced in a cell with required equipment, machines, and operators	Power distribution industry, construction industry	Martínez-Jurado and Moyano-Fuentes (2014), Baysan *et al.* (2019), Chica and Alzate (2019)
Just in time	In this technique, a customer request is handled in a way that "pulls" all necessary resources	The steel industry, construction industry, textile industry	Abdulmalek and Rajgopal (2007), Oluwatosin Babalola *et al.* (2019), Karadag (2023)
Kanban	It's a marking method used to establish just-in-time (JIT) manufacturing based on customer requests	The automotive industry, fashion, and textile industry	Savino and Mazza (2015), Simic *et al.* (2021), Nayak (2022), George *et al.* (2022)
Total preventive maintenance (TPM)	This tool is used to identify and protect against irregularities in any business process	Cement industry, Defence industry, manufacturing industry	Graisa and Al-Habaibeh (2011), Mutaqiem and Soediantono (2022), Mohanty *et al.* (2022)
Poke yoke	It's a method to use error-proofing in any production system	Automobile industry, textile industry, metal industry	Ahmad *et al.* (2017), Kumar *et al.* (2019), Prasad *et al.* (2020), Al Ayyubi *et al.* (2020)
Total quality Management (TQM)	It is a method used for managing the quality of business processes	Service industry, construction industry, hotel industry	Altayeb and Alhasanat (2014), Yeng *et al.* (2018)
Takt time	It refers to a tool used to measure productivity with customers' demands	Construction industry, manufacturing industry	Heinonen and Seppänen (2016), Melzner (2019), Abbasi *et al.* (2020), Giridar *et al.* (2023)
Value stream mapping (VSM)	It is defined as the mapping process of material and information flow as necessary to develop quality products for customers	Color industry, automotive industry, heater industry, construction industry	Rohani and Zahraee (2015), Lacerda *et al.* (2016), Zahree *et al.* (2020, 2021)
Group technology	This technology refers to grouping components that require similar processes but dissimilar machines are grouped to form a cell	Machining industry, furniture industry, manufacturing industry	Xiong *et al.* (2017), Dianita *et al.* (2020)
Continuous improvement (CI)/ Kaizen	This is a philosophy, where, continuous improvement is a culture of a workplace. According to Deming it is defined as "Improvement initiatives that increase successes and reduce failures"	The garment industry, packaging industry, manufacturing industry, infrastructure sector	Akter *et al.* (2015), Vo *et al.* (2019), Garza-Reyes *et al.* (2022), Tezel *et al.* (2023)
Production levelling/Heijunka	This phenomenon helps to avoid overproduction while customer demands are less and also supports managing underutilized capacities such as man and machine idle times etc.	The automotive industry, process industry	Rewers *et al.* (2019), Kjellsen *et al.* (2021), Boutbagha and El Abbadi (2022)

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Table 1. Summary of various lean methods, techniques and case sectors by various authors

3.2 Qualitative interviews

The qualitative part of the study was conducted through interviews with the specialists operating in different teams and phases of the O2C process. The interviews were conducted in Finnish as it was the native language of all interviewees. The interview was conducted based on the questionnaires, which are attached to Appendix. The interviews were conducted face-to-face or by a meeting call with specialists operating in different responsibilities in the O2C process. In summary, nine specialists were interviewed and they were held either as one-to-one or two-to-one personal communications. The interviews were carried out after studying the qualitative data to understand what were the areas of rework and challenges. The questionnaire aimed to find explanations describing the bottlenecks identified in the data. Furthermore, the interview questions studied the current challenges of the process giving guidance on the way ahead for the development of the process.

The interviews were conducted by dividing the process into six phases and responsibilities: trader responsibilities, operations specialist responsibilities, pricing specialist responsibilities, logistics specialist responsibilities, harbor specialist responsibilities and invoicing specialist responsibilities. The reason why the process was divided into six different phases was that according to the quantitative data, the major bottlenecks are in the area of pricing billing blocks, logistics ticketing and invoices that need canceling. The interviews aimed to focus on these activities and comprehensively investigate the effectiveness of the process in different teams. The interview questions focused on identifying the bottlenecks of the process. Moreover, the knowledge gathered from the quantitative and qualitative study provided a viewpoint for the issues to be discussed in the VSM workshop.

3.3 Workshop on value stream mapping (VSM)

In addition to both quantitative and qualitative analysis, a workshop on value stream mapping (VSM) was conducted as a part of this study. The workshop consisted of the current process assessment and analysis. The O2C process was gone through from start to finish by value stream mapping all of the actions following the scope of this study. The workshop was held to map the value stream of the current state of the O2C process. The process was mapped from the moment the trader sells a surplus sale to the point when the customer pays the invoice. The workshop was conducted with the use of the online workshop tool Jamboard which made it possible for all participants to join and add sticky notes to the canvas. The participants of the workshop were as followed:

(1) An O2C process owner,

(2) An operational excellence manager,

(3) A development manager,

(4) An operations specialist,

(5) A pricing specialist and

(6) An invoicing specialist.

The participants consisted of the operational excellence team and some of the key performers of the O2C process (e.g. operations specialist, pricing specialist, and invoicing specialist). The workshop had very good participation and all of the aspects of the process were covered. The workshop started by presenting the SIPOC (supplier, input, process, output, customer) model of the O2C process followed by the validation of the scope of the VSM.

The people participating in the workshop knew the O2C process as a whole and some participants were experts in a certain process area (e.g. operations specialists). This workshop aimed to map all activities of the process from the viewpoint of lead time and rework. Consequently, the aim was to locate issues affecting long lead times and rework as well as discover areas of improvement in the process. Before the workshop, the qualitative data were analyzed along with the interview results, which provided additional information for the workshop. To measure the activities and improvement areas in the workshop some metrics were needed. The chosen metrics were the lead time of activities and information flow (doing things right the first time and avoiding rework). Since there were various improvement areas, only the most important ones were highlighted and prioritized within the scope of this study.

4. Description of the case company

The case company operates in the field of energy and environment sector and is a leading corporation in sustainable business (Case Company, 2020). The company's operations are global; thus, the offices and production sites are located worldwide. However, its strongest presence is in the Baltic Sea area. In 2019, the company's revenue was 15.8 MEUR and it employed around 5,000 people worldwide. The case company's business environment is mainly focused on energy production and creating solutions for transportation by road, sea, air and pipeline. The strategy and vision of the case company are to operate responsibly and to offer sustainable solutions for consumer and corporate consumption (Case Company, 2020). Their solutions are constantly developing new ways to cut down on carbon emissions and to circulate and reuse its products. The case company's mission is to do business responsibly, innovatively as well as with excellence and these values are respected in their actions. Thus, the company has an operational excellence team that promotes unified ways of working following the company strategy to ensure growth and competitiveness.

