Business process reengineering: practical implications in the Source-to-Contract process

A case study at a large manufacturing organization

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Acknowledgement

This Master’s thesis represents the final part of Mostafa Moustaghni’s and Jesper Persson’s time as Master of Science students within Industrial Engineering and Management in the specialization area of Industrial Logistics at Luleå University of Technology during spring 2021.

This thesis is something that we can proudly look back onto and remember the good days where the majority of the hours have been of happy and thrilling character. Unfortunately, due to the pandemic Covid-19, friends, colleagues, and family members have been affected. Luckily all of them have fully recovered and are healthy today.

This thesis has been an exciting, educative, and challenging part of our education, where we have had the opportunity to utilize previous theoretical knowledge and combine it with new insights and methodologies to apply it to a complex problem in a real case study. These experiences will be greatly valuable for us in the future.

We want to thank several people for providing us with significant input and insights. First and foremost, we would like to thank our team and colleagues at the case study company. Without them, this would not have been possible. Many thanks to our supervisor, Anna S, who continuously supported us and answered our questions when there were ambiguities. Thanks to our opponents, Anna Eriksson, Amanda Hedgren, Charlotte Lindström, and Morteza Moustaghni, who have provided valuable feedback throughout this thesis. Lastly, we would like to thank our supervisor Athanasios Migdalas at Luleå University of Technology, for providing us with insightful and relevant inputs.

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Mostafa Moustaghni  Jesper Persson
Abstract

This study’s purpose is to give recommendations on how the purchasing process, specifically the Source-to-Contract (S2C) process, can be reengineered by evaluating areas of improvement inspired by Lean and digitalization. To fulfill the purpose, a five-step framework of business process reengineering (BPR) and its methodology was developed, of which this thesis primarily covers the last three steps. The data collection process was based on a total of 19 interviews with three tactical purchasers at the case study company (CSC), three managers from large manufacturing organizations (LMOs), and extracted data from the CSC’s ERP-system.

In the third step of BPR, the most crucial areas for improvement for the CSC and LMOs in the S2C-process were identified by Lean and digitalization. These areas were: lack of sharing the right information at the right time, poor integration of systems, a shortfall of internal transparency, an inefficient request for quotation (RFQ) software, and an absence of working proactively. Based on the most crucial areas for improvement, best practices in the S2C-process could be derived from the interviews conducted with the CSC and LMOs. In the fourth step of BPR, short- and long-term solutions are proposed regarding the most crucial areas for improvement. Finally, in the fifth step of BPR, recommendations are given on measuring the effectiveness and efficiency of the S2C-process based on the proposed solutions recommended in BPR step four.

This study aims to suggest practical implications for LMOs on how the developed five-step framework of the BPR methodology can be utilized, especially the third step, to analyze and potentially reengineer its S2C-process. Additionally, the study gives insights on how the most crucial improvement areas could potentially be solved by LMOs in order for them to be considered best practice. Currently, there is considerable literature covering theoretical parts of BPR. However, the literature lacks guidelines on practically executing each step in the BPR methodology that this study partially aims to fulfill.

This study is delimited to one part of the purchasing process, the S2C-process, and briefly covers the Procure-to-Pay process as the process had to be considered before changes were recommended.

Keywords: Business process reengineering, purchasing, Source-to-Contract process, Lean, digitalization.
Sammanfattning

Syftet med den här studien är att ge rekommendationer kring hur inköpsprocessen, specifikt Source-to-Contract kan omstruktureras genom att utvärdera förbättringsområden inspirerade av Lean och digitalisering. För att uppnå syftet utvecklades en femstegsmodell av Business Process Reengineering (BPR), där studien primärt täcker de tre sista stegen. Datainsamlingen baserades på totalt 19 genomförda intervjuer med tre stycken taktiska inköpare vid fallstudieföretaget, tre inköpschefer från stora tillverkande organisationer och extraherade data från fallstudieföretagets ERP-system.


Studien ämnar till att ge stora tillverkande organisationer praktiska insikter i hur femstegsmodellen BPR kan används, primärt det tredje steget, för att analysera och så småningom omstrukturera sin S2C-process. För närvarande finns det betydande litteratur som omfattar teoretiska delar av BPR. Litteraturen saknar däremot riktlinjer för hur man praktiskt genomför varje steg i BPR-metoden som denna studie delvis ämnar till att uppfylla.

Denna studie avgränsas till en del av inköpsprocessen, S2C-processen men täcker även delar av Procure-to-Pay processen då det var nödvändigt att överväga processen innan rekommendationer kunde ges.

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## Denotations

Abbreviations along with a brief description for frequently used concepts are provided in the table below.

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<thead>
<tr>
<th>Denotation</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Application programming interface</td>
<td>API</td>
<td>An interface that defines interactions between multiple software applications.</td>
</tr>
<tr>
<td>Business process reengineering</td>
<td>BPR</td>
<td>Refers to radical changes in a business process with the purpose of being more efficient and effective.</td>
</tr>
<tr>
<td>Case study company</td>
<td>CSC</td>
<td>A large manufacturing organization.</td>
</tr>
<tr>
<td>Enterprise integration</td>
<td>EI</td>
<td>IT-systems to integrate business applications into a single larger system.</td>
</tr>
<tr>
<td>Initial potential need</td>
<td>IPN</td>
<td>An initial request that is received through email.</td>
</tr>
<tr>
<td>Internal request order</td>
<td>IRO</td>
<td>When a customer order is placed, an internal request order will be sent to the purchasing department when a contract is new or open.</td>
</tr>
<tr>
<td>Large manufacturing organization</td>
<td>LMO</td>
<td>An organization with over 250 employees or a turnover that exceeds 50 million EUR per year and is active within any industry.</td>
</tr>
<tr>
<td>Machine learning</td>
<td>ML</td>
<td>Complex patterns in historical data to provide recommendations in the present.</td>
</tr>
<tr>
<td>Natural language processing</td>
<td>NLP</td>
<td>An integrated system to interpret and make sense of human natural language.</td>
</tr>
<tr>
<td>Non-value adding and avoidable</td>
<td>NVA</td>
<td>An activity that is non-value adding and can be avoided.</td>
</tr>
<tr>
<td>Non-value adding but necessary</td>
<td>NVN</td>
<td>An activity that is non-value adding but necessary.</td>
</tr>
<tr>
<td>Procure-to-Pay</td>
<td>P2P</td>
<td>The operative way of working within the purchasing process.</td>
</tr>
<tr>
<td>Potential improvement area</td>
<td>PIA</td>
<td>An area that has some weaknesses and can be improved.</td>
</tr>
<tr>
<td>Request for quotation</td>
<td>RFQ</td>
<td>A document sent to one or more potential suppliers eliciting quotations for a product or service.</td>
</tr>
<tr>
<td>Robotic process automation</td>
<td>RPA</td>
<td>Bot that can replicate human movements.</td>
</tr>
<tr>
<td>Denotation</td>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>----------------------------</td>
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<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Source-to-Contract</td>
<td>S2C</td>
<td>The strategic or tactical way of working within the purchasing process.</td>
</tr>
<tr>
<td>Smart workflow</td>
<td>SWF</td>
<td>Technologies that facilitate the routing of documents with involved departments.</td>
</tr>
<tr>
<td>Value-adding</td>
<td>VA</td>
<td>An activity that is value-adding.</td>
</tr>
<tr>
<td>Value-stream mapping</td>
<td>VSM</td>
<td>A Lean tool, which is commonly used to identify improvements and wastes of a process.</td>
</tr>
</tbody>
</table>
1 Introduction

In this chapter, the problem background and formulation are presented regarding Business Process Reengineering of large manufacturing organizations’ purchasing processes. This chapter also describes the purpose, subgoals, limitations, disposition, and confidentiality of this thesis.

1.1 Problem background

Strategically working in purchasing is an area that has received the attention of great importance since the mid-1980s. Thus, supplying, running, maintaining, and managing the activities in the purchasing process under the best conditions. Focusing on more value-adding (VA) activities in the purchasing process contributes to organizations achieving better competitive positions due to enhanced customer satisfaction and ameliorated delivery times and costs (Carr & Pearson, 2002). To gain further benefits of working strategically, important aspects such as fostering continuous improvements and utilizing the potential of cross-functional and supply base collaborations are essential (Hammer, 2007; Khushalani & Woodcock, 2018). To provide guidance for these aspects, the purchasing process could be divided into sequential end-to-end processes as Source-to-Contract (S2C) and Procure-to-Pay (P2P), where the S2C-process begins with a need for a service or a good and is concluded when a contract agreement with a supplier is finished. The P2P-process starts with buying a service or good based on the need in the S2C-process and ends with delivery and payment. Thus, the end-to-end purchasing process aligns all activities from sourcing to supplier management (Biltoft-Knudsen et al., 2018; Jain & Woodcock, 2017; Monczka et al., 2015; Van Weele, 2018). To implement these end-to-end processes in the purchasing function, a radical change through Business Process Reengineering (BPR) can be necessary for organizations to achieve an effective and efficient process (Bain & Company, 2018).

BPR has become an essential factor in organizations because of the external competitive pressures and the internal mindset of constantly improving corporate responsiveness to adapt to changes and customer needs. One factor differentiating similar organizations from one another is how they have defined their processes and how they are interconnected (Al-Mashari & Zairi, 2000; Grover et al., 1995). Similarly, what differentiates a purchasing department from another is its tasks and in which order they are performed. Therefore, if an organization improves its purchasing process, it is likely to gain competitive advantages (Hinterhuber, 1995; Myerson, 2018; Nicoletti, 2018a). With that in mind, organizations that successfully eliminate functional biases in their day-to-day activities within the purchasing process are the ones that are adopting new ways of doing things and finding novel solutions to old problems (Andreu et al., 1997; Nicoletti, 2013). Thus, organizations need to constantly look for improvements in their purchasing process and find more efficient ways of performing tasks to still be relevant in the industry (Al-Mashari & Zairi, 2000; Mahmoudi & Tavakkoli, 2020). However, Hammer (1990) states that even though BPR sounds promising theoretically, it can result in worse functional performance in the organization after the process has been changed.

To improve the purchasing process, several approaches could be used. Asefeso (2012) and Myerson (2018) highlight the Lean approaches as crucial in improving the purchasing process. The authors mean that the Lean tool, value-stream mapping (VSM), could be used to understand the current situation of a process and discover areas where waste, unevenness, and overload can be reduced in the value-stream. In a study by Jing et al. (2021), it was found that VSM helps to eliminate unnecessary activities, reduce costs, and cycle times in the purchasing process, similar to the thoughts mentioned by Womack et al. (1990). Another approach to improve the purchasing process can be pursued by digitalization (Bienhaus & Haddud, 2018).
Only when improvements of the purchasing process have been made, a digital transformation by implementing new technologies such as robotic process automation (RPA), machine learning (ML), and real-time availability can be achieved. Otherwise, the automation of the process will result in quicker produced errors due to the errors in the process (Harikrishnakumar et al., 2019; Hofmann et al., 2020; Nicoletti, 2018a). Many companies recognize this digital transformation. However, they are not aware of what tasks, roles, and responsibilities will suit their purchasers (Bienhaus & Haddud, 2018).

BPR, inspired by Lean and digitalization, could help purchasing organizations discover necessary tasks, roles, and responsibilities to facilitate a digital transformation. Bain and Company (2018) highlight the importance of BPR, eliminating unnecessary activities, and using information technology to reduce an organization’s costs and cycle times. According to Aziz (2019), it is more challenging for large organizations to implement BPR because of the bureaucracy and the lack of effective communication resulting in reduced overall responsiveness to changes. Henceforth, small to medium-sized enterprises have the advantage of being more flexible and keen to implement process changes in the purchasing department when necessary (Myerson, 2018). Despite the nature of competition and organization size, large manufacturing organizations (LMO) such as IBM and NCR in the computer industry have succeeded in implementing new changes within their processes with promising results. Similarly, other LMOs such as SHM and IWC in the watch industry, Daimler, VW, and Benz in the automobile industry (Hinterhuber, 1995). Studies that contribute to a deeper understanding of BPR in the purchasing process at LMOs inspired by Lean and digitalization are thereby of interest.

1.2 Problem formulation

In a survey conducted by Bartolini (2019), the drive for digital transformation was the most crucial need for chief procurement officers, followed by improving processes for better effectiveness and efficiency. In 2020, the results were similar, where chief procurement officers still considered digital transformation but also improved collaboration and communication as the most critical factors for a purchasing organization to focus on (Bartolini, 2020).

The case study company [(CSC) is an LMO that recently restructured its organization to emphasize new end-to-end core processes to foster continuous improvements, better adapt to changes, and adopt a digitalized working environment. Due to the organizational restructuring, the purchasing department’s current activities are now primarily divided into two end-to-end core processes, S2C and P2P. However, these processes currently have several manual and inefficient activities due to the administrative work required for the employees. To identify what activities add value, software and IT need to be used to understand and map the current S2C-process at the CSC. Otherwise, it is likely that non-value adding and VA activities will be challenging to point out, and improvements would not be as efficient as they could be (Im et al., 1997). When implementing changes, one thing to be careful of is deviating from the corporate strategy, leading to the CSC not reaching its objectives and goals (Guha et al., 1993; Hammer, 1990). Another risk is that the changes might not be accepted or approved by the CSC’s employees resulting in resistance to change (Al-Mashari & Zairi, 1999; Guha et al., 1993). There is also a lack of knowledge in measuring the process performance in the process landscape, an essential characteristic to work with improvements (Harrington, 1991). Furthermore, roles and responsibilities in the new process landscape are vague. These ambiguities result in the department not being as efficient as it could be. Therefore, radical changes have to be taken to align the objectives set from the organization’s restructuring and clarify roles and make the

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1The name of the studied company is not mentioned in this thesis due to confidentiality.
purchasers’ life easier by reducing the administrative tasks to focus on more VA activities in the S2C-process through BPR.

### 1.3 Purpose and goals

The purpose of this thesis is to give recommendations on how the purchasing process, specifically the Source-to-Contract (S2C) process, can be reengineered by evaluating areas of improvement inspired by Lean and digitalization.

In order to fulfill the purpose of this thesis, four subgoals (SG) have been established, which are the following:

- **SG1:** Examine and map the current purchasing S2C-process among purchasers at the CSC and obtain insights for areas of improvement from other LMOs.
- **SG2:** Assess the most crucial areas that have to be improved for the CSC and LMOs.
- **SG3:** Determine best practices among crucial activities in the S2C-process for LMOs.
- **SG4:** Propose solutions and recommendations for the most crucial areas for improvement at the CSC.

### 1.4 Limitations

This thesis is limited to a time frame of 20 weeks, and to achieve its purpose, the purchasing process has to be delimited to the S2C-process, where tactical purchasers do the main tasks. Thus, the P2P-process will not be in the scope of this thesis, rather an area that will be briefly touched upon if necessary to discover improvements for LMOs in the S2C-process. Additionally, the S2C depends on other end-to-end processes, and when there is a predefined risk of affecting other processes negatively by changing the S2C-process, the other processes are considered before changes are recommended. An LMO in this thesis is an organization with over 250 employees or a turnover that exceeds 50 million EUR per year and are active within any industry (Region Västernorrland, 2018). This thesis is delimited to LMOs due to the number of resources available to implement digitalized solutions compared to smaller organizations. Furthermore, regardless of industry, it is assumed that these organizations somewhat have similar overall activities, for instance, finding appropriate suppliers, sending requests, and selecting the most competitive supplier in their purchasing processes, necessarily not in the same order. Therefore, this thesis is not delimited to a specific industry.

### 1.5 Disposition and confidentiality

This thesis disposition is slightly adjusted compared to the traditional written report due to the utilization of the BPR methodology. Specifically, findings, analysis, and recommendations are presented in Chapter 4, 5, and 6 in this thesis. The reason why steps one and two in the BPR methodology have a strikethrough is further described in Chapter 3. The findings and analysis are primarily touched upon in the methodology’s third step, while the recommendations are described in the methodology’s fourth and fifth steps. The comparison of dispositions between the traditional report and this thesis is visualized in figure 1.
This thesis does not include the CSC’s actual name due to confidentiality. In the report, the origin of each purchaser’s data is kept anonymous to avoid violating the policies of the CSC. Therefore, each purchaser is entitled to a letter. Additionally, the mapping presented in Chapter 4.1.1 is not illustrating the detailed S2C-process at the CSC due to the risk of revealing sensitive information to the public. Thus, the visualization and what is described about the process are kept at a general level. For the interviews conducted with LMOs, each manager is also entitled to a letter, and the information regarding the organizations and the managers are briefly touched upon to abstain from the sharing of confidential information.
2 Theoretical framework

In this chapter, BPR and its five-step methodology, how areas of improvement can be identified through Lean, digitalization, communication and collaboration, followed by change management, are presented.