The Case Company (2020) has created a Commercial Excellence Management System to track and manage common goals and interests of all business actions. In the case company, commercial excellence is carried out by focusing on customers and optimizing operations. As presented in Figure 1, the commercial excellence activities are divided into the following

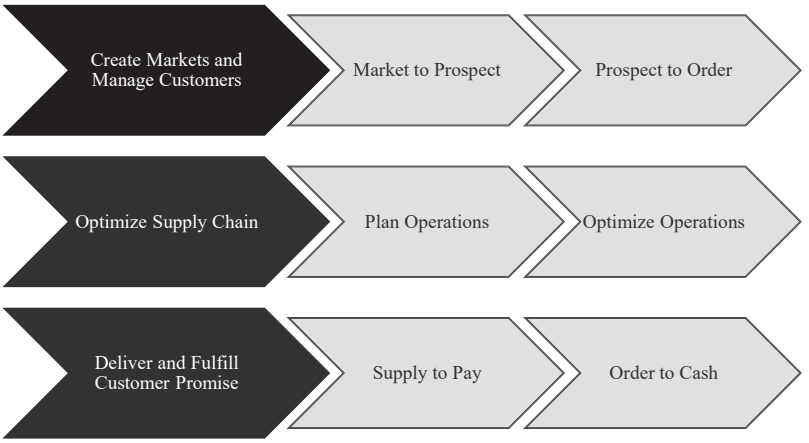

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Figure 1. Case company's commercial excellence management system

categories: "Create Markets and Manage Customers," "Optimize Supply Chain" and "Deliver and Fulfill Customer Promise."

The purpose of the top-level phase "Create Markets and Manage Customers" is to create a market-to-prospect following with implementation of the prospect-to-order activities (Case Company, 2020). Creating a market to prospect is building a competitive marketplace allowing one to find potential customers. Thus, the prospect-to-order handles forecasting demand, developing sales and supply plans, managing key accounts, negotiating seller/buyer contracts and managing suppliers. The meaning of the second level "Optimize Supply Chain" includes commercial excellence activities built on planning and optimizing the operations (Case Company, 2020). These activities include sustainability and compliance, scheduling supply chain operations, managing supply chain performance and managing inventories and price risks. On the third level, "Deliver and Fulfill Customer Promise," the team members ensure that customer promises are delivered and fulfilled, on both supplies to pay and O2C processes (Case Company, 2020). "Supply to Pay" operations make sure that the order is executed, logistics are planned, and loading, transportation and unloading of the product are executed. Consequently, the O2C process manages and executes sales orders and deals, organizes logistics as well as makes sure that loading, transportation and unloading are executed.

The VSM workshop as organized within the case company was targeted to find out the bottlenecks and defects in its business processes. It was a postmortem of the business processes, which are needed to highlight the root causes of the operational processes in the case company. It reveals the weakness and mainly finds waste in the operational processes, especially the O2C processes. The outcomes from the VSM workshop support the case company to focus on its improvement strategies. Moreover, from the VSM workshop, additional matrices related to the O2C process such as touchless rate, credit invoice rate, the number of manual field changes and financial indicators are critically investigated for further improvements.

5. Study results

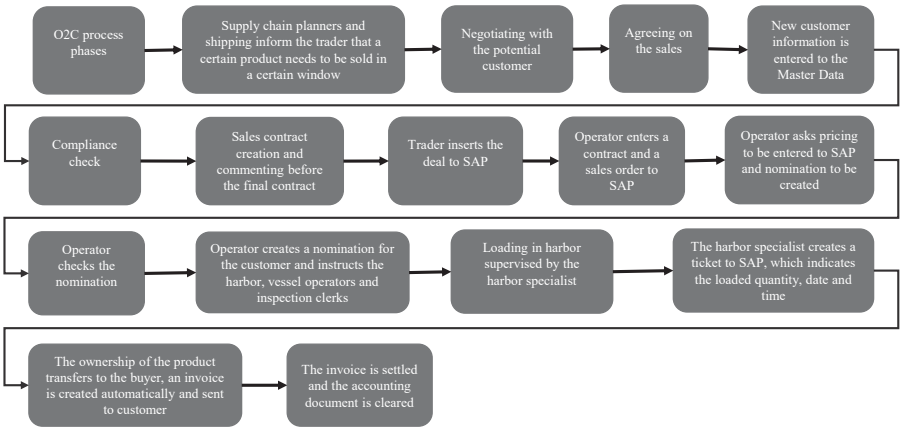
This section reviews the current O2C process management in the case company and the results of the study conducted. Moreover, the quantitative, qualitative, and workshop results are assessed and discussed. The quantitative and qualitative data focused on analyzing the bottlenecks and defects of the O2C process. Consequently, the VSM workshop was conducted based on the theoretical framework, and the method aimed to map the current state of the process and highlight the root causes of the problems. Based on the discussion, some recommendations are provided for the case company.

5.1 Current O2C process management

The O2C process management in the case company follows the steps presented in Figure 2 (Case Company, 2020).

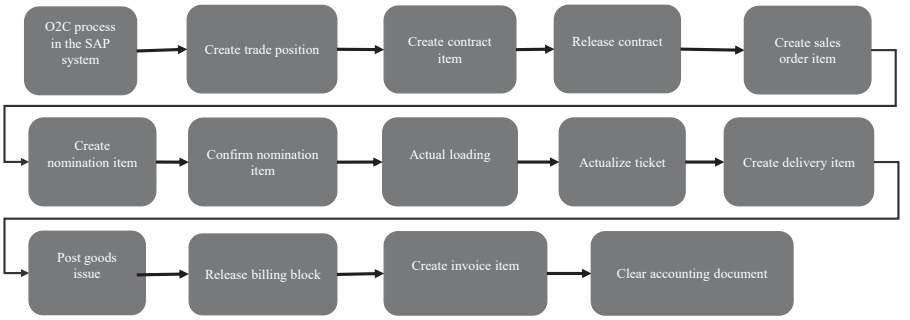
Figure 2 presents the O2C process phases and the flow of actions in the SAP system. In addition to the system steps, other parts of the process are; sale negotiations between the trader and customer, the addition of possible new customer information into the Master Data system, compliance checks, contract creation and instructing the loading activities are part of the process.

The O2C process has a clear systematic design that all cases should follow. However, the design is not always clear, and rework or errors occur in the process. For example, common errors that the case company faces are errors in data. Errors in data can cause misunderstandings in the harbor and the loading might not go as planned or incorrect invoices are sent that need to be canceled. Figure 3 presents an example of a case, where a variety of O2C process problems can be seen.



The O2C process phases in the case company

(a)



The O2C process flow of actions in the SAP system

(b)

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Figure 2.
The O2C process phases and the flow of actions in the SAP system

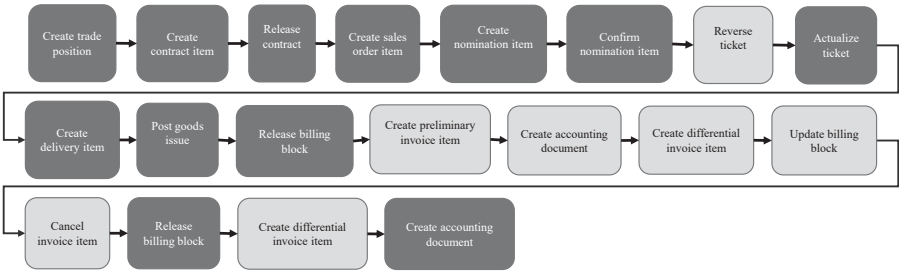

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Figure 3.
An example of the O2C process

This example displays several areas in which rework occurs. Once the loading activity is complete, the actualized ticket has inadequate data and it needs to be reversed and actualized again. After the preliminary invoice is generated and cleared, the differential invoice is

generated and the billing block is updated. However, there is still inadequate data as the differential invoice is canceled. Later the billing block is released and a new differential invoice is generated and finally cleared. In this case, rework was presented in ticket actualization, billing block updating, canceling invoices and reinvoicing activities.

5.2 Studied data analysis of the O2C process management

The dataset consists of 249 sales cases. These cases include 30 different customers and 38 different products transported to 71 different locations. Of the 30 customers, the majority of the deliveries, with all covering over 10% of the deliveries, were between three customers by 22%, 11% and 10%, respectively. From all of the products, there were three main product types, which constituted the majority of deliveries with 19%, 12% and 8% of the total, respectively. From all of the locations, the majority of deliveries have been delivered to the ARA region (Amsterdam-Rotterdam-Antwerpen) and the Baltic Sea area. These locations were the busiest during the period.

The dataset reveals that areas of rework and extra activities were the following:

(1) Manual field changes to sales orders,

(2) Canceled invoices debited by credit invoices,

(3) Releasing and updating the billing block and

(4) Reverse ticketing.

The following figures will show these actions in more detail.

Figure 4 shows the activity count of each process phase within the 249 cases. For example (6), the figure reveals that the billing block was released 412 times, meaning that there are many cases where the billing block was released more than once.

Figure 4 shows the activities on the *X*-axis and the number of activities on the Y-axis. Figure 5 states the number of activities done following a month's sales orders.

From Figure 5, it is seen that in September 2019, there were 20 sales orders done and 442 activities were executed for them. The activities counted included all the different categories (e.g. create a sales order, create nomination item) and the number of times it was performed.

5.2.1 Changes made to the sales order items. The dataset reveals that in most cases the data is not initially correct or reliable when it is inserted into the systems. Figures 6 and 7 show statistics on the manual field changes made to the sales orders. A change was counted whenever a modification was made and saved to the sales order. In total, 3,000 changes were made in the 249 cases analyzed. An average manual change for one sales order was 12 changes. Figure 6 describes the number of changes in sales orders changes within the limits provided.

From Figure 6, it is seen that in the majority of the cases, sales orders were changed between 1–16 times. Only 23 sales orders had 1–4 changes made, and 60 sales orders were changed 7–10 times. However, some changes are necessary and need to be made. Figure 7 states monthly the number of manual changes done to the sales orders.

Figure 7 displays the count of sales orders on the left axis and the count of manual field changes on the right axis. As the manual field change curve shows, all sales orders are changed. During November 2018, December 2018 and September 2019, the change count was the highest. Figure 8 shows the trend of manual field changes per sales order.

According to Figure 8, in September 2019, on average 15.45 manual changes were done per the case of one sale. The manual field change curves in Figures 7 and 8 clearly show that in those periods when there have been a lot of manual changes, the business model has changed by expanded operations. According to the Case Company (2020), in October 2018, the operations were unified with Europe's office operations by creating a mutual process

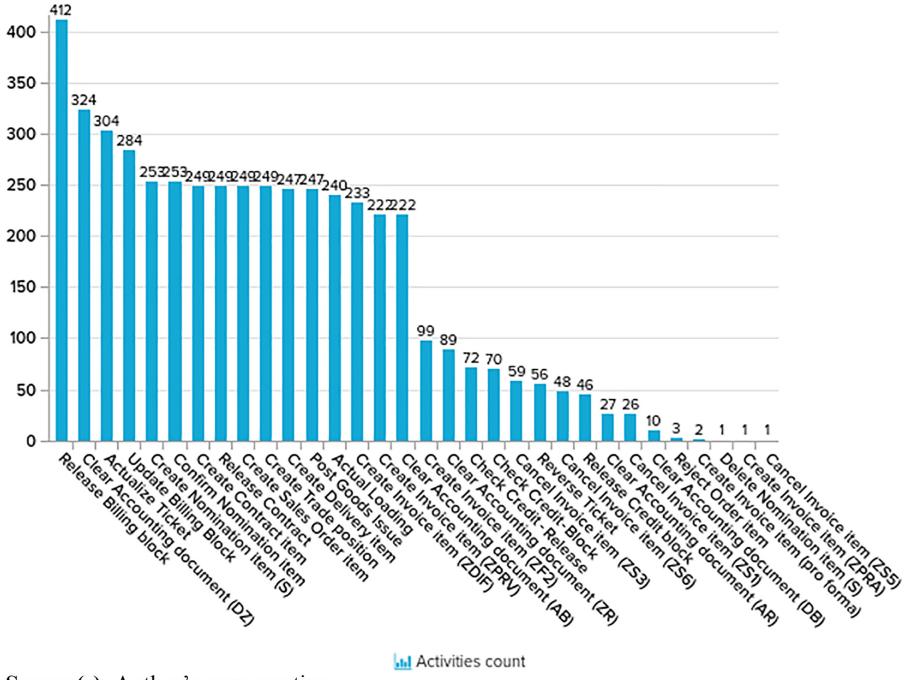

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Figure 4.
Activity count of each process phase

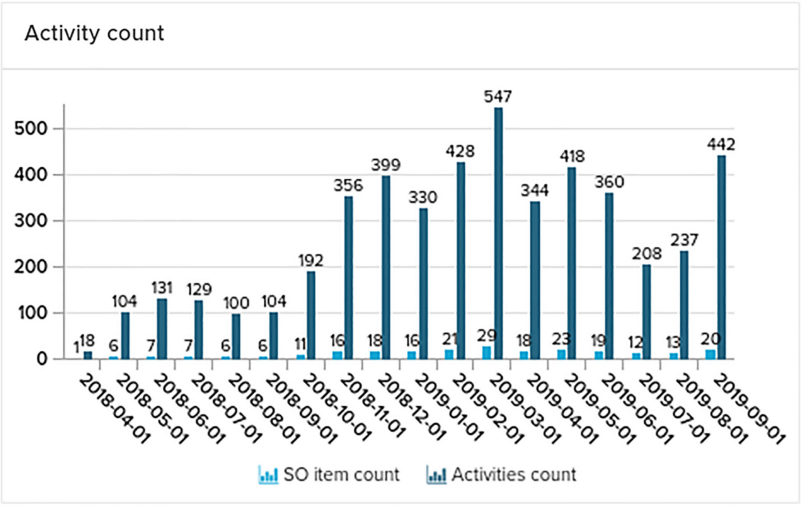

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Figure 5.
Activity count following sales orders per month

altogether, except that operations specialists are still separate in both locations: in Finland and Europe. Starting from October 2019, a new product category operation was also unified and the rising amount of changes reflect the change, which occurred in the business model.

5.2.2 Billing block rates. According to the data, the billing block rate in all of the cases was 97% meaning that only 3% of the cases did not have a billing block. The following figures present billing block rates and counts. The billing block rate of all the cases is shown in Figure 9, and the rate was under 100% for a few months, only.

Figure 10 shows the number of billing block activities done on average each month. For instance, in April 2018, there was one sales order and its billing block was updated four times. On average there were 2.8 billing block updates made per sales order.