2.1 Business Process Reengineering

The notion of BPR is to break away from outdated rules and assumptions of the underlying fundamentals in a business process. As a result, a radical redesign of existing processes can be made with the help of modern technology to achieve dramatic improvements in their performance (Hammer, 1990). Reengineering processes aim to rethink the existing processes and reengineering them to achieve higher quality, lower the cycle times and increase productivity (Aziz, 2019). The reason behind the reengineering is to eliminate processes that do not add any value to the business (Alavi & Yoo, 1995). This elimination, in turn, assists the organization to survive and remain competitive in the fast-growing industry (Mukwakungu et al., 2018). Since organizations are reengineering old business processes by introducing new instructions, procedures, and structures, a new way of doing business is emerging. Thus, an organization is consistently moving towards dramatic and revolutionary changes (Al-Mashari & Zairi, 2000). Therefore, BPR is not only appropriate for organizations that are under high competitive pressure but also when they are in peak conditions and have an aggressive business strategy to become even better (Hammer & Champy, 1994).

2.1.1 Methodology of reengineering a process

The approach of BPR may slightly differ from one organization to another. One author’s approach can overlap the steps in another author’s approach, but there are still characteristics that all of them have in common. A merged BPR framework is presented in the following steps (Abdous, 2011; Bahramnejad et al., 2015; Bradford & Gerard, 2015; Grover et al., 1995; Hinterhuber, 1995; Mohapatra, 2013):

1. Understand the purpose and the risks of BPR.
2. Identify and select the business process.
3. Identify and visualize the activities within the process.
4. Design a prototype of the new process.
5. Implement and evaluate the new process.

BPR step 1 - Understand the purpose and the risks of BPR

The first step of the BPR methodology aims to understand the purpose of the reengineering process, the goals, and the potential risks of changing (Attaran, 2000; Grover et al., 1995; Love & Gunasekaran, 1997; Mahmudi & Tavakkoli, 2020). It also enlightens the stakeholders that reengineering enables the organization to take action when a customer needs change and encourages technological innovation (Aziz, 2019). All stakeholders at the senior level associated with the change need to participate in the first step and document the outcomes of the discussions. This participation ensures that a supportive environment and cross-functional dynamics are established among the stakeholders from the start (Grover et al., 1995; Hinterhuber, 1995). This step aims to have clear goals to strive for and plans to achieve the goals, both
regarding the communication medium such as forums where giving feedback is possible and a
plan regarding the deliverables (Abdous, 2011; Mohapatra, 2013).

**BPR step 2 - Identify and select a business process**

Once the purpose and the risks are identified, the organization needs to determine the key
processes that need a redesign. There are two approaches to consider: the priority- and critical
success process approaches (Abdous, 2011; Mohapatra, 2013):

- The priority approach is to list the processes within a department and prioritize the
  processes that need a redesign. The prioritization is based on two criteria: corporate
  policy and competency in the organization. An example of processes within the material
  management department would be vendor development, scrutiny of indents, inquiry
  processing, processing quotations and placements of purchase orders, dispatch follow-up,
  inland clearance, and customs clearance.

- The critical success process approach is redesigning processes critical to the organization’s
  success while taking the industry, the organization itself, and the people into consideration.
  Each senior-level manager from the respective department associated with the chosen
  process is responsible for their processes but works tightly together to achieve consistency.
  Hinterhuber (1995) adds that, even though the senior-level manager is responsible for the
  processes, a dedicated reengineering team is responsible for understanding and designing
  the process.

It is also important to note that all processes should not be reengineered simultaneously
(Changchien & Shen, 2002; Love & Gunasekaran, 1997).

**BPR step 3 - Identify and visualize the activities within the process**

When it is clear what processes need to be redesigned, the dedicated reengineering team must
deply understand and visualize how the process currently is without any consultation of
how the process should be. It is also important to determine the input and output of each
process (Attaran, 2000; Bradford & Gerard, 2015; Mahmudi & Tavakkoli, 2020; Nicoletti,
2013). According to Attaran (2000), the visualization can be represented in technical and social
designs. The technical design includes tools as a flow chart to present an overview of the current
situation. The social design includes a block diagram where the involved departments with their
respective responsibilities are included (Bradford & Gerard, 2015; Harrington, 1991; Mohapatra,
2013). As the process is visualized, the team should identify wastes and unnecessary activities.
The easier the process is to be measured, the easier it is to reengineer it (Hinterhuber, 1995).
Effectiveness and efficiency should be considered when measuring the processes’ performance
(Harrington, 1991; Mohapatra, 2013). Effectiveness refers to how well the process meets the
customer’s expectations, while efficiency is the degree of resources spent to minimize waste.

If a process is not measurable, then it is not manageable. Therefore, it is essential to measure
its effectiveness and efficiency to manage it better, increasing the likelihood of improvements
being made (Harrington, 1991). However, these measurements need to be carefully selected to
ensure that they are clear for the employees. In addition, the reengineering team should take the
employee’s recommendations and improvements regarding new features or functionalities into
consideration. Otherwise, the desired outcome might likely be counterproductive or ineffective
(Abdous, 2011; Kestenbaum & Straight, 1995). Generally, it is the process owner’s responsibility
to establish how effectiveness and efficiency should be measured and what targets should be set
for improving a process (Harrington, 1991). The effectiveness and efficiency can be measured
by working closely with the employees who directly perform the process’s activities.
Measuring effectiveness

Measuring a process’s effectiveness helps an organization realize how well goals and objectives or requirements from internal and external customers are met (Valiris & Glykas, 1999; Van Weele, 2018). However, no matter how effective a process is, there will always be potential areas for improvement. An issue with measuring effectiveness is that the employees involved in the process usually are too busy with their daily work, which results in no improvements identified. Therefore, a process improvement team must understand the process to identify its opportunities for improvements based on effectiveness characteristics. These characteristics are, for instance, the following (Harrington, 1991):

- Is there incomplete output?
- Is there late output?
- Is there output that is rejected?
- What accuracy, timeliness, reliability, responsiveness, and costs does the process have?

Great care must be exercised when implementing these measures to ensure that they are easy to understand and focus on management’s objectives. If not, they might not provide the incentives desired and resulting in worse performance than before. Additionally, these measures should be specific for each process to be improved due to the process-specific subprocesses that usually vary (Kestenbaum & Straight, 1995).

Measuring efficiency

Measuring a process’s efficiency is usually beneficial for the process owner to understand potential areas of improvement, eliminate inefficiencies, and reduce costs (C. Meyer, 1993). Harrington (1991) mentions the importance of measuring time and categorizes it into processing and cycle time. Processing time is the time required to complete an activity in a process and the cycle time is the total time from start to end of a process, including the processing time and the time it takes to wait, store, rework, review and move documents. These measurements are important to understand the difference between the actual and total process time to gain insights into where waste and additional costs exist (Harrington, 1991; Kren & Tyson, 2002; Page, 2015). Harrington (1991) also briefly discusses four methods used to measure the cycle times of a process:

1. End-point measurement is suitable for measuring repetitive processes where information is available about start and end dates.
2. A controlled experiment is an appropriate approach for repetitive processes with short to medium cycle times and when the information about dates is not available and cannot be correlated.
3. Historical research is fitting when a process is repetitive but occurs infrequently.
4. Scientific analysis is an approach that is applicable when the other approaches are not, and the analysis has its foundations in breaking down a process into smaller components to estimate the process component and total cycle time.

Another method of measuring cycle times is to measure the objective cycle time versus the subjective cycle time, similarly, as Hult et al. (2002) measured the average length of a process from its initiation to completion. An issue that occurs when an organization strives to improve their cycle times is that the greater their need is to improve it, the quicker they want to improve (C. Meyer, 1993). This results in the organization focusing on tactics that are easy to learn
instead of finding tactics that will work out long-term. Thus, organizations need to carefully redesign their processes and develop cross-functional teams to focus on more VA activities. Another important dimension of understanding the efficiency of a process is by looking at its organizational dimension (Van Weele, 2018):

- What competencies do the staff have?
- How is the function managed, and how does the communication work?
- Are there available working instructions to ensure that the work done is done most efficiently?
- Are the information systems supporting the staff’s daily activities and providing the manager enough information on its performance?

**BPR step 4 - Design a prototype of the new process**

The visualization enables the reengineering team to analyze the current situation and present a prototype of the redesigned process (Attaran, 2000; Love & Gunasekaran, 1997). The prototype is established through a participative approach where the reengineering team has to note the users’ concerns. The participative approach is a continuous process that keeps on adjusting the design with the help of management and other stakeholders to ensure that the new process is solving the previous processes’ problems. Aside from changing the processes, the employees are also undergoing a training process to develop the required skills and competencies for the new processes. For instance, understanding new technologies, improving problem-solving- and communicating skills. Before the processes are implemented, the new processes need to undergo a pilot testing period. Thus, a limited number of employees are testing the new processes to generate data for the reengineering team to continuously refine the processes (Attaran, 2000; Love & Gunasekaran, 1997; Mohapatra, 2013). Throughout the BPR methodology, but especially in this step where changes are tested, communication and change management are crucial factors for a successful initiative (Davenport, 1993).

**BPR step 5 - Implement and evaluate the new process**

The new processes are then implemented in full scale, where the reengineering team has to keep measuring and monitoring them to determine how effective and efficient the process has ended up after the redesign (Attaran, 2000). The management still has to be involved and support the reengineering team in this step (Love & Gunasekaran, 1997). A cost-benefit analysis can reveal the savings acquired by reengineering the processes (Abdous, 2011). BPR provides a framework for managers to eliminate redundant costs and increase the organization’s profitability (Aziz, 2019). Further measurements could be done such as how well the organization receives the change in the long run, has the change contributed to increased supplier responsiveness, positive employee attitude, and changed the customers’ perception of the overall organization (Mohapatra, 2013). Furthermore, there is always room for adjustments for the better even after the redesign because the significant benefits are laying in the continuous improvement, which is a never-ending process.

### 2.2 Areas of improvement

To be able to change a business process according to the ever-changing environment in modern society, it requires great ideas that are developed with underlying principles. Hammer (1990) introduces seven principles that emphasize areas for improvement for business processes in general. Three of them are relevant in this thesis and are discussed further.
1. **One person should perform all the steps in a process**, refers to the fact that an employee’s job should strive to reach an objective instead of performing a single task. A bad practice of this principle is when several departments perform separate parts of the sequential process to fulfill the ultimate goal of the process. A change in responsibility from one individual to another for an activity creates gaps in the process where potential delays might occur (El Sawy, 2001). This is a bad practice because of the increased risk of misunderstandings and human errors that could occur along the way (Hammer, 1990).

2. **Parallel activities should be linked instead of lumped together in the end** to merge parallel activities while the processes are ongoing rather than in the end. A bad practice of this principle is that each department is working on a separate part of a product in isolation until the departments present their solution to combine it into a final product. Sharing vital information between the involved departments and increasing transparency as the project progresses is possible with communication networks and shared databases. This is referred to as closed-loop teams by El Sawy (2001), which avoids longer cycle times because of a lack of information.

3. **Information should be collected and read from one source.** The purpose of this principle is to store information electronically in one place to make it possible to fetch the up-to-date version of the information from wherever by eligible persons or departments. Subsequently, a paperless process is what to strive for (El Sawy, 2001). This eliminates the risk of duplicating or losing data, reduces delays associated with searching, and reduces overhead costs (Love & Gunasekaran, 1997; Zhao & Li, 2018). Furthermore, the information flow is increased because the distance between the information and decision is shrunken. Thus, the information is available close at hand instead of depending on someone else (Lockamy III & Smith, 1997).

Based on the principles discussed by Hammer (1990), several wastes could be identified in a process. These wastes are connected to the processes' effectiveness and efficiency (Bradford & Gerard, 2015; Harrington, 1991; Smith, 2010). The authors bring up wastes that are similar to each other but also some that differ:

- **Bottlenecks** are when several sources of information from other activities are loaded into one single activity causing the whole process to delay and decrease in performance.
- **Data duplication** occurs when different departments are involved in the same process, and each one of them is preserving the same data locally.
- **Duplication elimination** refers to eliminating activities that are identical but performed in different parts of the process.
- **Handoffs** are when responsibility is transferred from one person or department to another and could lead to information loss.
- **Intermediaries** are activities that are passed by to an individual that is performing a non value-added activity.
- **Manual steps** are the manual activities that could potentially be substituted with digitalized solutions.
- **Old ways** refers to when digitized solutions are in place but are not used because of a lack of training.
- **Rework** is when employees have to spend their time remediating errors.
- **Simplification** is when a process is complicated and could be simplified.
• **Standardization** is when there is a potential of performing a task in a single way that everyone has to stick to.

• **Supplier partnerships** are when the output of the process depends on the quality of the input it receives.

### 2.2.1 Lean in Procurement

Lean thinking is described by Womack and Jones (1997) as a five-step process to eliminate waste. Firstly, the value needs to be identified. Secondly, the value stream needs to be recognized. Thirdly, the flow of the process needs to be created. Fourthly, the customer needs to pull the product. Lastly, seek perfection. To implement the Lean philosophy, top management must offer total support to employees while communicating the importance of Lean to make a cultural change. Otherwise, the initiative likely fails (Myerson, 2018; Womack et al., 1990). Within procurement, Lean is described by Myerson (2018) as a way of working with fewer suppliers while improving coordination and collaboration with them. Moreover, in Lean procurement, the focus is on shifting relationships into the long-term by having extensive trust instead of limited, decreasing costs and lead-times, and increasing the time spent on VA activities by employees. To identify these activities and where wastes exist, a commonly used tool is VSM (Asefeso, 2012; Jing et al., 2021; Schiele & McCue, 2011).

VSM is a part of Lean, and its purpose is to analyze the current state of a process, identify waste, rearrange activities to enhance the effectiveness of the process if possible, map the future state process and compare the two maps to identify areas of improvement. An activity in a process can be categorized into three categories, VA, non-value adding but necessary (NVN), and non-value adding and avoidable (NVA) to realize if it is a waste or not (Lacerda et al., 2016). Additionally, Lean metrics can be helpful to identify these activities. In procurement, these are for instance (Basware, 2017; Myerson, 2018):

- **Transportation**, are invoices being transported from one person to another? Are there steps that could be eliminated or automated?

- **Inventory**, are there multiple copies of one document stored in one place? Are there several invoices or contract requests in the backlog?

- **Motion**, how many times is a document exchanged between stakeholders? Is there a need to confirm the data from a document in one system then another?

- **Waiting**, is there a long waiting time to get the right information before proceeding with the next step? Does the reviewing of contracts take a long time? How are the sourcing and contracting workflows managed? Could technologies or policies be changed to streamline the process?

- **Overproduction**, are the purchasers doing more than what is required? Are they creating documentation or reports that are not used? Can the production and publication of these files be automated?

- **Over-processing**, are there unnecessary reviews or signatures that are required? Can redundant oversight be reduced by increasing authority?

- **Defects**, are there reports that have to be reworked due to inaccurate information? Are there requisitions that have to be returned because of this? How many contracts or purchase orders need to be changed out of the total amount created?
- **Intelligence**, are the employee’s time being wasted or misallocated? Is there a lack of training and employee empowerment? Is the staff being used to their full potential?

### 2.2.2 Digitalization in Procurement

In a study by Jain and Woodcock (2017), they claim that technology is evolving rapidly and has enabled organizations to automate more activities in their processes to a higher degree. As a result, 46 percent of the employees’ time could be saved by automating their activities across any occupation and industry. Automation is enabled through many different technologies, but a few of them are: RPA, ML, smart workflow (SWF), natural language processing (NLP), and enterprise integration (EI).

**RPA** refers to bots that can replicate human movements by a series of if-then-else statements on structured data to finish a task (Willcocks et al., 2015). It is preferred in situations when a task is highly repetitive and performed in a specific way, thus tasks that do not require human judgmental capabilities (Hofmann et al., 2020). The advantage of RPA is that it can be integrated with existing systems without having access to the underlying code (van der Aalst et al., 2018). RPA is typically used for signing and approving invoices.