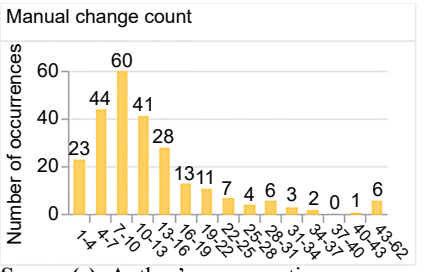

Figure 6.
Manual change count occurrences

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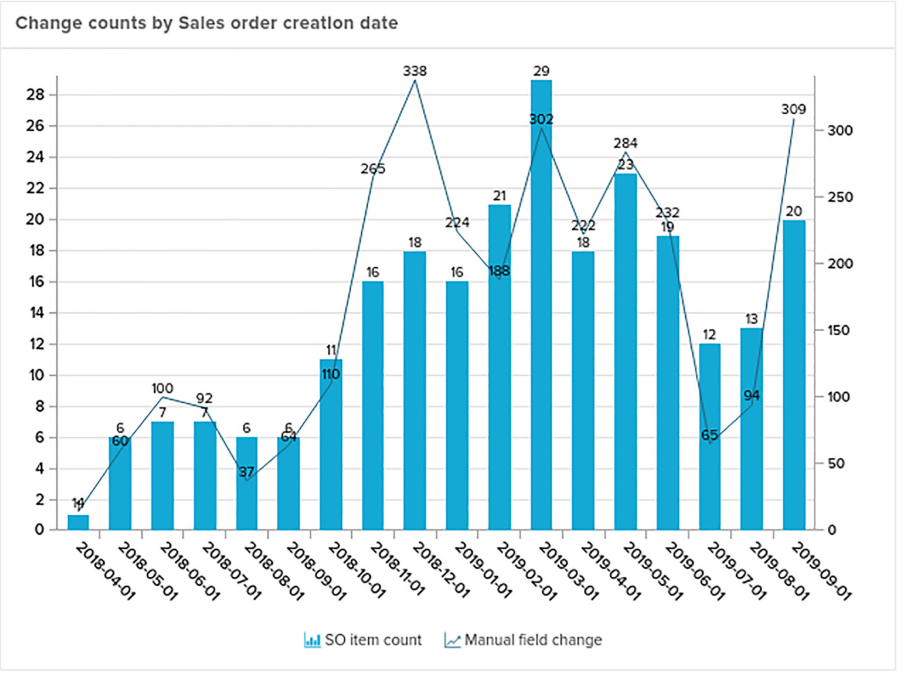

Figure 7.
Amount of manual field changes following the sales order amount

Source(s): Author's own creation

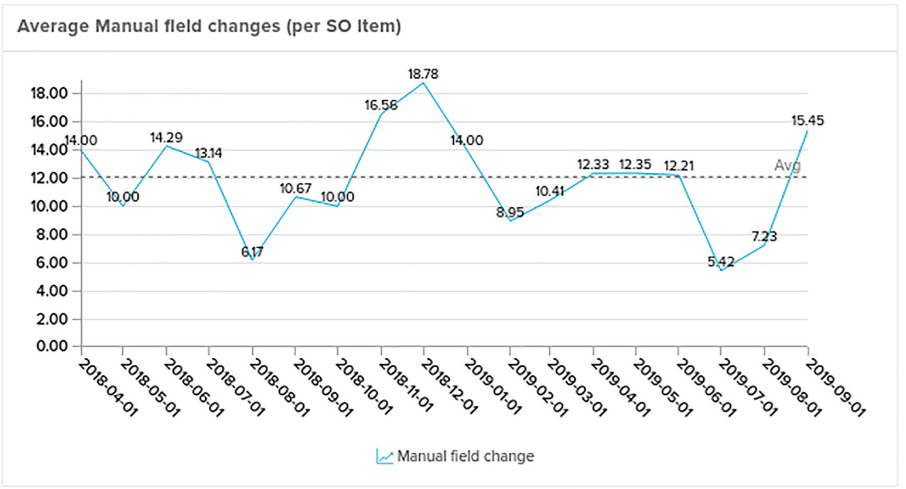

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Figure 8.
Manual changes are made per sales order

Figure 11 presents the billing block occurrences of the sales orders. It displays that the majority of cases were only once held in the billing block but also updating the billing block three times was common for one case. Only eight sales orders were not held at the billing block at all.

The billing block figures state that this is certainly one bottleneck of the process. Almost all cases held in the billing block need to be manually released before the invoicing can be executed automatically. Billing blocks were one of the aspects of the interviews with pricing specialists. The aim was to find out the reason sales orders needed to be held in blocks manually, which slows down their work processes.

5.2.3 Reverse ticket count. A reverse ticketing activity is done if the actualized ticket has inadequate data, which needs to be corrected. Reverse ticketing means that the ticket is revoked and a new one is created. According to the data, in most cases, no reverse ticket was needed (202 cases), but in some cases, the ticket was reversed once (38 cases) or twice (9 cases). This is shown in Figure 12.

Figure 13 shows the number of reverse ticket activities made monthly. The count of reverse tickets is average. In April 2018, there was one process of reverse ticketing in the case of one sale.

It can be seen that from all of the cases, reverse ticketing activities were done for 23% of cases and mostly once.

5.2.4 Credit invoice rate. A credit invoice is an incorrect invoice, which needs to be canceled. From all of the 249 cases, there were 600 invoice items created, and overall, the credit invoice rate of the cases was 46%. Figure 14 shows the amount of sales orders per month and the number of those sales order invoices credited.

From Figure 14, it is seen that in September 2019, there were 20 sales cases of which 70% were canceled with a credit invoice (14 credit invoiced cases). These data also show well the timeframe the operating business has been changed by the introduction of a new sales office or a new product category. One explanation for the high amount of credited invoices could be the new operations, which are being executed the first time leading to errors occurring more often than usual.

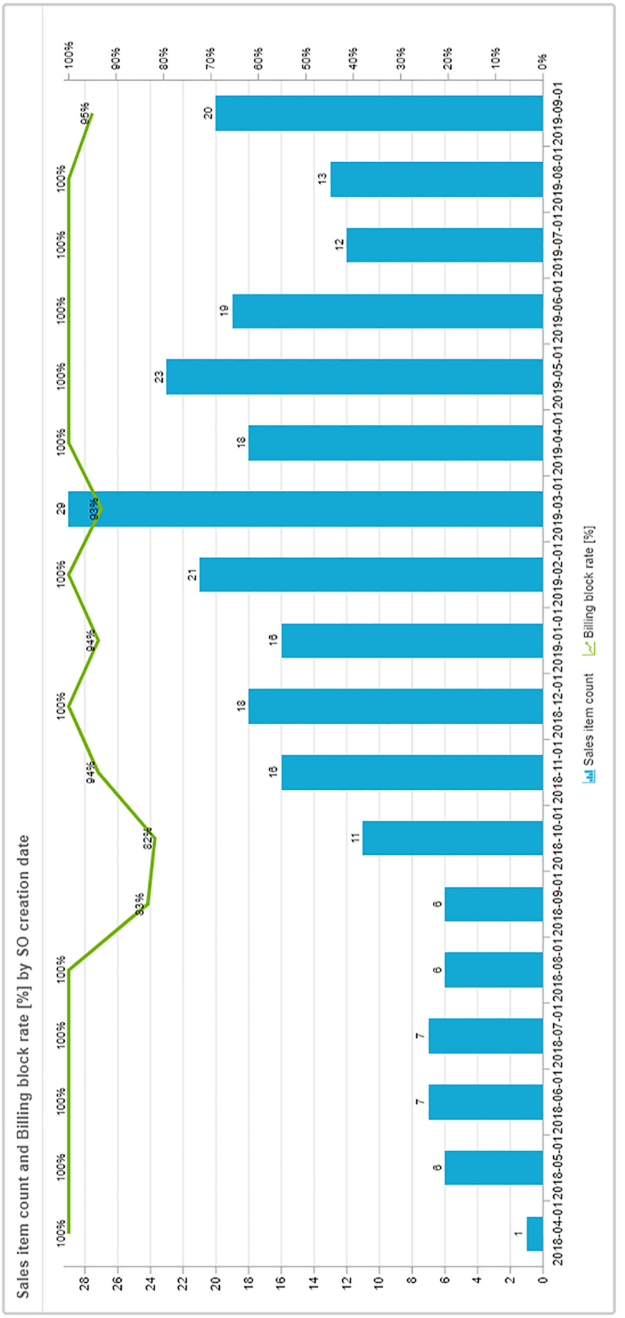

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Figure 9.
Billing block rate

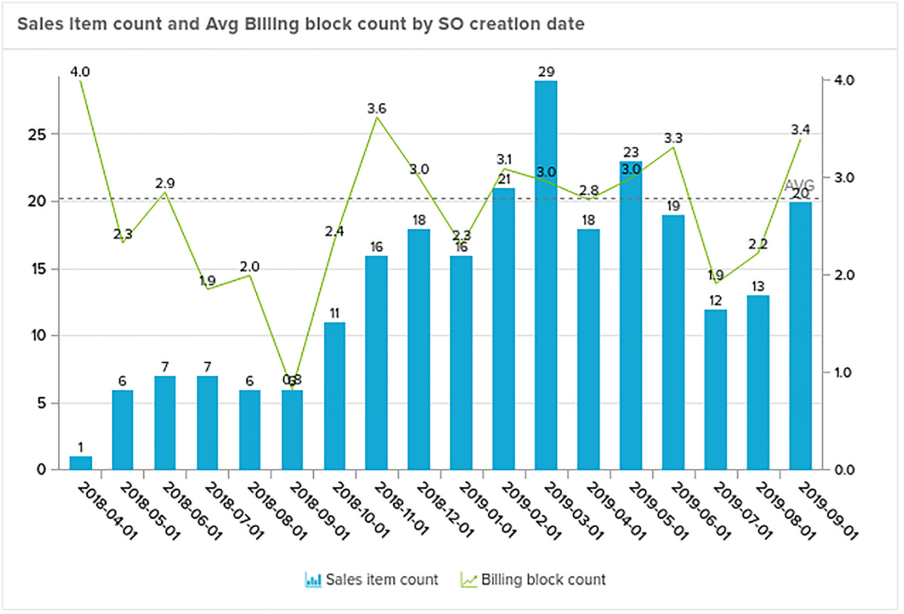

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Figure 10.
Average billing block count

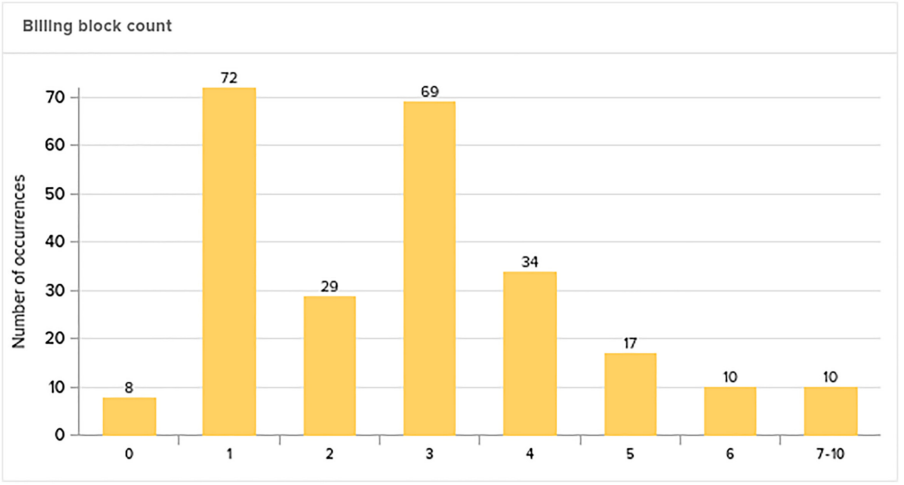

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Figure 11.
Billing block count occurrences

5.3 VSM workshop on O2C process management

The VSM workshop was held to map the current state of the O2C process. The process was mapped from the moment the trader sells a surplus sale to the point when the customer pays the invoice. The workshop was conducted with the use of an online workshop tool Jam Board

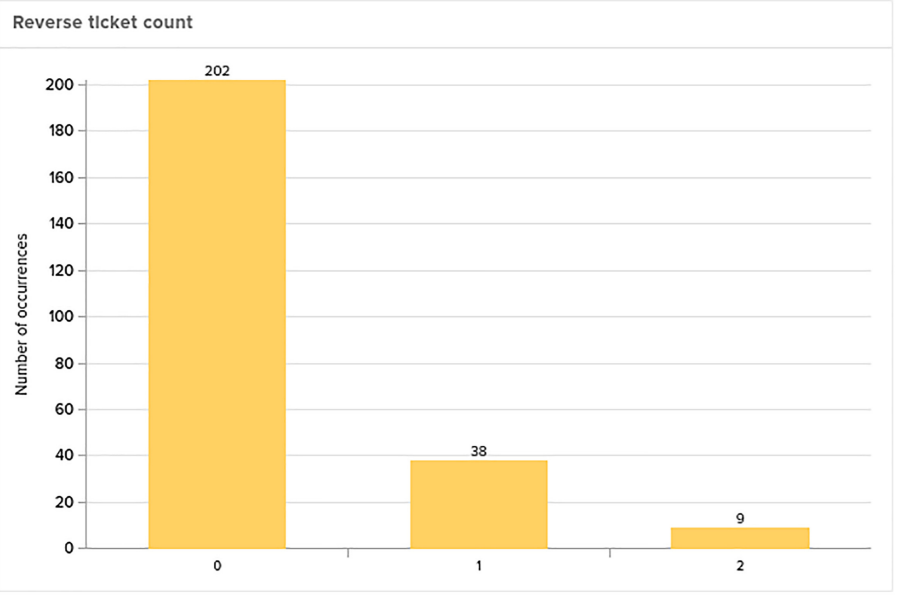


Figure 12.
Reverse ticketing times

Source(s): Author's own creation

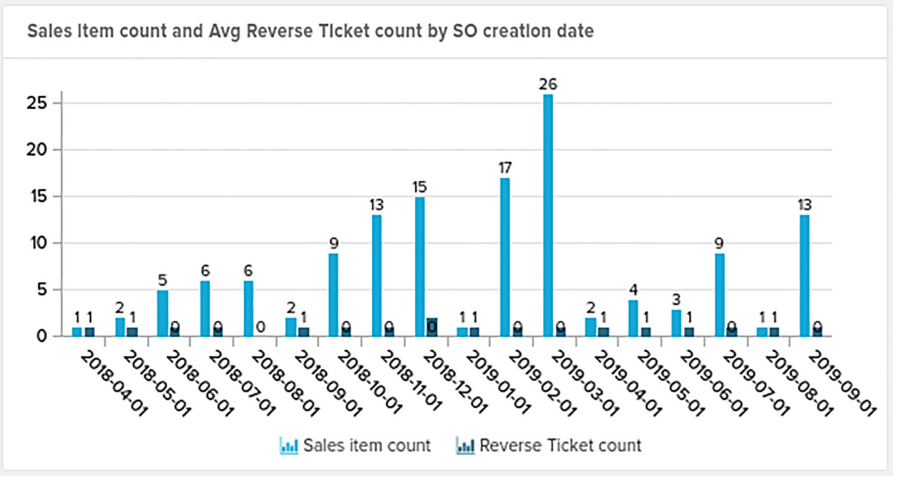
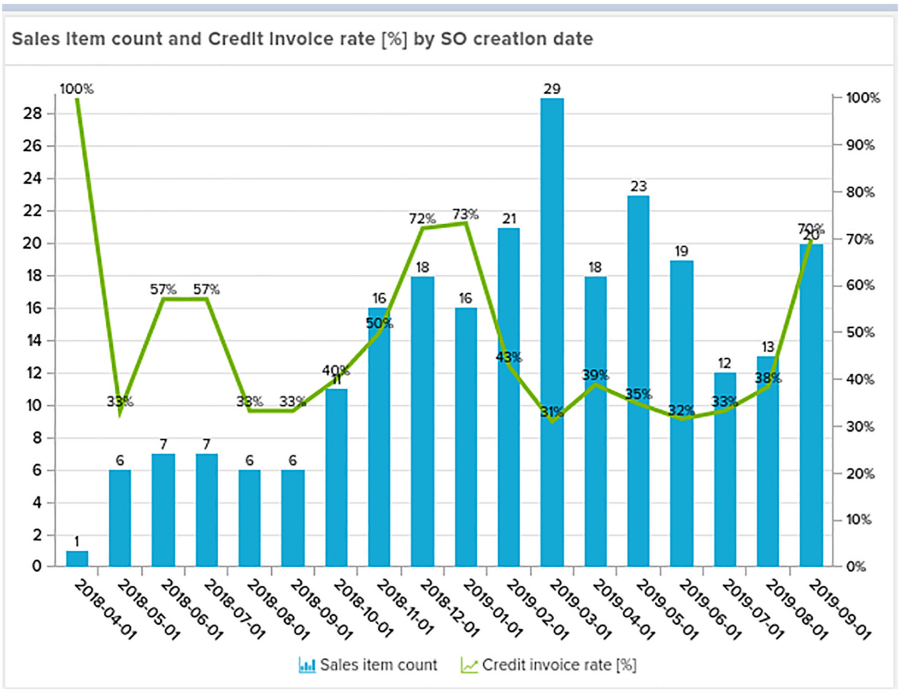