**ML** is based on complex patterns in historical data to provide recommendations in the present. ML is essentially several algorithms making systems capable of learning from past experiences (Jordan & Mitchell, 2015). It is preferred in processes that traditionally required human decisions, for instance, in the negotiation process by analyzing successful negotiation tactics in the past to provide the most fitting tactic for the current situation. ML is also used to perform strategic tasks in the sourcing field, such as assigning transactions to spend categories that ultimately lead to finding cost-saving opportunities quicker. Furthermore, Harikrishnakumar et al. (2019) investigate different ML algorithms for supplier assessment based on predetermined criteria.

**SWF** technologies facilitate for involved departments the process of accessing the right documents, transferring responsibilities, and assigning tasks coherently to not disturb the consistency in the process (Jain & Woodcock, 2017). Furthermore, SWF ensures that all information is gathered in one place to avoid misunderstandings concerning who and what has to be done. Thus, whenever a department has finished its task, the responsibility is automatically transferred to the next department. This ensures that all the involved parties are finishing their tasks and storing and accessing documents securely (ProcureSafe, 2021).

**NLP** enables an integrated system to interpret and make sense of natural human language, in the form of words and sentences to take actions or recommend suggestions based on the input information (J. Meyer, 2019). This technology is already used in modern customer-based environments where potential solutions are provided based on the customer’s text input in a chat (Sievo, 2021). In the same way in purchasing, an internal or external customer explains a need in text form, which NLP then interprets to provide the purchaser with suppliers that fit the customer’s needs (Jain & Woodcock, 2017).

**EI** is the process of using IT systems to integrate business applications into a single larger system which enables several applications to work together. Since many organizations’ business processes depend on different software that is not connected, it is easy for such an environment to quickly grow in complexity and slow down the entire process rather than enhancing it (Hughes, 2021). A way for the software to work together is by using application programming interfaces (API) to allow external applications to access and manipulating data. The data can then be fetched from a central database by using different database query languages (Borovskiy & Zeier, 2010).
2.2.3 Communication and collaboration

An important factor for purchasing organizations to consider is their transparency. According to Umbenhauer and Younger (2018), a majority, 65 percent, of procurement leaders have restricted or no visibility beyond their main suppliers. This is considered as internal transparency, which Lapsley and Rıos (2015), Roge and Lennon (2018), and Street and Meister (2004) mention in their studies. Harbert (2020) emphasizes two fundamental elements included in internal transparency; visibility and disclosure. Visibility refers to accurate data collected from important departments that are shared in one place within the organization. Disclosure, as the communication between the departments that reflects the degree to which the employees have access to that information for performing their day-to-day tasks. One way to enhance the internal transparency is to conduct flowcharts and communicate clearly about the performance indicators (Ahrens & Chapman, 2004). Furthermore, if the communication level is reduced, it will negatively affect the transparency (Street & Meister, 2004). A purchaser’s ineffective communication can result in relationship conflicts, misunderstandings and worsen the relationships with suppliers (Hung & Lin, 2013). The importance of communication skills is greatly recognized in literature and is mentioned as the most-cited social skill by Karttunen (2018) in purchasing. An effective communication strategy is about sharing meaningful information at the right time and that the sender and receiver of a message perceive it similarly (Hitt, 2015; Mohr & Nevin, 1990).

2.3 Change management

In change management, there are soft and hard characteristics. Soft characteristics involve people and how they are affected by changes, while hard characteristics include project planning and software implementation. The soft characteristics tend to be more difficult to observe - making them more challenging to measure than the hard ones (Sarayreh et al., 2013). An important aspect when implementing changes is that the group that will experience the changes perceives the changes as meaningful. Otherwise, the changes will likely face resistance. The employees might also fear that the changes will result in a loss of control, which could lower their motivation (Huq et al., 2006; Lauer et al., 2010). To manage change and resistance, a widely used model is Lewin’s Change Model (Grover et al., 1995; Lauer et al., 2010; Levasseur, 2001; Sarayreh et al., 2013).

Lewin (1947) describes that change could be managed in a three-step procedure: unfreeze, change/moving, and refreeze. Unfreeze is about minimizing the barriers to change to increase the likelihood of a successful implementation of change (Levasseur, 2001). This can be done in two different ways, according to Lauer et al. (2010):

- **Strengthening the forces that push for change.** This approach is suitable when opposing change forces are equally strengthened as the forces to push for change. To overcome or decrease the resistance to change, pressuring the pushes for change is essential. This can be done by, for instance, ensuring that the new ways of working are seen as more attractive than the old ways for the employees.

- **Reducing the opposing forces,** which is the most usual approach to initiate change. To reduce the resistance to change, it is necessary to understand what contributes to successful changes. In the initial phase of a change, the employees are usually skeptical towards it, and the consultants realizing and implementing the change. Therefore, the necessity of a change must be communicated to the employees quickly in the change process. Otherwise, resistance will likely be faced. Additionally, motivation tends to increase if results are shown early in the change process (Lauer et al., 2010). If an employee is excluded in the decisions taken for changes, it evokes a high barrier for change. To
remove this barrier, active participation and communication with the employees are crucial factors to ensure effective changes (Levasseur, 2001). The proposed changes should be developed and communicated with the affected employees through iterations of feedback throughout the change process to show that their efforts are valuable (Huq et al., 2006; Lauer et al., 2010). Moreover, statements containing empty phrases that are long and complex should be avoided due to their tendency to signal arrogancy and low esteem towards the affected employees (Lauer et al., 2010).

In the change/moving step, where the actual changes are being implemented, it is essential to focus on all the forces that occur to realize and counteract opposing forces to ensure a successful change process (Lewin, 1948; Sarayreh et al., 2013). These changes have to be tested, used, debugged, measured, and verified to reassure a successful implementation, which is done in the refreeze step of Lewin’s Change Model. In this step, it is important to understand that the new changes do not happen overnight; rather, it is a process that requires active involvement to replace prior behaviors (Levasseur, 2001). The changes verified must be refrozen to prevent old habits from relapsing, a common trait happening nine to twelve months after initiating the change initiative (Lauer et al., 2010).
3 Methodology

In this chapter, the methodology used in this thesis is presented by describing the research approach, literature review, data collection, and methodology of BPR. This chapter also describes the validity and reliability of the chosen methodology.

3.1 Research approach

This thesis was carried out at a CSC using the inductive approach due to the authors’ lack of prior knowledge in the area. Thus, interconnections about the purchaser’s daily activities at the CSC were explored in the form of qualitative interviews, where the first interview led to more data forming a basis for the following interview. Qualitative methods tend to work in harmony with indicative and exploratory research papers because it enables the researcher to delve into the relevant fields that the collected data is indicating to (David & Sutton, 2011). When the data was analyzed, and the phenomenon was explored, a conceptual framework of BPR was designed. The early adaptation of the conceptual framework was carried out as a theory for the deductive approach to be tested and validated. The research was not done after the deductive approach, as the conceptual framework needed corrections and improvements. Thus it had to go through the inductive approach again since new data had to be implemented. Consequently, the research had to revisit the deductive approach. Therefore, this thesis had an abductive approach because of its characteristics explained above. The entire research approach is visualized in figure 2. The first and second steps of the BPR methodology are not included in the figure because the CSC prepared them before starting this thesis. In the pre-phase of executing BPR, the literature review and the unstructured interviews introduced the authors to the subject of this thesis. In the third step of the methodology, semi-structured interviews were conducted to achieve SG1, SG2, and SG3. In the fourth and fifth steps of the BPR methodology, recommendations were given to accomplish SG4.

Figure 2: Research approach.
3.2 Literature review

In the initial phase of this thesis, a literature review was conducted to obtain a search strategy for the discussed problem in Chapter 1. Specifically, how improvements of the purchasing process could be pursued by utilizing the BPR methodology. The search engines that were used for finding relevant articles within the area were Google Scholar and Scopus. CiteScore was used to determine how trustworthy a journal was within the area of research, which is a metric system in Scopus that evaluates how well-cited a journal is during a period of three years (Zijlstra & McCullough, 2016). An article was considered more relevant if its journal had a CiteScore greater than two. However, exceptions were made when a journal for an article had a CiteScore below that criteria if the information provided by the article was considered relevant in the topic. The highest-ranked journals are visualized in Table 1. Sources of literature used were peer-reviewed academic journals, professional journals, books, e-books, newspapers, blogs, and reports.

Table 1: Summary of the highest ranked CiteScores used.

<table>
<thead>
<tr>
<th>Journal</th>
<th>CiteScore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>46.8</td>
</tr>
<tr>
<td>Information and Management</td>
<td>12.3</td>
</tr>
<tr>
<td>Journal of marketing</td>
<td>12.3</td>
</tr>
<tr>
<td>Production Economics</td>
<td>12.2</td>
</tr>
<tr>
<td>MIS Quarterly</td>
<td>11.6</td>
</tr>
</tbody>
</table>

Mean (all articles): 7.38

3.3 Data collection

The primary data was collected from a total of 19 qualitative interviews with the three tactical purchasers and the process owner of the S2C-process at the CSC, and three purchasing managers at other LMOs. To determine the most crucial areas for improvement and best practices in the process, insights were given from the interviews conducted. Secondary data was collected from already existing material that the CSC provided the authors with. This data consisted of flow charts representing parts of the current theoretical purchasing process. Quantitative data was collected by prioritizing the identified improvement areas at the CSC and LMOs, but also by measuring the effectiveness and efficiency of the S2C-process solely at the CSC.

3.3.1 Qualitative data collection

The qualitative interviews were primarily held in the early stage of this thesis to get as much information as possible about the purchasers’ processes. In Table 2, Interview A to Interview E were conducted with the three tactical purchasers at the CSC, one at the time, through Skype and Microsoft Teams, where the purchasers could explain and perform their daily tasks by sharing their computer screens for the interviewers to observe and study. The tactical purchasers were interviewed because they are the ones performing the tasks in the current S2C-process and are likely to know potential areas for improvements. One of the purchasers works more with recurring material, while the other two work with one-time orders.
Table 2: All conducted interviews.

<table>
<thead>
<tr>
<th>Name</th>
<th>Number of interviews</th>
<th>Role</th>
<th>Type</th>
<th>Purpose</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interview A</td>
<td>Three</td>
<td>Tactical purchasers</td>
<td>Unstructured</td>
<td>To get an overview of what activities the purchasers are working with on a daily-basis related to the S2C-process.</td>
<td>Gave insights in how the current S2C-process could be visualized by mapping “main” activities.</td>
</tr>
<tr>
<td>Interview B to D</td>
<td>Nine</td>
<td>Tactical purchasers</td>
<td>Semi-structured</td>
<td>To get feedback on the previous mapping done, discuss disturbance areas, roles, and responsibilities.</td>
<td>Gave knowledge on how the S2C-process currently is for the purchasers.</td>
</tr>
<tr>
<td>Interview E</td>
<td>Three</td>
<td>Tactical purchasers</td>
<td>Semi-structured</td>
<td>Prioritize what areas of improvement should be focused on.</td>
<td>Gained insights into the most crucial areas for improvement at the CSC.</td>
</tr>
<tr>
<td>Interview F</td>
<td>One</td>
<td>Process- owner, tactical purchasers</td>
<td>Semi-structured</td>
<td>To understand the cross-functional perspective in the S2C-process. Re-ensure that effectiveness and efficiency measurements are sustainable and do not affect other departments negatively.</td>
<td>Obtained information regarding what effectiveness and efficiency measurements should be used for the current and future S2C-process.</td>
</tr>
<tr>
<td>Interview G</td>
<td>Three</td>
<td>Managers</td>
<td>Semi-structured</td>
<td>To get an overview of issues that occur for LMOs and prioritize identified improvement areas.</td>
<td>Gained insights into best practices and the most crucial areas for improvement among LMOs.</td>
</tr>
</tbody>
</table>
Each initial interview with the purchasers was unstructured, Interview A. Thus, the questions were wide and open-ended to form dialogues and gather as much information as possible. There were no predetermined questions before the unstructured interviews. However, if a question was asked, it was based on general knowledge in the specific problem area. This knowledge got narrowed down to specific areas of choice as the interview went on. These interviews were unstructured to increase the interview flow by letting the interviewees tell their stories without any interruptions.

To gain feedback on the results from the previous interview and gather new data regarding a large number of complex questions, semi-structured interviews, Interview B to Interview E, were conducted. For these interviews, predetermined questions were asked when needed depending on the flow of the conversation with the interviewee. To gain additional knowledge of the S2C-process, a semi-structured interview, Interview F in table 2, was conducted with the process owner and two tactical purchasers through Skype to see the process from a cross-functional perspective and align measurements with goals and strategies. To steer Interview B to Interview F in the right direction, key questions and areas were detected beforehand, which can be seen in Appendix 1 and Appendix 2.

In table 2 Interview G was held with three purchasing managers at other LMOs and was conducted through Microsoft Teams, Skype, and Zoom. Due to the likelihood of the managers having a great understanding of what disturbance areas that different purchasers face and what areas are the most crucial ones to be improved, managers were chosen over tactical purchasers. The chosen LMOs acted in different industries and were chosen to provide insights into the most crucial areas for improvement and best practices in the S2C-process. The interviews were semi-structured based on the prepared key questions in Appendix 3. When the interviewers felt a need to go in-depth, further questions were asked.

All interviews, Interview A to G, were sound- and video recorded and transcribed during and after the interviews to be analyzed as an input for the following interview or concluded if it was the final interview.

3.3.2 Quantitative data collection

In the following chapter, it is described how the prioritization was made for the identified potential improvement areas (PIA) and what measurements were suitable for those areas to determine the effectiveness and efficiency of the S2C-process.

Prioritization

The quantitative data was collected from a prioritization of the identified problems areas with the three tactical purchasers at the CSC, and three managers at LMOs, Interview E and Interview G. With the purchasers at the CSC, a ranking of each identified problem areas were done, one at the time, followed by a discussion about why the purchaser perceived the area as less or more important. When a purchaser had rated an area, they had the opportunity to change their mind during the interview if they recognized another area as less or more important. The rankings were measured in quotients, one out of seven should result in high priority, but the decimal value is low and could be misunderstood as the lowest priority. Therefore, the score was inverted by calculating one minus the rank (in this example, one out of seven) to generate a greater number, thus a higher priority. Because of the similarities in different problem areas, a clusterization was made. If problem areas were similar, their scores were added and summarized, and a cluster was assembled. Finally, a confirmation was done through an interview to ensure that the clustered areas were of the same importance to the purchasers.
Measurement of effectiveness and efficiency

Based on the prioritization in Interview E, an interview was conducted with the process owner of the S2C-process and two tactical purchasers, Interview F, where the following measurements of effectiveness and efficiency were identified for the CSC.

Effectiveness:

- What percentage of initial potential needs (IPN) and internal request orders (IRO) are provided with enough information? Thus, complete output.
- What number of requests for quotations (RFQs) are sent through the dedicated RFQ software from 2020-05 to 2021-05?

Efficiency:

- How long does it take to complete an IRO on average?
- How long does it take to send an RFQ through the dedicated software?
- How is current software ensuring that the purchasers are working as efficiently as possible?
- How do the current working instructions support the purchasers’ daily activities?

In the S2C-process at the CSC, it was perceived that the missing information in an IPN was too challenging to measure due to the variations in the process. Instead, it was estimated how often this issue occurred. The data for measuring the effectiveness and efficiency of IROs were retrieved from the CSC’s Enterprise Resource Planning (ERP) system into an Excel sheet with columns such as start- and end date, given information, and IRO status. This data contained 1453 rows, and out of these rows, 191 were uncompleted or cancelled, thus, removed from the datasheet resulting in 1262 remaining rows. In this data, 190 outliers were found, and a data point was considered an outlier if its completion time exceeded 40 days. A reason behind this could be that the customer wanted the material on a new date resulting in a longer cycle-time than first expected, which resulted in 1072 rows left to analyze. To understand what a purchaser perceives as enough information in an IRO, informal interviews were conducted, then through analyzing the datasheet, it could be determined how many IROs were missing information. The objective cycle-time it takes to send an RFQ to a supplier through email was roughly determined in an interview with one purchaser. The measurements regarding how current software and working instructions support the purchasers’ daily activities were discovered in the conducted interviews.

3.4 Methodology of BPR

This thesis was based on the BPR five-step methodology presented in Chapter 2.1.1. Since the CSC prepared the first two steps before the start of this thesis, where it was decided that the S2C-process had the need of being redesigned, only the last three steps of the methodology will be further described.

3.4.1 BPR step 3 - Identify and visualize the activities within the process

The data collected through interviews were analyzed by mapping the activities in a flow chart representing the current state of the process. The flow chart is a method that was prioritized over other methods due to the ease of visualizing the flow and order of the activities in the process, similarly to the studies done by Attaran (2000), Bradford and Gerard (2015), Mahmudi
This data was composed in an online platform named LucidCharts, which made it possible to share and edit flow charts concurrently. The advantage of using this software was that the flow charts were updated in real-time, which made information easily shared between the authors. When the mapping was finished, an identification of VA, NVN, or NVA activities was analyzed through VSM, similar to the studies done by Jing et al. (2021), Lacerda et al. (2016), and Schiele and McCue (2011). The symbols shown in Table 3 were used to map the flow chart, similar as Bradford and Gerard (2015) did in their study.

Table 3: Symbols used for VSM.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>Represents a VA, NVN, or NVA activity in the process.</td>
</tr>
<tr>
<td>Decision</td>
<td>Represents a point in the process where a decision has to be taken.</td>
</tr>
<tr>
<td>Start/end</td>
<td>Represents the start or the end of the process. If there are decisions taken</td>
</tr>
<tr>
<td>Subprocess</td>
<td>Represents activities that vary significantly between the purchasers.</td>
</tr>
<tr>
<td>Process</td>
<td>Represents the process flow line and connects activities, decisions and</td>
</tr>
<tr>
<td>Terminators</td>
<td>terminators.</td>
</tr>
</tbody>
</table>

From the flow chart that represented the current situation, roles and responsibilities were identified by conducting a RASIC-matrix, a tool widely used within the CSC, similar to the block diagram and the social design described by Attaran (2000), Bradford and Gerard (2015), Harrington (1991), and Mohapatra (2013). The advantage of using a RASIC-matrix is that it helps to clarify roles.

To identify the most crucial areas for improvement in the S2C-process, a prioritization had to be made. This facilitated the process of focusing on the most crucial areas for improvement to create significant value for the CSC and LMOs. Corresponding measurement performance indicators were carefully selected for each improvement area with the process owner and two tactical purchasers at the CSC to avoid counterproductivity based on what is mentioned about effectiveness and efficiency by Abdous (2011), Harrington (1991), Kestenbaum and Straight (1995), Mohapatra (2013), Valiris and Glykas (1999), and Van Weele (2018). The indicators were formed to align with the strategies and goals that the purchasing department works with at the CSC, as Guha et al. (1993) discussed in their study. The effectiveness indicators were formulated based on factors that are discussed by Harrington (1991), Valiris and Glykas (1999), and Van Weele (2018) to emphasize in what frequency a desired activity occurs to realize how often it affects both internal and external customers. The efficiency indicators were
developed to eliminate inefficiencies and reduce the cost of performing a task but still retain high effectiveness (C. Meyer, 1993). To analyze the efficiency of the process, the authors examined the CSC organizational dimension, measured its end-point measurements and objective cycle-time (Harrington, 1991; Hult et al., 2002; Van Weele, 2018).

3.4.2 BPR step 4 - Design a prototype of the new process

Based on the most crucial areas for improvement, Lewin’s Change Model has been used similarly as in the studies by Grover et al. (1995), Lauer et al. (2010), Levasseur (2001), and Sarayreh et al. (2013). During the unfreeze and moving stage, reducing the opposing forces has been the primary approach to overcome the resistance faced while working with proposed solutions. The solutions were discussed thoroughly in a participative approach with the involved stakeholders such as process owners and tactical purchasers at the CSC to ensure that these changes were perceived as meaningful and that they would be implemented effectively. Combining the theory, short-term and long-term recommendations were proposed to establish a strong foundation for what should be implemented while taking the CSC’s goals and strategies into consideration (Attaran, 2000; Love & Gunasekaran, 1997).

3.4.3 BPR step 5 - Implement and evaluate the new process

Since this thesis does not include the implementation of different recommendations, this step was not thoroughly executed. Thus, only recommendations were presented in Chapter 6 regarding how to measure the effectiveness and efficiency of the process allowing the CSC to compare the measured values in the current process compared to when the proposed solutions are implemented, an approach recommended by (Attaran, 2000).

3.5 Validity and reliability

Validity refers to the extent of how well a paper’s research method is regarding its quality of measurement (Saunders et al., 2016). In other words, how close the data fit reality. Reliability indicates how well a paper’s research method is a consistent measure over time (David & Sutton, 2011). In other words, high reliability represents the same responses from the same respondents retrieved from different observers at different times.

In table 2 on page 16, it can be seen that Interview A was an unstructured interview, which makes the interview challenging to replicate. However, it is recommended by the authors to utilize this method to gain initial knowledge about the process to-be reengineered. The data collected from Interview A to Interview E were most likely biased. Therefore, further interviews were conducted, Interview F, to realize how the actual S2C-process could be visualized by seeing the process from a holistic perspective. To establish a valid measurement method, it was realized in the early stages of this thesis that some cautions had to be taken to generate objective results. Consequently, it was chosen to conduct interviews with managers outside of the CSC, Interview G, to realize how the S2C-process could be visualized from several perspectives of LMOs. At the beginning of each interview, the managers were asked to see the S2C-process from a tactical purchaser perspective to make it as close to reality as possible. Since the interviews were conducted with managers, it is assumed that the results might slightly vary from interviews with tactical purchasers, Interview A to E. Partly because of the managers’ comprehensive view of the process, but also that they might see the process from how it is supposed to be rather than how it actually is. To ensure that the data from the interview was valid, the interviewers emailed the transcribed results after the interview to the interviewee.
to confirm that the data was correct or to see if some adjustments were needed regarding the prioritizations. The interviewee then verified these adjustments.

Regarding the reliability of this thesis, historical data connected to the completed IROs was extracted from the ERP system to be later analyzed in an Excel spreadsheet. To ensure that the measuring was done correctly, the perceptions from the authors regarding each measurement area were validated by the tactical purchasers. For instance, the cycle-time to complete an IRO shown in the Excel sheet corresponded to the reality according to the purchasers.

Connected to the validity, trustworthy sources were used in this thesis by utilizing the CiteScore feature on Scopus. Due to the lack of up-to-date journals about digitalization in procurement, newspapers, and blogs were used to collect the latest information within the area. When possible, this information was confirmed or invalidated by other sources.
4 BPR step 3 - Identify and visualize the activities within the S2C-process

In this chapter the third step of the BPR methodology is presented for the CSC, followed by how the current S2C-process is for LMOs and what PIAs they perceive as the most crucial ones. Lastly, a comparison will be made between the CSC and LMOs to determine the best practices in the S2C-process for LMOs.

4.1 Case study company

A technical design in the form of a flowchart is presented to give an overview of what a purchaser’s day-to-day work looks like at the CSC, followed by a social design through a RASIC matrix to pinpoint the responsibility areas for each activity in the technical design. Subsequently, PIAs in the current process state are identified, prioritized, and measured.

4.1.1 Current process state

From Interview A to D, a technical design in the form of a simplified process map could be drawn to generalize the S2C-process, as shown in figure 3. The grey squares in the mapping represent subprocesses, which vary depending on the purchaser’s responsibilities. Because of the different obligations of the purchasers interviewed, they follow the generalized process differently. Therefore, the mapping should be examined with some caution. The time spent on the different activities might vary depending on if the purchaser is working with one-time or recurring orders. For instance, one activity might not be typical for a purchaser working with one-time orders, while it is common for a purchaser responsible for recurring orders. Moreover, some activities are done in one sequence for one purchaser, while those activities might be of more cross-functional characteristics for others.

Interview A is the foundation for the CSC’s technical design. The flowchart in figure 3 is based on the following process: an initial need is ultimately derived from a customer, and it could trigger two ways of handling them from the tactical purchasers’ perspective. One way is when a quotation engineer, constructor, or other departments notify the purchaser that there will be an IPN for a specific material based on a customer request. The other way is through an IRO created based on a customer order, but some materials are not assigned to a supplier or have an expired contract. Thus, the contract is open for assigning a new or previous supplier for the tactical purchaser to close the contract. The idea is that when an IPN is received from other departments, the purchaser needs to find and assign a corresponding supplier to the requested material in advance before an IRO is received later on. However, information in both the IPN and the IRO sometimes lacks vital information, making it difficult to proceed with, which sequentially delays the process. If no information in the IPN or IRO is missing from the previous steps, it is possible to send an RFQ to each appropriate supplier. A quotation is later received from the suppliers, which goes through a feedback check to ensure the requested material is possible for the supplier to provide. Otherwise, the technical specification has to be reworked. The process of selecting the most competitive supplier is based on strategies that involve essential variables such as the price of the material, their lead-time, and other relevant criteria depending on what is needed. If the requested material cost exceeds a threshold, more stakeholders need to be involved in the decision-making process. Otherwise, once the supplier selection is completed, the purchaser waits to receive an IRO to close the contract. Thus, makes it possible for the logistics department to purchase the material from the preferred supplier.
Figure 3: A simplified process map of the current S2C-process
Interviews B to D are divided into key areas regarding the S2C-process of the purchaser’s day-to-day work noted during the unstructured Interview A. The key areas can be split into five parts where an initial need is triggering a start of the S2C-process, followed by selecting supplier(s), signing contracts with the supplier(s), potential improvement and disturbance areas, see table 4.

Table 4: Key areas for Interview B to D.

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gather information based on triggered need</td>
</tr>
<tr>
<td>Selection of supplier(s)</td>
</tr>
<tr>
<td>Contract with supplier(s)</td>
</tr>
<tr>
<td>Potential areas of improvement</td>
</tr>
<tr>
<td>Disturbance areas</td>
</tr>
</tbody>
</table>

Considering the key area ‘Gather information based on triggered need’, the purchasers primarily receive documents and information about an IPN through email or an IRO from their ERP-system. The emails regarding the IPN are primarily received from a quotation engineer or a constructor but also other departments. Sometimes these departments have to remind the purchaser about an errand when they have not received a response about the errand’s progress. The purchasers get several requests per day, making their errands challenging to organize and prioritize in a full email inbox. The purchasers perceive that they receive many questions that are not formally part of their responsibilities, resulting in them performing their actual tasks with a lower quality. The information shared from other departments varies from employee to employee. For instance, the technical specification is sometimes exchanged with included documents through email, while other times, the documents are available in a software and sometimes not at all. A standardized template of what should be included in the errand has been discussed among the departments before but has not been followed up by the employees. Occasionally, the constructors have already found a favorable supplier on their own, which could ultimately lead to a collision with the purchaser’s strategy of finding a supplier. Some IPNs that come from other departments are considered more straightforward to handle. These types of needs are usually perceived as time-consuming since they are received more frequently. Due to their simplicity, the department which is usually sending an IPN could handle the need themselves. Working with IROs tends to be relatively repetitive in nature. If the information from an IRO is insufficient, the purchaser searches and collects necessary information stored in software if possible. Otherwise, the purchaser will email the person responsible for the IPN to extract missing information and proceed with the query. However, the person who sent the IPN might also not be mentioned in the IRO, resulting in detective work that takes unnecessary time. The purchaser might not have been included in an IPN either, making the information difficult to retrieve. Although the purchasers are provided with documentation and instructions on how to work most efficiently, the documentation is considered cumbersome to find and is sometimes too general, including redundant activities for the process of one-time orders.

Regarding the key area ‘Selection of supplier(s)’, all purchasers agree that finding a supplier could become detective work if they have no experience with the specific material group. The strategy of finding appropriate suppliers is done by searching for information about current suppliers in the ERP-system or by asking colleagues for recommendations as there is no local database. Instead, a global database does exist from which needs to be analyzed to extract the local suppliers. However, due to the inefficiencies of using the global database, the purchasers
primarily use their own experiences to find appropriate suppliers. In other cases, strategies such as searching for suitable suppliers on Google or contacting external firms can facilitate finding new suppliers. Currently, an RFQ is sent to suppliers through email. However, a dedicated software is supposed to be used according to their documentation and instructions. This dedicated software is not used because of its inefficiency and complexity compared to just sending a simple email. Also, the software is perceived as challenging to use for suppliers who are not using it regularly, which has led to some rejections of sending a quotation. The supplier assessment is done manually by comparing the suppliers’ assessment criterion against each other in an Excel file, even though this feature is done automatically in the dedicated software.

The contracting part in the ‘Contract with supplier(s)’ key area is uncommon among the purchasers. When the material cost exceeds a certain threshold, more people are involved in the errand. However, a formal contract might be necessary for development and investment projects. The software currently used for signing a decision taken of the selected supplier is made through an online service. The final documentation which closes the contract is made through the ERP-system.

Regarding the ‘Potential areas of improvement’ and ‘Disturbance areas’, the information received by the purchasers from other departments is sometimes insufficient or, on the other hand, too much, which makes it overwhelming and challenging to interpret. Some people from other departments are good at explaining what they require, while others neglect the importance of sharing the correct information. The purchasers consider searching for the missing information as an NVA activity because they know that someone in the organization has access to it. Thus, the transparency between the departments is considered low as a result of insufficient information sharing. This leads to another area of improvement where information-sharing regarding what suppliers that purchasers frequently use could be shared with other departments to handle simple queries on their own. Considering the technological aspects of the purchasers’ workflow, a disturbance area is that the purchasers need to use several software concurrently to fetch documents and information from other departments because one software is not communicating with the other. This means that the purchasers need to be experienced in several software instead of focusing on becoming skillful in one, which makes it challenging to work efficiently. Since software is used in general by the purchasers to perform tasks, the administrative and NVA tasks could potentially be automated.

The social design, a RASIC matrix, is based on the data from Interview E with each of the tactical purchaser at the CSC to understand who is responsible (R), who gives approval (A), who gives support (S), who needs to be informed (I), and who needs to be consulted (C) for each activity in the S2C-process. Additionally, each activity has a brief explanation of what happens in each step of the process. Because of the similarities and differences between the purchasers, an attempt to summarize their thoughts is visualized in Appendix 4.

Currently, the purchasers perceive the process as relatively similar, where the majority of the activities have been assigned with the same departments as responsible and supportive. For instance, each purchaser thinks that the responsible department for process step two depends on where the request comes from. What varies between the purchasers are primarily the activities four, six, and ten. For example, in activity four, one of the purchasers receives support from the logistics department while the others do not. In activity six, one purchaser takes help from all the involved stakeholders, as the other two purchasers generally receive support only from the constructors. Likewise, in activity ten, one purchaser is single-handedly responsible for this activity and receives no support, while the other purchasers get support from all the involved parties except the logistics department.
4.1.2 Analyzing PIAs

In the current state of the S2C-process, there are primarily seven wastes derived from scientific articles leading to useful PIAs to analyze further, as shown in table 5. These PIAs are visualized in figure 4 on page 28. Additionally, the figure shows whether an activity is VA, NVN, or NVA according to the purchasers.

Table 5: PIAs for the CSC and what they represent.