Figure 13.
Average reverse ticketing monthly

Source(s): Author's own creation

that made it possible for all participants to join and add sticky notes to the canvas. The participants of the workshop were an O2C process owner, an operational excellence manager, a development manager, an operations specialist, a pricing specialist and an invoicing specialist.



Source(s): Author's own creation

Figure 14.
Credit invoice rate of the sales cases

The participants consisted of the operational excellence team and some of the key performers of the O2C process (e.g. operations specialist, pricing specialist and invoicing specialist). The workshop had very good participation and all of the aspects of the process were covered. The workshop started by presenting the SIPOC model of the O2C process followed by the validation of the scope of the VSM. The SIPOC model is shown in Figure 15.

The SIPOC model describes the O2C process scope by appointing (a) the case company, (b) the supply chain management planners and (c) the traders as the suppliers of the process. The inputs of the process are (a) the deal data and the recap provided by the trader, (b) the deal detailed information provided by the SCM planners and (c) the customer order. The process phases are the actions to manage sales and cargo-related activities until the invoice is settled.

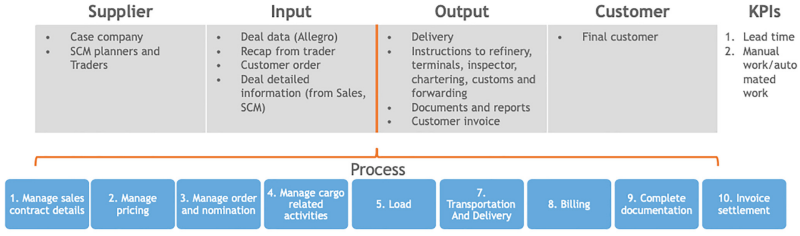


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Figure 15.
A SIPOC model of the O2C process

Consequently, (a) the delivery, (b) all instructions and documentation as well as (c) the customer invoice are the outputs of the process. The customer of the process is the final customer receiving the goods. After agreeing on the process scope made with the SIPOC model, the process actions were discussed with the swimlane diagram, which presented the responsibilities of each action of the operation. It also contained the order of the actions following each other. The swimlane diagram of the O2C process is shown in Figure 16.

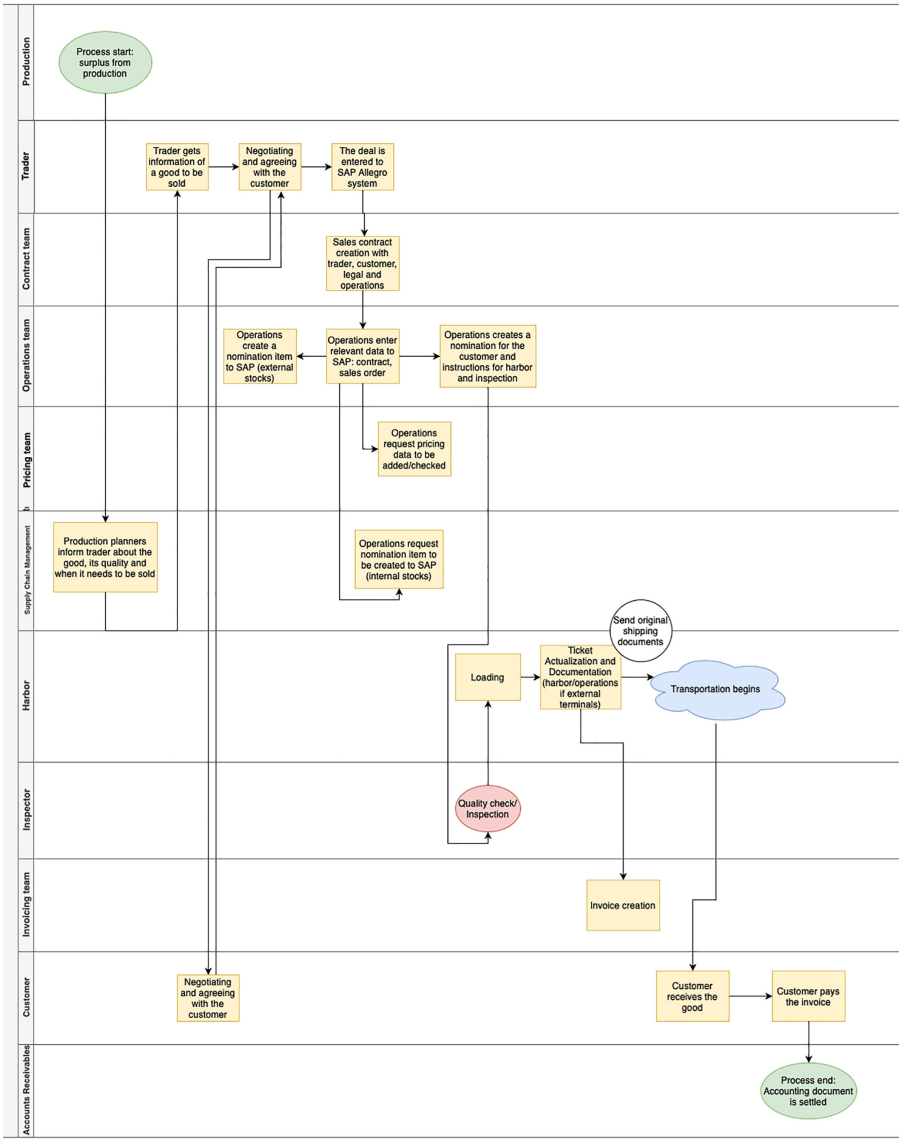


Figure 16.
A swimlane diagram of the O2C process

Source(s): Author's own creation

The swimlane diagram presents the process actions by the performer. The rows show the performer providing also information on the process flows between different performers and which actions follow each other. The process is divided into several processes performing departments, which are production, trader, contract team, pricing team, supply chain management, harbor, inspector, invoicing team, customer and accounts receivables as seen in Figure 16.