<table>
<thead>
<tr>
<th>PIA</th>
<th>Waste</th>
<th>Problem description</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIA1</td>
<td>Supplier Partnership, Handoffs, Waiting, Bottleneck, SWF, Inventory, Intermediaries, Standardization</td>
<td>Missing information from other departments when an IPN is received.</td>
<td>Bradford &amp; Gerard (2015), Basware (2017), Harrington (1991), Jain &amp; Woodcock (2017), Myerson (2018), ProcureSafe (2021), and Smith (2010)</td>
</tr>
<tr>
<td>PIA2</td>
<td>Data duplication, EI, Motion, RPA</td>
<td>Gather information from separate systems</td>
<td>Bradford &amp; Gerard (2015), Hughes (2021), Hofmann et al. (2019), Myerson (2018), and Willcocks et al. (2015)</td>
</tr>
<tr>
<td>PIA4</td>
<td>Manual steps, Old ways, ML</td>
<td>Send RFQ through email</td>
<td>Bradford &amp; Gerard (2015), Harikrishnakumar et al. (2019), and Smith (2010)</td>
</tr>
<tr>
<td>PIA5</td>
<td>Defect, Rework, Motion</td>
<td>RFQ rejected by supplier</td>
<td>Bradford &amp; Gerard (2015) and Myerson (2018)</td>
</tr>
<tr>
<td>PIA6</td>
<td>Intelligence, Bottleneck, Waiting</td>
<td>Missing information when an IRO is received</td>
<td>Basware (2017), Bradford &amp; Gerard (2015), El Sawy (2001), and Myerson (2018)</td>
</tr>
<tr>
<td>PIA7</td>
<td>RPA, Manual steps, Over-processing</td>
<td>Administrative work when working with IROs</td>
<td>Bradford &amp; Gerard (2015), Hofmann et al. (2019), Myerson (2018), Nicoletti (2017), and van der Aalst et al. (2018)</td>
</tr>
</tbody>
</table>

When an IPN is sent to a purchaser, they tend to lack crucial information, **PIA1**, which sometimes leads to the purchaser sending counter-questions to the person who sent it. The incomplete output from the previous process when the responsibility is transferred to a purchaser in the S2C-process is described as *supplier partnership* by Harrington (1991) and *handoffs* by Bradford and Gerard (2015), resulting in unnecessary cycle-times. A waste that Basware (2017) and Myerson (2018) mention as *waiting*, while Bradford and Gerard (2015) remark it as a *bottleneck*. To keep the IPN organized and standardized, *SWF* software could involve all the relevant departments in the process from the beginning to avoid misunderstandings. Thus, the
responsibility is transferred automatically to the following department when the assigned task is finished for the respective department, as described by ProcureSafe (2021). Additionally, the purchasers receive several requests per day, which adds up extra cycle-time for each request, resulting in many unfinished requests. Thus, a backlog of requests in the email inbox, described as inventory by Myerson (2018), for each purchaser because of the need to wait for simple responses that ultimately could affect end customers. When the purchasers receive an IPN, they can be perceived as an unnecessary intermediary because of the simplicity in the question (Smith, 2010). The information shared between the different departments could potentially be solved by standardization (Harrington, 1991).

Through the different software that the employees are using at the CSC, the purchaser can gather documents and vital information if the requests from quotation engineers and constructors do not contain enough information, PIA2. However, because of several software not being integrated, duplication of files and documents could occur. For example, documents might be available in two separate systems, and it can be difficult to realize which of the documents is the latest version. This waste is described as data duplication by Bradford and Gerard (2015). Thus, increases the likelihood of human errors. Another risk is that documents are exchanged back and forth between stakeholders via email at the CSC, which is mentioned as a motion waste by Myerson (2018). This refers to the fact that the purchasers are dependent on someone else to provide them with information instead of being close at hand in a software (Lockamy III & Smith, 1997). Furthermore, Love and Gunasekaran (1997) and Zhao and Li (2018) mean that this information should preferably be collected and read from one source to eliminate the risk of duplicating or losing data and reducing delays associated with searching documents. Hughes (2021) believes that integrating different business applications into one single system where each software can work together is the way to be more efficient and eliminate manual steps, described as EI. Another way of improving this area could be to utilize RPA technology in the process of fetching and comparing documents from one software to another, minimizing the likelihood of making human mistakes (Willcocks et al., 2015). Furthermore, since moving files from one software to another is considered repetitive and does not require human judgmental capabilities, an RPA could be applicable to handle the file management (Hofmann et al., 2020).

Currently, when a purchaser is searching for what suppliers are available, based on the information given in an IPN or IRO, they do it from their personal experience, PIA3, which has several risks. For instance, if the purchaser were to leave the company, much of their experience will be lost. This improvement area could potentially be solved by implementing digitized solutions to have this information shared in one place, making it more accessible for colleagues and other departments, described as manual steps by Bradford and Gerard (2015) and SWF by Jain and Woodcock (2017). Thus, increasing the internal transparency of the S2C-process, an important area, according to Van Weele (2018). If crucial information is shared with other departments, they could potentially do single and simple errands themselves instead of involving the purchasing department to eliminate the extra cycle-time that occurs by including them (El Sawy, 2001). Another solution could be to implement an ML algorithm into searching for available suppliers that could provide information to the purchaser about the leading suppliers within a specific material group based on historical data. Combining ML and NLP, a system could interpret the text from errands to provide recommended suppliers that fit the customer’s needs the best (Jordan & Mitchell, 2015; J. Meyer, 2019; Sievo, 2021).

When a purchaser sends an RFQ to the supplier(s), it is usually done by email, even though a dedicated software is available for doing it, PIA4. The problem with the current software is that it requires many manual steps, which makes it inefficient to use. This means that the current software must be further developed to streamline the process of sending RFQs
Figure 4: The S2C-process map with PIAs.
efficiently or that another software could be used, characterized as manual steps by Bradford and Gerard (2015) and old ways by Smith (2010). Furthermore, an ML algorithm could facilitate supplier assessment by ranking each supplier’s quotation and selecting the best one out of them all, according to Harikrishnakumar et al. (2019). However, the supplier assessment should be controlled and approved by the purchaser to ensure that the system has included vital parameters.

Suppliers sometimes reject some RFQs because the requested material is obsolete or impossible to provide, PIA5. It could also be due to the inaccurate information provided in the RFQs, which Myerson (2018) mentions as a defect. This results in the department requiring this material to rework their request or accept the provided alternative offer. Bradford and Gerard (2015) describe this as a rework, while Myerson (2018) considers it a motion.

When a purchaser receives an IRO they have not been involved in earlier, they have to go through the left branch of the flowchart in figure 4. This can negatively affect lead-times for the end customers in worst-case scenarios, PIA6. Thus, the purchasers could be involved earlier in an IPN to utilize their potential fully, a waste described by Basware (2017) as intelligence. This significantly increases the cycle-time of an errand because of the need to enter the branch to the left, described as a bottleneck and waiting waste (Basware, 2017; Bradford & Gerard, 2015). Because of the risk of the purchasers not being early involved when selecting a supplier, it indicates that the purchasers’ activities should be linked together parallelly with other departments instead of being lumped together when a favorable supplier has been selected (El Sawy, 2001). Essentially, this means that previously mentioned PIAs can be faced instead of instantly updating or closing the contract when a customer order is received.

When the purchasers work with an IRO, it is done manually through their ERP-system, PIA7. The tasks are relatively repetitive, where similar text boxes are supposed to be filled in. This repetitive nature enables opportunities in implementing RPA to the existing software (Hofmann et al., 2020; van der Aalst et al., 2018). However, since some human judgmental capabilities are involved, the implementation of RPA must be done with some caution not to increase the number of errors that occur (Nicoletti, 2018a). When the purchasers have updated or closed a contract, they are supposed to create or change existing documentation, a repetitive manual procedure (Bradford & Gerard, 2015). Thus, RPA would also be possible to implement here. One of the purchasers finds the number of signatures required at the CSC too many and unnecessary, described by Myerson (2018) as over-processing.

4.1.3 Prioritization of PIAs

In Interview E, the purchasers prioritized and assigned a score for each PIA found, which can be seen in table 6. The average score of each PIA from each purchaser is calculated to finalize what PIAs should be focused on when implementing improvements.

From table 6 it can be seen that PIA1 is ranked as the most valuable PIA for purchasers B and C, while it is ranked as the fourth most crucial area for improvement out of seven for purchaser A behind PIA3, PIA4, and PIA7. Because of the PIA’s ranking from each purchaser, it got an average final score of 0.71 out of 0.86. The second-highest ranked improvement area is PIA3 at an average score of 0.57, the internal transparency that purchaser A and C highlights particularly important, while purchaser B ranks the area at the third lowest out of all PIAs. Due to the inefficient way of working in the current RFQ software, there is much potential to develop the software to avoid using email and better manage and organize different requests, which purchaser A and purchaser C ranks highly valuable compared to purchaser B. Thus, receiving an average score of 0.52. Furthermore, it can also be seen from table 6 that purchaser B values
### Table 6: Prioritization of PIAs.

<table>
<thead>
<tr>
<th>PIA</th>
<th>Problem description</th>
<th>Purch. A Score</th>
<th>Purch. B Score</th>
<th>Purch. C Score</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIA1</td>
<td>Missing information from other departments when an IPN is received</td>
<td>0.43</td>
<td>0.86</td>
<td>0.86</td>
<td>0.71</td>
</tr>
<tr>
<td>PIA3</td>
<td>Lack of internal transparency</td>
<td>0.86</td>
<td>0.29</td>
<td>0.57</td>
<td>0.57</td>
</tr>
<tr>
<td>PIA4</td>
<td>Send RFQ through email</td>
<td>0.71</td>
<td>0.14</td>
<td>0.71</td>
<td>0.52</td>
</tr>
<tr>
<td>PIA6</td>
<td>Missing information when an IRO is received</td>
<td>0.29</td>
<td>0.71</td>
<td>0.43</td>
<td>0.48</td>
</tr>
<tr>
<td>PIA7</td>
<td>Administrative work when working with IRO</td>
<td>0.57</td>
<td>0.57</td>
<td>0.14</td>
<td>0.43</td>
</tr>
<tr>
<td>PIA2</td>
<td>Gather information from separate systems</td>
<td>0.14</td>
<td>0.43</td>
<td>0.29</td>
<td>0.29</td>
</tr>
<tr>
<td>PIA5</td>
<td>RFQ rejected by supplier</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

PIA6 as the second most valuable improvement area, while purchaser A and C interpret it as the fifth and fourth most crucial area to improve, resulting in the area receiving an average score of 0.48. Administrative work, PIA7, is an area that purchaser A and B perceive as the third most crucial area for improvement, while purchaser C does not see as many issues in the area, thus obtaining an average score of 0.43. Gathering information from separate systems, PIA2, is an area that all purchasers have prioritized at the bottom half of their ranking list, leading to a relatively low average score of 0.29. Finally, PIA5 is an area that all purchasers valued the lowest because of its infrequency of occurring, receiving a score of 0.00.

In the interviews, the purchasers also gave vital information about the different PIAs while prioritizing them, summarized in Table 7. Later in this thesis, PIA5 is abandoned because of its score of zero and infrequency of occurring. Thus, an area that would not help to diminish a lot of time.

From Table 7, it can be seen that purchaser A emphasizes the importance of internal transparency, PIA3, while purchaser B does not see it as necessary. This could be because purchaser A is relatively new at the CSC and sees problems from a different perspective than purchaser B, who has worked at the company for several years. It could also mean that purchaser B has gained enough experience to fix certain issues that do occur quickly. Thus, not seeing the PIA as much of a problem as purchaser A. Purchaser A believes that if the different PIAs were to be solved, it would be valuable for them to focus on more VA activities such as cost-savings projects, while the other purchasers who have more experience, thinks that only some of the PIAs would greatly benefit them. Regarding PIA7, purchasers A and B have prioritized this area higher than purchaser C, most likely because they tend to receive more IROs meaning they spend more time on the administrative work required.

Due to the fact that some of the PIAs are relatively similar to others, those areas are clustered together. For instance, PIA1 and PIA6 both regards missing information in different parts of the S2C-process. Thus, an area that could be solved by digging further into why there is a lack of information and the root causes behind it. Similarly, this applies to PIA2 and PIA7, in which there are issues regarding the integration of the current software used. Therefore, an area that has to be analyzed further to understand what could be done to integrate these systems.
The score of the clustered PIAs is added and summarized to get a final score for the clustered problems, which is shown in table 8.

From table 8 it can be seen that the most crucial area for improvement for the CSC is to solve the issues regarding missing information in the S2C-process. Without these proper aspects, the CSC will likely lose some information where PIA1 and PIA6 are occurring in the current process, receiving a final score of 1.19. The second most crucial area for improvement for the CSC is to integrate their current systems better and automate manual tasks to enhance the efficiency of the purchasers resulting in a final score of 0.71. The CSC should also focus on increasing its internal transparency, C3, with a final score of 0.57. This enables the relevant departments in the purchasing process to have access to vital information at all times. Lastly, the current RFQ software is the fourth most crucial area for improvement, C4, receiving a final score of 0.52, which should be developed further to simplify the process of making an RFQ to increase the efficiency of the purchasers.
### Table 8: Final score of the clustered PIAs.

<table>
<thead>
<tr>
<th>Clustered notation</th>
<th>Clustered problem</th>
<th>Clustered PIAs</th>
<th>Final score</th>
<th>Final rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Missing information</td>
<td>PIA1, PIA6</td>
<td>1.19</td>
<td>1</td>
</tr>
<tr>
<td>C2</td>
<td>Integration of systems and automation</td>
<td>PIA2, PIA7</td>
<td>0.71</td>
<td>2</td>
</tr>
<tr>
<td>C3</td>
<td>Internal transparency</td>
<td>PIA3</td>
<td>0.57</td>
<td>3</td>
</tr>
<tr>
<td>C4</td>
<td>Develop RFQ software</td>
<td>PIA4</td>
<td>0.52</td>
<td>4</td>
</tr>
</tbody>
</table>

#### 4.1.4 Measurements of effectiveness and efficiency

**What percentage of IPNs and IROs are provided with enough information?** Thus, complete output.

Out of the requests that the purchasers receive from other departments through an IPN, the information tends to be complete in roughly 50 percent of the cases. However, this varies between the different purchasers since they have different contact persons from other departments. The information missing is usually “basic” information, for instance, quantity and when it is needed resulting in unnecessary cycle times. Currently, the information available from an IPN tends to disappear when an IRO is received for the purchaser. Thus, only 70.8 percent of the time, the information in an IRO is considered complete.

**How long does it take to complete an IRO on average?**

In the process, more than half of the IRO’s sent to the purchasers are set as needed with a high priority, 672 out of 1072 cases (62.7 percent). For these IROs, the average cycle time of completion is roughly 9.83 days, which can be explained by the large variances of processing an IRO. For the cases that are not a high priority, the completion time is approximately 11.3 days, which is interesting since it only tends to differ slightly more than one day for a high priority case compared to a normal one. If the outliers are not removed from the data, meaning that 1262 data points are left, the average completion time gets significantly higher for both high priority and standard cases. For the high priority cases, the time to complete an errand is around 18.2 days, while it is 22.5 days for standard cases. This indicates that high priority cases are completed quicker than the standard ones, but similar here, the difference between the two different types of cases does not differ a lot.

**What number of RFQs are sent through the dedicated RFQ software? How long does it take to send an RFQ through the dedicated software?**

When sending RFQs, 18 cases have been completed through the dedicated software this year, from 2020-05 to 2021-05. This is primarily because of the inefficient way of currently sending one. This also varies depending on what role each tactical purchaser has, which can be reflected in how many cases they have done in the dedicated software. The time it takes to send an RFQ through the software is roughly six times longer than sending one through email. Therefore, a new and more efficient way of working with the software is necessary for the purchasers to consider a new way of working.
How is current software ensuring that the purchasers are working as efficiently as possible?

Even though the purchasers are using several software that eventually leads to them finishing their tasks correctly, there are still inefficiencies considering how these tasks are performed with their current software. One software intended to store vital documents from a certain department requires data from another software to get access to other vital documents. Thus, the purchasers need to manually copy and paste the output data from one software to another software to proceed. Additionally, since the purchasers are required to work in several software, this results in them being less efficient and less professional than if they primarily worked in one or a few software.

How do the current working instructions support the purchasers’ daily activities?

Currently, the working instructions available for the purchasers are easy to understand and straightforward. However, an issue with them is that they are perceived as challenging to find when needed. Today, an internal knowledge database is not fully utilized for storing internal knowledge regarding working instructions, which opens up opportunities to make these more accessible for the purchasing department to increase its efficiency.

4.2 Large manufacturing organizations

A description of the current process state is presented to give an overview of what activities occur in the daily work life of a tactical purchaser at LMOs, followed by an analysis and a prioritization of the identified PIAs.

4.2.1 Current process state

Interview G is divided into key areas regarding the S2C-process of the purchaser’s day-to-day life from the managers’ perspectives. The key areas can be split into five parts: initial questions, gather information based on triggered need, selection of supplier(s), signing contracts with supplier(s), and a discussion of PIAs, see table 9.

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial questions</td>
</tr>
<tr>
<td>Gather information based on triggered need</td>
</tr>
<tr>
<td>Selection of supplier(s)</td>
</tr>
<tr>
<td>Contract with supplier(s)</td>
</tr>
<tr>
<td>Discussion of PIAs</td>
</tr>
</tbody>
</table>

Regarding the key area ‘Initial questions’, LMOs usually have two separate processes depending on whether it is a recurring material or service to be bought or a one-time order. The recurring process tends to have higher volumes, larger transactions involved, and more steps to ensure the best possible purchase compared to the one-time order process, where fewer steps and faster decisions are usually required.