The swimlane diagram displays the process starting from the production of surplus products and the production planners informing the trader about the product. The swimlane diagram ends when the customer has paid the invoice and the accounts receivables team settles the accounting document. Once the workshop participants agreed that the swimlane diagram was correct, the next task was to initiate mapping the current state of the process. The output of the workshop is shown in the following Figure 17.

The value stream mapping of the current state was conducted by starting from the beginning and discussing all the process phases, information flow, manual/automation rate and the possible challenges of the phases. A rough process flow of the basic phases was mapped beforehand according to:

(1) surplus from production,

(2) trader negotiating the sale with the customer,

(3) deal with the Allegro system,

(4) compliance check,

(5) contract creation,

(6) data to SAP (contract, sales order, pricing, nomination),

(7) documentary instructions and nominations,

(8) quality check at the harbor,

(9) loading,

(10) ticket actualization and documentation,

(11) invoice creation and

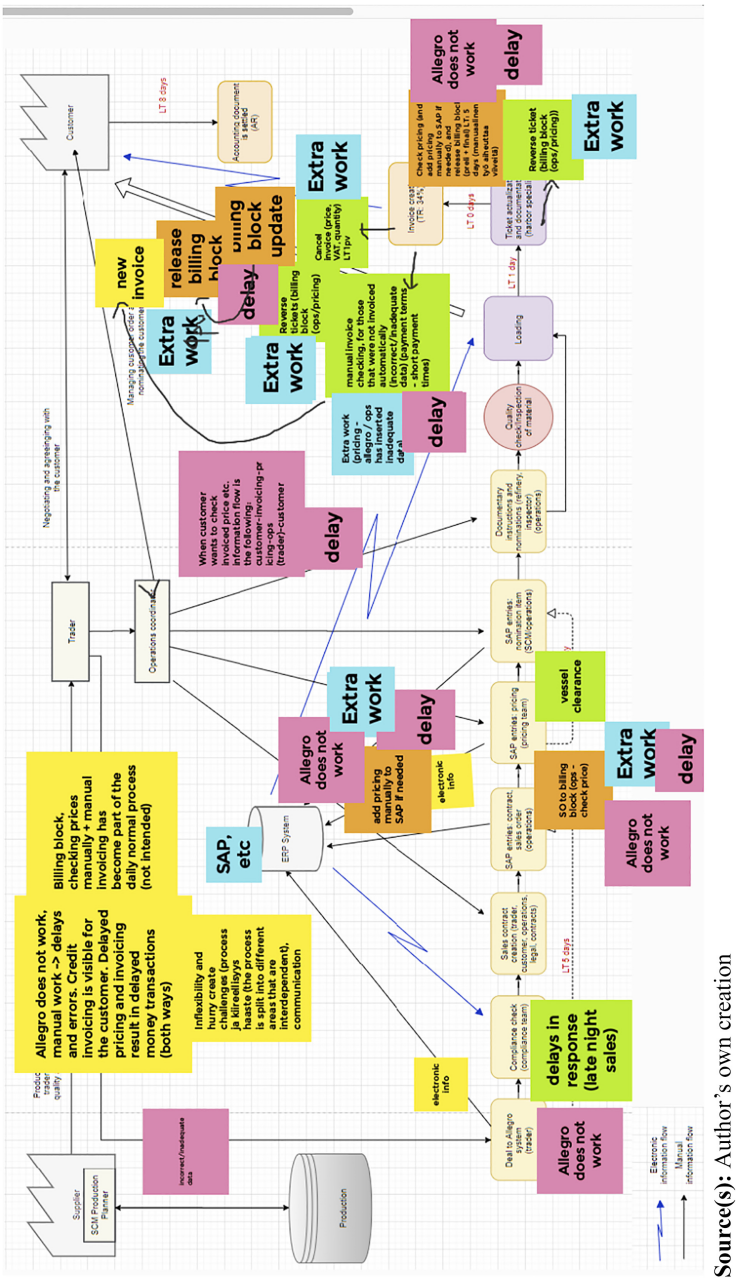
(12) settling the accounting document.

During the mapping of the process, many issues came up and these issues were highlighted next to the activity by describing the problem and the effects of the issue. The discussion was fruitful and provided new insights into the process. Lastly, the main issue areas were highlighted together. Figure 18 shows the VSM chart which was transcribed after the workshop.

As Figure 18 shows, several issues were brought up in the discussion. These are indicated by the blue clouds and their consequences with the red diamond shape. The main issues were as follows:

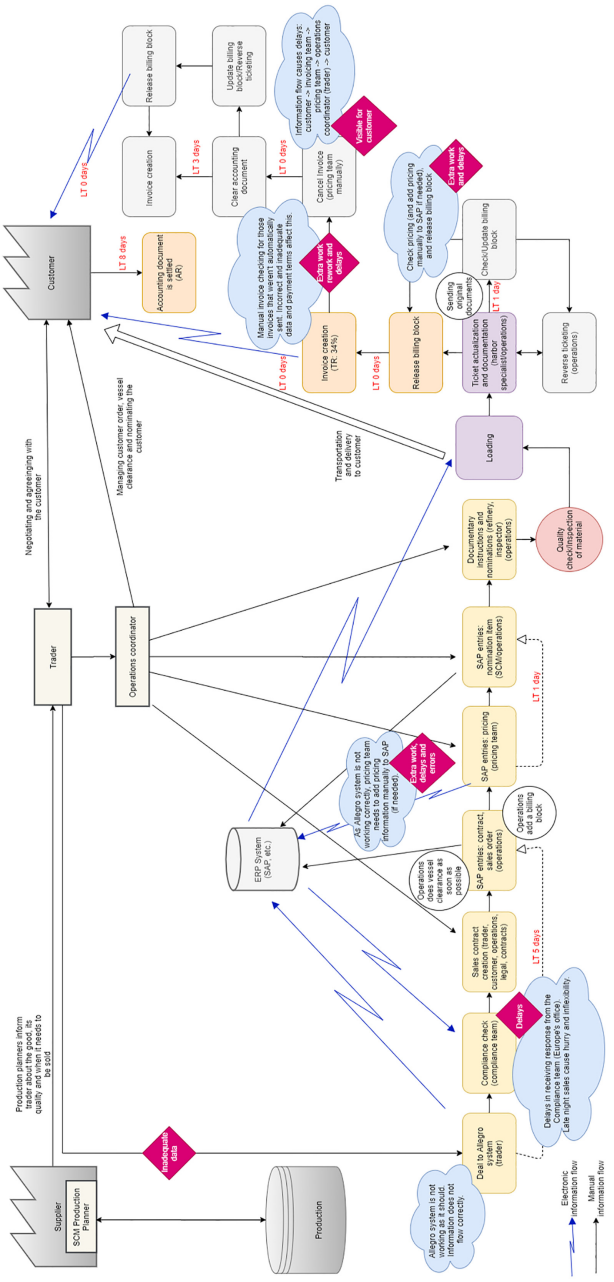
(1) The Allegro system is not functioning, as it should. The information does not flow correctly from that system to SAP.

(2) The compliance team is located at the European office and receiving quick responses might be challenging. The sales might be done late in the night which causes delays, rush, and inflexibility in the activities (especially those operations dealt from Finland's office).



Source(s): Author's own creation

Figure 17.
Display of the outputs from the VSM workshop



Source(s): Author's own creation

Figure 18.
O2C process VSM

(3) The pricing needs to be manually checked and added for each sale as Allegro cannot be trusted. The pricing also needs to be checked when the billing block is released and ready for invoicing. Both of these phases cause extra work, delays and errors.