Considering the key area ‘Gather information based on triggered need’, a need can occur from basically any department in the two processes. For instance, from maintenance, constructors, market, or sales. The IRO comes through email, an ERP-system, or an S2C-suite, a software
that can be considered a platform where the purchasers do their primary tasks. However, the information shared through the ERP-system or the S2C-suite is not always enough. Thus, email has to be used to complement this information. An issue for LMOs is that they do not have enough information about each material group in their software, which results in a lack of information being shared with the purchaser.

If the information is enough for the purchaser, they can start figuring out what suppliers would be appropriate to send an RFQ to for that specific request, the key area ‘Selection of supplier(s)’. Usually, LMOs have a database with existing suppliers for each material group, making it easily accessible for new purchasers to determine what suppliers would be appropriate for a specific request. If it is a new supplier to be found, the detective work regarding it is usually more difficult for less experienced individuals, as expected. However, there is still much information that could be added to get a better overview of each product. When suitable suppliers have been found, the purchaser sends an RFQ through email, the ERP-system, or the S2C-suite, depending on whether it is a recurring or a one-time order. An RFQ is specifically designed by the purchaser to make it a good fit for each specific case. If the order concerns recurring materials or services, then terms and conditions with specific requirements are also included in the RFQ for the supplier to be aware of before a purchase order is placed. When evaluating suppliers, the software is well-functioning and gives the purchasers support from their S2C-suite regarding these activities for some LMOs, while others who are in a transformation currently use Excel manually to summarize the quotations from each supplier. It is common that other departments perceive that the purchasing department is neglecting other departments’ opinions when selecting a supplier. This enables the opportunity of enhancing the transparency between the involved departments by making the process of supplier assessment more accessible. When the most suitable supplier is selected, an order is placed to see if the supplier is confirming the RFQ together with the agreed lead-time, price, and other criteria.

Regarding the key area ‘Contract with supplier(s)’. If the material or service is a one-time order, the order confirmation will become the foundation for the contract between the supplier and the purchaser. However, if the order is of a larger transaction, a formal contract is formed for both parties to sign, usually done manually through their S2C-suite, an online service, or by hand. LMOs are finished with the S2C-process after they have either gotten an order confirmation or signed a formal contract that makes the material or service possible for purchase.

Lastly, considering the key area ‘Discussion of PIAs’, LMOs emphasize the importance of involving the purchasers in the early stages to work more proactively. One reason to work proactively is to prevent other departments from requesting quotations of specialized materials from unknown suppliers without the right conditions and requirements. Since the products are specialized, they tend to be more expensive, leading to an overall more expensive technical specification. This could be avoided by building more robust communication and collaborations between purchasers and other departments to promote early inclusion of the purchasers in the decision-making, leading to the usage of cheaper and standardized material but still maintaining the same quality. Some of the LMOs believe that it is essential for them to work more strategically, thus, working more with recurring orders and standardizing products when possible to have less informal contracts and concentrate on larger transactions. Another aspect of working proactively is to forecast contracts that will be needed with suppliers in the future, thus having contracts already ready when a purchase is needed. Most of the LMOs believe that their communication and collaboration could be further improved internally. Another improvement area for LMOs is that there currently are some difficulties for a new purchaser to understand what suppliers are competitive and which ones are not. Thus, there is a possibility to scrape and analyze the internet for valuable data that will in advance tell whether a supplier
is sustainable enough for a long-term partnership. The analysis will help eliminate the detective work that currently has to be done manually. Another important aspect is to migrate to a single integrated system that supports the purchasers in their day-to-day work to avoid inefficiencies that emerge from using several software that is not connected to each other. A beneficial software would increase the visibility of the information flow between the involved departments, generate better data analysis, and promote an environment where already existing contracts are more frequently used rather than signing a new contract for each specific need. There are also thoughts among the LMOs considering automating administrative work through bots and other services.

4.2.2 Analyzing PIAs

Because of the lack of information concerning each material group in the LMOs systems and the importance of involving the purchasers in an early stage to encourage working proactively, it indicates that the communication and the collaboration between the different departments could be improved to avoid bottlenecks (Bradford & Gerard, 2015). Confusion tends to arise because meaningful information is not communicated, leading to the receiver not perceiving the information as intended (Hitt, 2015; Mohr & Nevin, 1990). This, in turn, affects the internal transparency regarding when the purchasing department neglects other departments' opinions when selecting a supplier. This is a sign of information disclosure within the LMOs, which means that the process of choosing the right supplier is not shared with other departments, even though it indirectly affects their day-to-day tasks (Harbert, 2020).

At some LMOs, the software is well-integrated where most of the information needed is available in their S2C-suite, similar to a single more extensive system, EI mentioned by Hughes (2021). Thus, the purchasers have one primary place of working with their day-to-day tasks. While other LMOs are undergoing a software transformation to an S2C-suite, for instance, ARIBA, Ivalua, or Coupa, it highlights the importance of developing the utilized systems to make them more integrated. For the LMOs undergoing the transformation, they currently have several software used for different parts of the S2C-process and believe that transitioning into one suite would be valuable for them to work more efficiently. Furthermore, LMOs have common areas where automation would be applicable and appropriate to enhance the effectiveness and efficiency of the S2C-process since areas regarding, for example, contracting and documentation are manual and in some cases analog (Bradford & Gerard, 2015). To achieve the desired automation, RPA and a combination of ML are powerful tools enabling them to outsource the administrative work to bots (Jordan & Mitchell, 2015; Willcocks et al., 2015). Considering the scraping and analyzing the internet for valuable data about suppliers, a combination of RPA and ML could also be used because the process of gathering information is repetitive to an extent but also judgemental to tell whether the scraped information is valuable or not. LMOs are currently working towards a digital transformation but have not yet managed to accomplish it due to the high barrier of ensuring that all current data is correct.

4.2.3 Prioritization of PIAs

What has been found in Interview G is that LMOs have similar issues in their S2C-process, which can be translated into the same clustered problems as the CSC presented in table 8 on page 32. A summary of LMOs' scores of each PIA is presented in table 10.

From table 10, it can be seen that the most crucial area for improvement for LMOs is C1, missing information, an area that LMO A highlights as the most crucial one combined with better collaboration and communication. LMO C believes that improvements regarding sharing information and collaboration always could be improved, an area that they rank as number
Table 10: Prioritization of PIAs for LMOs.

<table>
<thead>
<tr>
<th>Notation</th>
<th>PIA</th>
<th>LMO A</th>
<th>LMO B</th>
<th>LMO C</th>
<th>Final Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Missing information</td>
<td>0.75</td>
<td>0.25</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>C4</td>
<td>Internal transparency</td>
<td>0.50</td>
<td>0.00</td>
<td>0.75</td>
<td>0.42</td>
</tr>
<tr>
<td>C2</td>
<td>Integration of systems and automation</td>
<td>0.25</td>
<td>0.75</td>
<td>0.25</td>
<td>0.42</td>
</tr>
<tr>
<td>C3</td>
<td>Develop RFQ software</td>
<td>0.00</td>
<td>0.50</td>
<td>0.00</td>
<td>0.17</td>
</tr>
</tbody>
</table>

For the same reason of LMO A and C having somewhat integrated systems, their purchasers also have useful dedicated software to send RFQs, **C3**, thus no need to develop their RFQ software. However, LMO B sees more potential in improving their dedicated software resulting in the improvement area receiving a final score of 0.17.

4.3 Most crucial areas for improvement

Putting the prioritization of each improvement area from the tactical purchasers at the CSC and the managers at the three different LMOs side by side, there is a consensus of the most crucial areas for improvement for LMOs. The scores from each respondent and the final scores are summarized in table 11.

Table 11: Summary of most crucial areas for improvement.

<table>
<thead>
<tr>
<th>Notation</th>
<th>PIA clustered problem</th>
<th>Rank for the CSC</th>
<th>Rank for LMO A</th>
<th>Rank for LMO B</th>
<th>Rank for LMO C</th>
<th>Final rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Missing information</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>C2</td>
<td>Integration of systems and automation</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>C4</td>
<td>Internal transparency</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>C3</td>
<td>Develop RFQ software</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

The final rank resembles the prioritization of the improvement areas done by the CSC. As seen from table 11, the respondents consider communication and collaboration between departments as the most crucial area for improvement as there is a lack of information that is usually shared, C1. The second most crucial area for improvement to consider is integrating the different systems to access information more easily, open up for visibility across departments to increase
transparency, C4, and standardize the information flow, C1, in order to avoid sharing insufficient information. Enhancing the transparency could contribute to the purchasers being involved in the early stage when an IPN is received, which makes it possible to work more proactively. Although the previously mentioned improvement areas, C1, C2, C4, are correlated to each other, the last improvement area, C3, is still important because it examines a different area that is not included in the previous areas, thus, to send an RFQ to the supplier in the most efficient way through the integrated system.

Besides the prioritized improvement areas, another crucial improvement area for LMOs to consider is working more proactively by standardizing material, early information-sharing to purchasers, and forecasting contracts when possible.

4.4 Best practices for all LMOs

The CSC and the different LMOs are compared chronologically in each step of the S2C-process. Additional recommendations about the best practices for all LMOs are included in table 12 on page 39.

For both the CSC and LMOs, there are two ways of handling a customer’s needs. LMOs use a separate process depending on if the customer order is a recurring or a one-time order, while the CSC uses a single process to handle both. The best practice is to use two processes for each order type to define the responsibility areas better and decrease the risks of transferring the responsibility from one person to another (El Sawy, 2001). However, it is important to note that two processes might not be appropriate for all organizations.

Although an IPN or IRO can contain insufficient information, most LMOs receive them through an integrated software and use email if the information is insufficient, while the CSC is solely communicating regarding the requests through email. As a result, vital information is missing in the messages that traverse from the source to the purchaser. The best practice is to standardize the information from the source when possible to ensure it stays the same throughout the whole process (Harrington, 1991). Here, it is also essential for LMO to work more proactively by enhancing the communication and collaboration between the involved departments to share information to the purchasers when necessary to avoid bottlenecks and activities being lumped together (Bradford & Gerard, 2015; El Sawy, 2001). Some LMOs have come further than others regarding working proactively.

For the process of finding potential suppliers that suits the requests the best, the CSC is currently not having a local database to search through the available suppliers, while the LMOs have but find it challenging to utilize it because of the insufficient background information provided about each supplier. Thus, the best practice is to use a database of suppliers that exist within the organization, which opens up the possibility of increasing the transparency between the departments since vital information about the supplier can be shared with departments requiring this data (Harbert, 2020).

Depending on if it is a one-time or recurring order, an S2C-suite, email or ERP-system is used at LMOs to send out RFQs, while email is primarily used at the CSC even though a dedicated RFQ software is supposed to be used. The best practice is to send both types of orders through the same software but with different instructions depending on which type of order to send. One-time orders should be efficient to use, while recurring orders should be more detailed. Utilizing one primary platform would help the purchaser get more professional in that software, meaning that the EI could be considered as high as it is for some LMOs (Hughes, 2021).

Both the CSC and LMOs select a supplier depending on criteria such as the best price, lead-time,
and sustainability. These criteria can differ depending on what kind of product is purchased. The CSC is currently using Excel manually to summarize each quotation from each supplier, which the LMOs also do (Bradford & Gerard, 2015). However, some LMOs get support from their S2C-suite to do the supplier assessment, which is the best practice of deciding what supplier is the most suitable one.

The contracting part is similar for both the CSC and the LMOs. Both have a price threshold, leading to more people involved and a formal contract if that threshold is exceeded. The process of signing a contract is handled in a similar way for both the CSC and the LMOs, but some LMOs are doing the signing part on paper (Bradford & Gerard, 2015). The best practice is to forecast customers’ future needs, find suppliers, and prepare contracts before the actual customer need is received.

The LMOs who are undergoing a transformation value integration, automation, and improvements of the RFQ software the highest. They envision a more modernized way of working where inefficiencies are eliminated by integrating software. Interestingly, the CSC ranks the ‘Integration of systems and automation’ as the second most crucial area for improvement, while the LMO that has not yet undergone a transformation is ranking it as the first. This means that LMOs are eagerly trying to undergo a transformation to an S2C-suite as soon as possible if they have not done it yet while the CSC considers other areas to be improved first before a transformation is needed. For the CSC, it may be because most of the customer orders are one-time orders, resulting in not finding an S2C-suite as applicable since it enables more efficiency for recurring orders. Thus, the best practice is to integrate the software or use an ERP-system to increase the overall efficiency in the organization and avoid the inconveniences of using several software (Hughes, 2021).
### Table 12: Comparison of the CSC and LMOs and best practices for all LMOs in general.

<table>
<thead>
<tr>
<th>Description of steps in the S2C-process</th>
<th>CSC</th>
<th>LMOs</th>
<th>Best practices for all LMOs in general</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process for different types of orders</td>
<td>Using one process for both one-time- and recurring orders.</td>
<td>Using a separate process for one-time order and recurring orders.</td>
<td>It is recommended to use two separate processes for one-time- and recurring orders.</td>
</tr>
<tr>
<td>Enough information?</td>
<td>Tend to be a lack of information when receiving an IPN or IRO.</td>
<td>The information shared in their ERP-system is not always enough. Email is used to complement this information.</td>
<td>The information is lost with each handoff. Thus, a standardized way of structuring a request is recommended when possible.</td>
</tr>
<tr>
<td>Find supplier(s)</td>
<td>No local database available for searching through approved suppliers.</td>
<td>Database available for searching for suppliers, but could be managed better.</td>
<td>A database with available suppliers is recommended to facilitate the process of finding suppliers.</td>
</tr>
<tr>
<td>Send RFQ</td>
<td>Currently RFQs are sent through email. However, they have dedicated software, but it is barely used.</td>
<td>Done through S2C-suite for recurring material with larger volumes. Done through ERP-system or email for one-time orders.</td>
<td>A recommendation is to make it possible to send RFQs for both one-time- and recurring orders in one software in an efficient way.</td>
</tr>
<tr>
<td>Select supplier</td>
<td>Based on price, lead-time, and other factors. Depends a lot on what is purchased. Excel is used to decide which supplier should be selected.</td>
<td>Based on price, lead-time, and some sort of sustainability. Depends a lot on what is purchased. S2C-suite and Excel are used to select a supplier.</td>
<td>A recommendation is to use the RFQ software to do the analysis automatically.</td>
</tr>
<tr>
<td>Formal contract needed?</td>
<td>Exceeding a threshold leads to formal contracts and more people need to get involved.</td>
<td>The purchaser order is used as an informal contract and formal contract has to be formed if a threshold is exceeded.</td>
<td>The recommendation is to forecast future needs of customers, find suppliers and prepare contracts before the actual customer need is received if possible.</td>
</tr>
<tr>
<td>Sign and close contract</td>
<td>Done manually through a combination of online service and ERP-system.</td>
<td>Analog process of signing on papers but some LMOs do it through their S2C-suite, an online service, or by hand.</td>
<td>It is recommended to sign, close the contract and write the documentation all in one software.</td>
</tr>
<tr>
<td>System integration</td>
<td>Several software are used because each one of them is not communicating with each other.</td>
<td>At some LMOs the software is well-integrated where most of the information needed is available in one software and the purchasers work in one platform.</td>
<td>It is recommended using an ERP-system or S2C-suite that has all the important features in one place.</td>
</tr>
</tbody>
</table>
5  BPR step 4 - Design a prototype of the new process

In this chapter, the recommendations for the most crucial areas for improvement at the CSC: missing information, internal transparency, integration of systems and automation, develop RFQ software, and some general ones are presented.

Based on the most crucial areas for improvement, changes will revolve both around soft and hard characteristics. Missing information and internal transparency is essentially about changing how the people currently are working at the CSC, a soft characteristic, compared to the hard characteristic of integrating systems, working more with automation, and develop the current RFQ software to enhance the efficiency within the CSC (Sarayreh et al., 2013). To ensure that these changes are perceived as meaningful and implemented in an effective manner, regular communication with involved stakeholders and an understanding of the CSC strategies and goals have been essential. Additionally, these changes have been developed through iterations of feedback and active participation with the employees at the CSC. Otherwise, there would have been a risk of the employees perceiving the changes as a loss of control, affecting their motivation negatively (Huq et al., 2006; Lauer et al., 2010; Levasseur, 2001). Therefore, other LMOs need to ensure that their recommendations do not contradict their goals or strategies. Moreover, LMOs are recommended to follow a participative approach to avoid the implementation of ineffective solutions. The short and long-term recommendations are described in table 13 on page 41 for the most crucial areas for improvement at the CSC, followed by how to proceed with these recommendations. These recommendations are thoroughly described in the following parts of this chapter.