(4) The invoicing team needs to go through manually all those invoice items that were not automatically created. Incorrect and inadequate data are the main reason for the errors. Additionally, some payment terms might cause errors in the invoicing process as the invoice is waiting for the payment term to be completed for invoicing. This causes delays and results in delayed money transactions both ways.

(5) Also, the problems with information flow cause delays. In case a customer would receive an incorrect invoice and would like to check the pricing the information chain is complex, for example:

the customer → the invoicing team → the pricing team → the operations specialist (sometimes even the trader) → the customer

Consequently, all errors in invoicing actions are visible to the customer, as they have already received an incorrect invoice.

The current state also indicated that some process activities, which were never intended to become a part of the process, are now common. Activities such as updating the billing block, manual price checks and manual invoicing have become normal daily processes. The billing block is updated in the majority of the sales because Allegro cannot be relied on and everything needs to be double-checked manually. These actions cause additional work or even rework and result in mistakes and delays. The inflexibility and the challenge of the activities being interdependent were also brought up since some sales are done in a rapid timeframe and all actions need to be performed by different process performers.

It must be highlighted that the main reasons for the issues are the system errors, as the Allegro system does not work as intended. This causes delays and errors as manual work increases. A critical challenge is that credit invoicing is visible to the customer and causes additional work for the customer. According to the data and the pricing specialist, approximately half of the sales cases were credit invoiced. The discussion brought up issues in which the extent of the problem was not previously known and the stakeholders became more aware of the current challenges in the process.

6. Discussion

Management of business processes is very important to make a business profitable with higher customer satisfaction. This is especially critical in the case of managing the O2C business process, where customer satisfaction is directly involved. Many studies are done to improve this O2C process. Eboigbodin (2016) studied to improve the O2C process by studying a case company, where the methodology was to conduct business process interviews and questionnaires efficiently, along with theoretical investigation. Muurinen (2020) studied the O2C process through the survey of four performance indicators such as time, quality, cost and flexibility. Blankenvoorde (2022) investigated and optimized the O2C process in a food company based on identifying the process inefficiencies. This study was conducted following the methodology of interviews with workers and creating a process flowchart within the case company.

It is noticed that the previous studies on the O2C process were mainly based on the interviews and development of flowcharts to identify the process bottlenecks. However, the practical implication of this study is that it considers lean methodology along with creating the swimlane diagram detailing the O2C process from beginning to end. Moreover, along with

questionnaires surveys, and data collection from the case company, this study also organized a VSM workshop highlighting various value-added and non-value-added activities within the O2C process. This approach opens up the process bottlenecks based on the participants' opinions, who are directly involved in the O2C process execution in the case company. From this study, it is revealed that by focusing on certain development areas the process can be improved to provide more value to the stakeholders. The main challenges in the current O2C process arise due to (a) incorrect and inadequate data, (b) manual work and (c) lack of communication and visibility to other functions of the process.

In addition to practical implications, this study offers theoretical implications concerning a thorough analysis of the theory surrounding business process redefinition, business process mapping and the order to cash process. As the data acquired from the case company's database aims for business process improvement with the need to be relevant and accurate to conduct business process interviews and questionnaires efficiently. The data gathered through questionnaires and interviews, along with the theoretical investigation and perspectives make up the discussion that wraps up this study.

7. Conclusions

This study is supported by the ongoing development project of the O2C process alongside which this study focused on the current state and the challenges of the O2C process. The theoretical background provided deeper insight and understanding into the ways the O2C process should flow, how the business process should be managed in the organization and what different possibilities the setting of good Key Performance Indicator (KPI) and implementation of lean methodologies could provide at their best.

The first research question was addressed by identifying several areas of development and by providing some possible KPI suggestions to indicate the performance of the most crucial business actions. The results of the dataset, interviews and the VSM workshop all highlight challenges such as a large amount of manual work which causes mistakes, activities delay and extra work or rework. Another challenge is that the current process creates waste internally and externally in the credit invoice actions. The credit invoice rate is at a high level of 46% meaning that this is a crucial area of improvement in increasing value for the stakeholders. Additionally, repairing the Allegro system functionality would decrease the amount of manual work for the pricing and invoicing team. The second research question was addressed by identifying the best metrics such as touchless rate, credit invoice rate and the number of manual field changes per sales case. The touchless rate of actions would show how many percent of invoice creation is done automatically as this should be the default. Additionally, the percentage of credit invoices could be shown as one metric, and the number of manual field changes done per sales case. Also, a financial indicator could be relevant for the management to showcase the amount of money the process is performing. Creating the KPIs for Celonis, it would show the real-time process performance to all the relevant stakeholders in the process. Moreover, the VSM matrix revealed three of the most critical areas of development such as Allegro system functionality, manual pricing actions and manual invoicing actions.

Allegro system functionality causes manual work for the pricing team, as the information does not flow correctly. This is the reason that the pricing team needs to manually check and add pricing to the case of each sale. The amount of manual checking and adding causes incorrect invoices, which need to be credited by invoicing team. It can be stated that this affects rework for the invoicing team. In addition to credit invoicing, the invoicing team needs to manually check all the invoice items that for some reason have not automatically been invoiced. Usually, the main reason for this is the inadequate data missing from the systems.

Repairing the Allegro system would solve most of the major issues for the pricing and invoicing teams because this will lead to the number of human errors decreasing.

This study has several limitations. First of all, the use of important process performance metrics is one of this study's weaknesses. It is difficult to assess if there would have been additional important predictors because it was not statistically demonstrated that the chosen indicators can significantly predict the O2C process performance. The fact that the process performance indicators are only applicable to O2C processes and cannot be used to assess the performance of other process types is another restriction. The second limitation can be stated that this study is conducted in a single case company whose outcomes may not support strongly the generalization of the study outcomes globally. Finally, this study uses limited participants from the case company's personnel, which may restrict the true representations of the study outcomes.

In the future study, a similar methodology can be used with other companies working in various sectors to know the bottlenecks and performance metrics related to the O2C process. Additionally, in addition to identifying three metrics, other available metrics such as order handling time, delivery time, lead time, etc., can be considered for a wider acceptance of the study outcomes. Furthermore, future studies can be orchestrated not only focused on the O2C process but other operations processes such as the production process, sales process, purchasing process, etc.

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Appendix

The interview questions.

(1) What are the challenges (bottlenecks and defects) of the current process? What causes these?

(2) How are the defects handled and resolved?

(3) Are there any extra features or rework that increase or affect your workload?

(4) Are there any activities in your job that require guidance/information/permission from a colleague before you can get started? If yes, who/whom are contacted for further information?

(5) What KPIs or other performance metrics do you have?

(6) What would you change/develop in the current process?

About the authors

Emilia Kääriä worked as a Master's of Science student at the University of Vaasa, Finland.

Ahm Shamsuzzoha is working as a Tenure Track Professor, at the Industrial Systems Analytics Unit, School of Technology and Innovations, and in the research platform Digital Economy, University of Vaasa, Finland. He received his Master's degree in Mechanical Engineering, majoring in Energy and Environment from the University of Strathclyde, UK, and a Ph.D. in Industrial Management from the University of Vaasa, Finland. His research interests are mainly focused on supply chain and logistics management, business networking, innovation management, blockchain, space data, entrepreneurship, etc. Ahm Shamsuzzoha is the corresponding author and can be contacted at: ahsh@uwasa.fi