Missing information

As mentioned before, roughly 50 percent of IPNs and 29 percent of IROs that the purchasers at the CSC receive tend to either miss or include too much information depending on who sent the task. This results in the purchasers email inboxes getting full of intermediary and NVA matters affecting the cycle-time of all tasks and how the purchasers prioritize and organize their tasks in a full inbox (Lacerda et al., 2016; Smith, 2010). Additionally, since the purchasers primarily work in their email, the transparency gets low within the department due to the disclosure of information shared with others (Harbert, 2020). This opens up opportunities for more efficient collaboration and communication between different departments. Thus, sharing the right information at the right time, hence, the sender and receiver perceive the task similarly (Hitt, 2015; Mohr & Nevin, 1990). What we recommend is first to figure out what the right information is by examining what type of information can be standardized from involved departments and stakeholders to minimize the variation in the message sent from one person to another, as it is an issue in the current process (Harrington, 1991). Here, it is also essential to understand what type of information one department is preserving and how they can utilize it in the best way possible when sharing it with another department. Thus, how can the output of one person’s process match the input of the next person’s process as accurately as possible, which is an important area discussed by Mahmudi and Tavakkoli (2020). This output and input could be determined, for instance, in meetings where the involved departments and stakeholders should discuss what is possible to share and what is not for the different stakeholders, which previously has been pursued vaguely in the CSC. We recommend that this information should be clarified and updated in an additional meeting. Sharing the information at the right time is further discussed under the area, internal transparency.

To enable sharing the right information at the right time while also emphasizing enhanced collaboration and transparency. We recommend that the CSC use a platform for internal communication to make it easier for the purchasers to organize and prioritize the tasks that
Table 13: Summary of the proposed solutions for the most crucial areas for improvement.

<table>
<thead>
<tr>
<th>Most crucial areas for improvement</th>
<th>Short-term recommendations</th>
<th>Long-term recommendations</th>
<th>How to proceed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missing information</td>
<td>Determine what the right information is to share.</td>
<td>Implement an internal communication platform.</td>
<td>Examine how many departments will be able to use the platform.</td>
</tr>
<tr>
<td>Internal transparency</td>
<td>Implement a restricted supplier list that other departments can utilize. Determine when the right time is to share information.</td>
<td>Extract the local suppliers from the global supplier database to create a local supplier database.</td>
<td>Investigate what suppliers should be included in the restricted supplier list. Can the local database be extracted from the RFQ software?</td>
</tr>
<tr>
<td>Integration of systems and automation</td>
<td>Automate activities that are repetitive and administrative through RPA.</td>
<td>Storing all files in one central database enabling information fetching from different software.</td>
<td>Identify further repetitive and administrative tasks and solve them with digitalized solutions.</td>
</tr>
<tr>
<td>Develop RFQ software</td>
<td>Discuss with developers what should be included in a template for one-time orders.</td>
<td>A clear distinction between one-time order and recurring order in the dedicated software.</td>
<td>Determine the unnecessary fields that one-time orders need to fill in.</td>
</tr>
<tr>
<td>General recommendations</td>
<td>Explore how the remaining crucial improvement areas can be utilized better.</td>
<td>Create a new role of an operative purchaser if digitalized solutions are not implemented.</td>
<td>Examine the possibilities and risks of creating a new role.</td>
</tr>
</tbody>
</table>

they receive. This solution could also be helpful for other LMOs if they perceive the same issues at the CSC. However, we recommend LMOs do an extensive analysis to grasp what fits their needs the best. Depending on which department the purchasers receive a request from, different templates are recommended to be utilized to keep the information standardized and make it easy for the person sending a request. The subject line of the request could also be used in the templates, where material number, request number, and process number could be included. This would make the information that goes missing from an IPN to an IRO easier to locate. Thus, the purchaser would not waste time searching for information already available in their email inbox. The platform also clarifies who has been involved throughout an errand making it easy to realize whom to contact, who has been, and who currently is responsible for it if questions were to arise. The whole concept of this new platform resembles the way of working in SWF technologies, where responsibilities for tasks are transferred between the departments until the task is eventually completed (ProcureSafe, 2021). To migrate from email to the recommended platform, it is crucial with simplicity, mentioned by one of the constructors. Otherwise, email will likely be the main platform within the CSC to share internal information, as it is today.

The platform gives the involved stakeholders from different departments an overview of, for instance, the average completion time of a task, how many tasks are in the backlog, how many...
tasks are completed, and what tasks are assigned to each specific individual. The platform also removes the waiting waste where other departments need to send reminders to the purchaser if they have taken care of the errand or not through email, which would reduce the purchaser’s total number of requests (Basware, 2017; Myerson, 2018). This is instead visualized in the platform by using a status for each task, enabling more transparency and less unnecessary communication between the different departments. The platform also clarifies the workload for all the employees within the department. Hence, if one person in the department notices that the workload for someone else is overwhelming, they could support and assist the person in need of help, which is not possible if conversations are isolated in an employee’s email inbox. Moreover, the platform facilitates investigating what kind of tasks usually take a longer time than others. Could it be because they lack information, or what are the actual root causes behind the long cycle-time for some errands? The platform also enables measuring some parts of the process automatically and makes statistics visualizable in charts and graphs in a dashboard.

An issue with this recommendation is that it could face resistance since all departments do not use the platform at the current state. However, we perceive that the platform is a valuable tool to communicate and collaborate more efficiently internally as the platform’s advantages surpass the disadvantages. The platform is also mentioned as an important tool by some managers as they highlighted that it would be helpful if their department could send requests internally only through the recommended platform instead of email. This needs to be further examined with other process-owners to understand their perception of the platform. Then it needs to be decided on a larger scale whether departments should use the software to communicate internally or not. Would it be possible for all departments to utilize the software? If only 50 percent of the organization were to use the software, it would most likely be less efficient than the purchasers’ current way of working since it would be just another platform to gather information from. To make this transformation on a larger scale, we recommend simplicity in the form of templates and the usage of change management by strengthening the forces that push for change or reduce the opposing forces (Lauer et al., 2010). We believe that communicating the advantages of the platform: transparency, opportunities in enhanced collaboration, better overview for employees and managers, and an easier way of prioritizing and organizing tasks would help the CSC to do this transformation. We also believe that the software should not be implemented right away. Instead, it is essential to promote active participation and realize the perspective from different employees, process owners, and managers to reduce the high barrier of change and make the implementation as smooth as possible (Levasseur, 2001).

**Internal transparency**

Because of the CSC’s current way of working with IPNs through email and the difficulties in finding appropriate suppliers for the purchasers and other departments, the CSC should focus on enhancing its internal transparency. As mentioned, our first recommendation for the CSC is to implement a new internal communication platform, where the information shared should be standardized. Sharing standardized information opens up opportunities to utilize ML and NLP software to interpret the requests’ template and automatically trigger activities in the ERP-system or the dedicated RFQ software (Jordan & Mitchell, 2015; J. Meyer, 2019; Sievo, 2021). However, we perceive that the transparency could be improved beyond this recommendation. The CSC could generate a local database in the dedicated RFQ software from historically used suppliers originating from the global database, see figure 3. The local database would give the purchasers a good overview of their current suppliers related to each material group. How this local database should be organized needs to be further examined. This database would help to eliminate the manual steps of finding an appropriate supplier, making it easier for other purchasers to support each other and for new purchasers to know...
what suppliers they could contact instead of a more experienced purchaser possessing most of the vital information in their head (Bradford & Gerard, 2015). An important aspect to keep in mind is that the decisions by the purchasers should not be based solely on the database. Instead, it is still essential for the purchasers to find new competitive suppliers and evaluate the current ones to select the best possible supplier.

A problem area found in this study, both at the CSC and LMOs is that employees from different departments contact suppliers when they do not know what is and is not vital from a purchaser’s perspective. Therefore, it is essential for other departments to involve purchasers whenever necessary, discussed earlier as the right time. To enable this involvement, we recommend the CSC to have a restricted supplier list derived from the local supplier database, see figure 5, which includes the suppliers they have established strong relationships with. What suppliers should be included in the list and what risks come from other departments using the list need to be further examined. The purchasing department also needs to determine the degree of authority they want to delegate to other departments. In the list, there should be information for each supplier regarding whom to contact, certain framework agreements that need to be followed, and optional remarks if necessary. Other departments are allowed to contact these suppliers and send RFQs to, as long as they ensure they follow the terms and requirements from the list, if the value of the errand will be less than a certain amount and if the errand is of a simple matter (El Sawy, 2001). This list is primarily applicable for errands that only have one supplier to potentially choose from, reducing the number of errands where a purchaser is considered an intermediary (Smith, 2010). Otherwise, other departments are obligated to contact the purchaser to ensure that the best possible supplier is chosen. Thus, for errands that are: non-standardized, complex, with a value above a certain amount, when there are many possibilities of finding appropriate suppliers, and with newer suppliers, other departments need to involve the purchasing department to share information at the right time. For instance, in a product-development phase, it can be crucial to involve a purchaser to ensure that the suppliers and the constructors develop solutions that follow the purchasing strategies. Otherwise, a solution might have been initiated with one supplier without the involvement of a purchaser, thus, ending up in the supplier not being chosen later on by the purchaser because it is not as competitive as other suppliers, mentioned as bad practice by El Sawy (2001). These activities should be linked parallelly instead of lumped together at the end of a process.
Roughly 85 percent of the requests received by one of the purchasers tend to come from well-established supplier relationships, and those requests are usually of simple matters. 80 percent out of those 85 percent are also of smaller value than a certain amount. Thus, this list would help to release time for the purchaser to focus on more VA activities and utilize their competencies better instead of being an intermediary for simple cases (Basware, 2017; Lacerda et al., 2016; Smith, 2010). To decrease the risk of other departments selecting suppliers for these errands, a training session should be held to discuss the important perspectives from a purchaser to ensure compliance (Attaran, 2000). Another risk with this is that the purchasers might lose control of the supplier relationships. Therefore, they still need to be involved in some errands to maintain and manage their relationships. How often this should happen needs to be investigated. A disadvantage of other departments being able to send RFQs themselves is that it contradicts with the migration from email to the dedicated RFQ software. Other departments would still prefer sending RFQs to suppliers through email, while the purchasers should send RFQs through the dedicated RFQ software. Thus, something that could result in data duplication and decreased internal transparency since some RFQs would be disclosed in an employee’s email inbox and some in the RFQ software (Bradford & Gerard, 2015; Harbert, 2020).

Integration of systems and automation

The day-to-day activities that include working with software to proceed in the S2C-process are considered inefficient due to the amount of different software used but also due to the manual steps and repetitive tasks that could potentially be automated. The high number of software used narrows down to the problem of manually moving and uploading files from one software to another because they do not interact with each other. Since email is currently used to communicate internally and because of the information disclosure within the organization (Harbert, 2020), it is likely that the purchasers download documents from the software and send it through email to someone else, which creates a different version of a file stored in another place. This increases the chance of data duplication (Bradford & Gerard, 2015). Furthermore, the documents are sometimes sent back and forth between the departments, which is considered an unnecessary motion by Myerson (2018), leading to several versions of the files being invented, which could eventually lead to file revision problems. The likelihood of sending the wrong version of the file to the supplier in an RFQ is therefore rising. To overcome this issue, an integration between the software is essential where files and documents are stored in one place where the involved departments can easily access them through a shared central database. The different software could then fetch these documents from the same database.

A new software is as of the time of writing this thesis being developed within the CSC, which aims to solve this issue. It will act as the central database and hopefully make it possible to share vital information between the current RFQ software and the ERP-system as effortlessly as possible. Possibly through API requests to fetch the data, but it also opens up for short-term solutions using RPA bots that move files from one system to another (Borovskiy & Zeier, 2010; Hofmann et al., 2020). The latter is considered slow and could add lead-time to the data availability between the software but is still more convenient than downloading and uploading files manually from one system to another. An extension to this recommendation is connected to the internal communication platform mentioned along with the ’missing information’ improvement area. The platform should ensure that files and documents are not duplicated, instead referred back to the central database. Subsequently, since email is avoided when communicating within this software, it enables increased internal transparency, and when files and documents are shared, it is not going to create new versions of the file, rather a renewal of the source file to ensure that the newest version of the file always is available.
Regarding the repetitive and administrative tasks, it is closely related to if the purchasers’ software is integrated. The higher degree of integration with the help of EI, the fewer manual steps and administrative tasks need to be eliminated because of the convenient tradeoffs that the software is taking care of automatically in the background (Hughes, 2021). The repetitive tasks performed manually by the purchasers could be substituted with RPA or other digitalized solutions (Bradford & Gerard, 2015; Hofmann et al., 2020; van der Aalst et al., 2018). Therefore, it is recommended to identify further repetitive tasks in the S2C-process. One of the repetitive and administrative activities in the process is the updating and closing of contracts in an IRO to allow for purchase. For instance, copying and pasting information from one software into the ERP-system and ensuring that there are no errors in the data. Performing all these steps manually increases the risk of doing something wrong. Thus, these steps have the potential of either being replaced by bots or that the software can itself gather the information through API calls to ultimately only leave the signing part to the purchaser (Borovskiy & Zeier, 2010). This could be done if the information shared on the internal communication platform is standardized, meaning that bots could utilize the standardized data to transfer it into the appropriate fields in the ERP-system automatically. The signing part is performed in a separate software and is seen as an unnecessary burden that the purchasers have to deal with manually, considered an NVA activity. Therefore, the signing part should be as easy as clicking on a button in their dedicated RFQ software to make it as convenient as possible.

Develop RFQ software

As earlier mentioned, the dedicated RFQ software currently takes roughly six times longer to use for one RFQ than a regular email for the one-time orders. Additionally, the user interface is challenging to use for the supplier. Thus, it needs to be improved to ensure higher supplier satisfaction when working with the CSC’s RFQs. The software should not be a reason for the suppliers to reject sending a quotation as it is in the present. This needs to be further examined with the suppliers who have rejected requests to understand how the user interface should look. Another approach could be to reach out to other business units within the CSC organization to gain insights into how they have convinced different suppliers to use the software. Here, change management could be used to persuade the suppliers to utilize the software by emphasizing its advantages in contrast to its disadvantages (Lauer et al., 2010).

The dedicated RFQ software is currently being developed with bots to automatically retrieve drawings for each needed material number from the ERP-system to make it easier to send an RFQ. This means that the purchasers will not be downloading documents from one software to later upload those in email anymore, which solves some issues regarding data duplication (Bradford & Gerard, 2015). From the ERP-system, several IROs can also be grouped into the RFQ software to send one common RFQ instead of several separate ones, if desired. Moreover, the software will be able to help the purchasers with the supplier assessment based on the global supplier database. We believe that this could be further improved by utilizing ML for the decisions taken locally from all previous RFQs to give the purchaser a more relevant assessment since the global suppliers might not always be the best ones for the CSC (Harikrishnakumar et al., 2019). Another advantage of the software is that it enhances the transparency since all RFQs will be visible to others meaning that the information will not only be available in a purchaser’s email inbox (Harbert, 2020). This software could also help the CSC to form a local database of historically used suppliers automatically. During this thesis, the tactical purchasers have also mentioned the difficulties in finding old information, which the software helps make available if all RFQs were sent through the software. However, for this to work, the software needs to be streamlined for one-time orders. Otherwise, it will make the process less efficient than it currently is (Bradford & Gerard, 2015).
In this thesis, it has been discovered that the inefficiency of using the software for one-time orders is currently an issue for other business units within the same organization as the CSC. With those units, it has been examined what their issues are regarding the software, which has been similar to the CSC’s issues. To solve these problems, we recommend that the CSC communicate with the software developers to make a one-time order template that could be used efficiently. Thus, only having a few fields to be filled in compared to how the current software enforces the user to fill in several required fields. The template should, for instance, include designation name, drawing number, material number if available, supplier, quantity, and when it is needed. Also, if desired, dummy numbers or text should be able to be used as a placeholder for the different fields to utilize the software as early of an errand as possible. What should be included in the template needs to be further examined.

**General recommendations**

Besides the four recommendations that are considered as the most crucial areas to improve for the CSC, we have some further recommendations that we would like to highlight. If an IPN triggers the initialization of the S2C-process, the required input should be standardized through templates. If an IRO triggers the process, the purchaser should retrieve this information through the internal communication system, ERP-system, or the RFQ software based on our recommendations. The output of the S2C-process should be to complete an IRO as soon as it is received to enable purchase. We believe that this can be done by enhancing internal transparency, communication, and collaboration. What also needs to be examined is the crucial improvement area: working more proactively by standardizing materials and realizing the possibilities of forecasting contracts described in Chapter 4.2.1.

Another recommendation could be to examine the possibilities of implementing new ways of completing an IRO. This revolves around simplifying and creating a role of an operative purchaser that could deal with IROs and other simple cases that would be great, for instance, for a newly graduated student to learn and gain experiences (Harrington, 1991). Currently, many parties are involved in the process of creating an IRO to complete the IRO to purchase. Instead, only one or two departments would be involved with this new role, which would shorten the cycle-time of the errand from start to finish. Essentially, something that could shorten the lead-time to customers. This new role would also mean more risks since they would have an increased authority with less involved departments, enabling more mistakes to not be detected (Myerson, 2018). However, due to the manual and administrative characteristics of completing an IRO, we believe that the task should be relatively simple to finish for a person with less experience. This new role would not be necessary if the recommended digitalized solutions were to be implemented since those solutions would eliminate most manual and administrative activities in the process. Since the tactical purchasers have several years of experience within purchasing, they should focus on more VA activities. Otherwise, it can be seen as an intelligence waste (Basware, 2017). For instance, cost-saving projects, negotiating for better deals with suppliers, finding potential solutions of standardizing material, finding new potential suppliers, and managing the current supplier base. Areas that, especially the one-time order purchasers, have not had time to deal with in the present. The tactical purchasers should still be responsible for IPN errands, thus sending RFQs and selecting the best possible supplier. Hopefully, they will also be involved earlier in errands by other departments resulting in that offers from suppliers have been received before an IRO has. Hence, making it possible for the new role to complete the IRO quickly, enabling for purchase, and making lead-times shorter to customers. The new role could also be responsible for sending some RFQs to suppliers to support the tactical purchasers when they have a large workload.

Based on the given recommendations for the most crucial areas for improvement, the CSC
has to consider if a pilot study is necessary after the following areas have been implemented: a new internal communication platform, a local supplier database, a restricted supplier list, better-integrated systems, automation software, and a new role. Here, it is also needed to examine if the employees need the training to develop the required skills and competencies in the new process and software (Attaran, 2000; Mohapatra, 2013).
6 BPR step 5 - Implement and evaluate the new process

In this chapter, implementing and evaluating the future S2C-process is described in a general manner to provide recommendations on how the CSC can continue measuring the process’s effectiveness and efficiency based on the measurements described in Chapter 4.1.4.

For the solutions recommended in BPR step 4, these changes must be tested, used, debugged, measured, and verified to ensure a successful implementation (Levasseur, 2001). In addition, these changes have to be refrozen to avoid the pitfall of going back to everyday routines (Lauer et al., 2010). For LMOs, these measurements should be formulated based on their specific, most crucial areas for improvement. To implement the changes recommended for the CSC, a summary of the recommendations regarding measuring the effectiveness and efficiency of the S2C-process is presented in table 14 on page 49.

What percentage of IPNs and IROs are provided with enough information? Thus, complete output.

Considering the IPNs, when the CSC has implemented the internal communication platform, the current requests need to be analyzed to determine what factors are frequently included in a request that leads to the completion of an IPN. These factors could, for instance, be the supplier’s name if known, what type of order it is, the quantity of the order, and when it is needed. Factors that have not been discovered yet or are deemed irrelevant need to be decided on whether they should be added or omitted. An analysis of the requests could be performed manually by going through each request and extracting the most relevant factors to decide whether the information shared is enough or not. Other ways of analyzing the requests could be done through ML building blocks provided in Knime or a similar software. When there is a formal template on how a standardized request should look, there will be possibilities for measuring how many IPNs follow the template, thus being provided with enough information. After implementing the internal communication platform, it is essential to measure and analyze this data each month to determine the frequently used factors, but as soon as they are determined and implemented, this should be measured after one year to discover other relevant factors that had been left out. The information shared later on in the process, in an IRO, is most likely to be identical to their corresponding IPN due to the templates. Thus, it is also unnecessary to measure the percentage of IROs provided with enough information. However, it is currently challenging to figure out which IPN corresponds to which IRO and understand whether all departments will use the recommended platform. If only the platform is used to send and receive internal requests, it would be easier to detect the corresponding IPN for an IRO through the subject line since all requests would be stored in one platform.

How long does it take to complete an IRO on average?

If the internal communication platform is implemented, it can, with the help of charts and graphs in dashboards, visualize the average time it takes to complete an errand for a purchaser from when they have received an IPN until they have received quotations then selected the most competitive supplier. The time it takes to receive quotations will, of course, depend on the suppliers. However, since this information is visualized automatically, it gives a slight indication of how efficient the current process is and what errands usually take longer or less time. This would help to understand how the lead-time to end customers could be decreased. For instance, do further requirements need to be set for some suppliers? By using standardized templates, this could make the process’s processing time easier to measure to indicate the process’s efficiency, which has not been possible in the current process due to its variations.
Table 14: Recommendations regarding measurements in the S2C-process.

<table>
<thead>
<tr>
<th>Future measurements</th>
<th>Recommendations</th>
<th>How to proceed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>What percentage of IPNs and IROs are provided with enough information? Thus, complete output.</td>
<td>A short-term recommendation to measure whether enough information is provided by manually examining requests in the internal communication platform.</td>
<td>Examine what type of measurements and statistics could be generated automatically through the internal communication platform.</td>
</tr>
<tr>
<td></td>
<td>A long-term recommendation to measure this is by building ML blocks in Knime or a similar software.</td>
<td>Investigate if Knime could help to support the purchasing manager or purchasers to do less manual tasks when measuring the process’s performance.</td>
</tr>
<tr>
<td>How long does it take to complete an IRO on average?</td>
<td>Monitor the time it takes for an IPN to be completed on the internal communication platform, which is done automatically. Extract data from the ERP system to measure the average completion time of an IRO. An area that potentially could be automated through Knime or a similar software.</td>
<td>Monitor the current time it takes for an IPN to be completed, once it is received until a supplier is selected to compare it with measurements after recommendations have been implemented.</td>
</tr>
<tr>
<td>What number of RFQs are sent through the dedicated RFQ software? How long does it take to send an RFQ through the dedicated software?</td>
<td>The amount of requests sent through the dedicated RFQ software should be measured to see if the software is still inefficient for one-time orders.</td>
<td>Examine how suppliers currently perceive the dedicated RFQ software.</td>
</tr>
<tr>
<td>How is current software ensuring that the purchasers are working as efficiently as possible?</td>
<td>If information can be fetched from one software to another by a button click, then the software is considered integrated. If the file transfer is handled manually, then they are not.</td>
<td>Determine what data each software needs from each other and create a connection between them with a button or another fetching method.</td>
</tr>
<tr>
<td>How do the current working instructions support the purchasers’ daily activities?</td>
<td>In the internal knowledge database for the S2C-process, six to eight main activities should be visualized in the process and with each activity comes a brief description.</td>
<td>Determine what the activity results are, what is essential to consider, who is responsible for what, what templates and working instructions could be used, and lastly, identify keywords for finding relevant documentation for each activity.</td>
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</tbody>
</table>
We recommend extracting data from the ERP system to measure how long it takes to complete an IRO on average, which could be done through Knime or a similar software. After implementing our recommendations, this should be measured after three months since it is assumed that enough data will exist. In this data, outliers should be removed to see if IROs are completed more efficiently compared to the current process since the information provided through an IPN will most likely be easier to find in the internal communication platform than in the email inbox. Later on, this should be measured every six months where outliers are included to see how further improvements can be made. We also recommend the CSC to examine whether an IRO should be set as a high priority case or not since roughly 63 percent of the cases are set as high priority.

What number of RFQs are sent through the dedicated RFQ software? How long does it take to send an RFQ through the dedicated software?

After our recommendations have been implemented regarding the efficiency of using the dedicated RFQ software, the CSC needs to measure how many requests are sent through the software. After three months, this should be measured to realize if the software is still inefficient to use for one-time orders. Are there still areas that need to be addressed, or is the software considered efficient to use among the purchasers? Do the suppliers perceive the user interface better and easier to use? If areas in the software are still inefficient, this needs to be discussed with the developers to examine the possibilities of further improvements.

What is also essential to note with the dedicated software is that it should not be considered less efficient than email. If it, for instance, were to take seven minutes to send an RFQ compared to five minutes in email, the RFQ software could still be considered more efficient due to the other advantages it has compared to email. Determining if the dedicated RFQ software is more efficient than email could be done by analyzing the following factors:

1. The software enhances the transparency since all RFQs sent would be gathered at one place and visible for all purchasers compared to in each purchaser’s email inbox.
2. The software is currently under development with bots that can retrieve the information needed from the ERP-system by only pressing one button. Essentially, this means that if the information is standardized in the to-be implemented internal communication platform, the information could be sent to the ERP-system, which in turn could be sent to the dedicated RFQ software by pressing one button.
3. The information that currently tends to be missing in some errands would be easier to find if only one software is used for sending RFQs.
4. The software could potentially support the purchasers in finding appropriate suppliers by searching in the generated local database.

Thus, measuring the time it takes to complete an RFQ in the software compared to email would not necessarily give the complete picture. Instead, these factors should be investigated to understand how efficiently the purchasers and suppliers perceive the software compared to email. If the purchasers and suppliers are satisfied with how the software is utilized, further measurements of how many requests are sent through the software are unnecessary.

How is current software ensuring that the purchasers are working as efficiently as possible?

Since there are ongoing implementations and developments of new software in the CSC, it is difficult to measure their integration and give recommendations on when this should be done. What could be measured is the ease of fetching information from one software to another. For
example, if the currently used ERP-system could fetch vital information from the dedicated RFQ software by clicking a button in the ERP-system, the software would be considered integrated. On the other hand, if the purchaser needs to download files from the ERP-system to import them to the dedicated RFQ software manually, these software would not be considered integrated. Another aspect of measuring the integration would be to consider the number of times the order of the activities in the S2C-process changes for the better by implementing features in one software that eliminates the utilization of another. One example of this would be eliminating the usage of the additional signing software by implementing a button for signing the decisions taken in the dedicated RFQ software. When this signing should be done in the process needs to be further examined because it depends on whether an operative purchaser role is implemented or not. The tactical purchaser could potentially perform the signing part to complete the errand of an IPN. Thus, when an IRO is later received, the operative purchaser can follow the decisions that were taken by the tactical purchaser when completing the IRO. For each decision taken, there should be a deadline on how long a signature is valid. If the signature has expired, the tactical purchaser needs to update the quotation for the errand if an IRO is received.

How do the current working instructions support the purchasers’ daily activities?

We recommend the CSC to improve their internal knowledge database regarding the working instructions since that is an essential part of supporting the purchasers’ daily work in the most efficient manner and reducing the delays associated with finding the correct instructions. Currently, working instructions are challenging to find, and there is no proper search function for finding what is needed. This results in that the available instructions are not used because of the difficulties of finding them. Therefore, the CSC is recommended to utilize the internal knowledge database to its full potential. In the database, all end-to-end processes should be visualized correctly and complemented with more information. For instance, the S2C-process could have one description for one-time orders and one for recurring orders. This description would clarify what activities are essential for the purchasers at the purchasing department and employees from other departments. Similarly, this clarification should be done for all end-to-end processes to ensure that the output from one process synchronizes with the input for the following process in line. We recommend that a minimum of six and a maximum of eight main activities are visualized in the process and that with each activity comes a brief description. For instance, what the activity results are, what is essential to consider, who is responsible for what, what templates and working instructions could be used, and keywords for finding relevant templates and working instructions for each activity. These questions need to be further examined within the CSC to determine what fits the best for their activities. An example of this is visualized in figure 6.
<table>
<thead>
<tr>
<th>Description of activity</th>
<th>Main activity 1</th>
<th>Main activity 2</th>
<th>Main activity 3</th>
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<tbody>
<tr>
<td>Result of activity?</td>
<td></td>
<td></td>
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<tr>
<td>What is important to consider?</td>
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<td></td>
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<tr>
<td>Who is responsible for what?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant templates and working instructions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key words for documents</td>
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</tbody>
</table>

Figure 6: An example of how the internal knowledge database could be visualized.
7 Conclusions

In this chapter, the conclusions of this thesis are presented in a sequential order leading up to the purpose being fulfilled. The purpose was divided into four SGs where conclusions are drawn to each of the goals.

This thesis has generated additional insights into how the purchasing process, S2C, can be reengineered through Lean and digitalization by fulfilling the four SG. These SGs were formed based on the developed five-step framework of the BPR methodology presented in this study. The study primarily covers the last three steps of the methodology as the first two steps were already considered at the CSC.

For the first SG, LMOs considering reengineering their S2C-process are recommended to conduct several in-depth interviews with as many employees as possible to gain insights into how the current process works and who is responsible for what activities in the third step of the BPR methodology. By visualizing this through a technical and social design, it will make the process easier to analyze by evaluating areas of improvement. This analysis helps the reengineering team to identify NVA, NVN, VA activities, and PIAs in the process. In this thesis, seven PIAs were identified and prioritized at the CSC, where four of them could be clustered into two improvement areas while one was removed due to its infrequency of occurring, resulting in four crucial improvement areas.

Regarding SG2, the most crucial areas for the CSC to improve are: missing information, integration of systems and automation, internal transparency, and developing the dedicated RFQ software to enhance the effectiveness and efficiency of the S2C-process. For LMOs, the same areas were prioritized. However, they were prioritized differently, where internal transparency was prioritized over the integration of systems and automation. Additional crucial improvement areas were identified at LMOs: better communication and collaboration and working more proactively by standardizing materials, early information-sharing to purchasers, and forecasting contracts.

The S2C-process is structured differently in each of the organizations studied. Because of the process diversity and similarities at different LMOs, the best practices could be generalized, SG3. LMOs distinguish between two different versions of the S2C-process depending on the order type, one process for one-time orders and one for recurring orders. Distinguishing between the two types helps LMOs to clarify responsibilities and roles in the current S2C-process landscape. The information shared between different departments should be standardized to be considered best-practice, meaning that the information should be enough and shared at the right time. Another best practice is that the purchasers at LMOs should be supported by digitalized solutions when performing most of their day-to-day activities in one primary platform that is well-integrated with other software to enhance the process’s efficiency and effectiveness. This platform should be usable for both one-time and recurring orders. Lastly, LMOs need to work more proactively by involving purchasers early in an errand, and better forecast customer needs to enable for purchase more efficiently.

For the CSC to get closer to best practice, recommendations are proposed on how the most crucial areas for improvement could be solved, SG4. To ensure efficient recommendations, a participative approach has been utilized in the fourth step of the BPR methodology. Firstly, the most crucial area for the CSC to improve is missing information. This area could be solved by implementing a platform for internal communication where information should be standardized through templates. The platform also allows different departments to work more efficiently due to the enhanced transparency, clear responsibilities, visualizations, and the ease of prioritizing...
and organizing the requests received in the software compared to the current way of working in email. Secondly, to decrease the number of administrative activities and software in the S2C-process, RPA bots could be utilized to automate repetitive tasks and API calls to increase the EI and prevent data duplication. Thirdly, other departments need to involve purchasers at the right time and avoid the extra costs of not following the purchasing strategies. To achieve that, it is recommended to have a restricted supplier list derived from the local supplier database that includes suppliers with strong and established relationships. If a supplier is not included on that list, other departments are obligated to involve a purchaser. Fourthly, the CSC needs to communicate with the developers of the dedicated RFQ software to make a one-time order template that could be used efficiently for both the purchasers and suppliers. Lastly, the CSC should focus on the crucial improvement area, working more proactively while also examining if a new role, operative purchaser, would be helpful to make the tactical purchasers focus on more VA activities.

To follow up on the proposed solutions in the fifth step of the methodology, related to SG4, an essential part of reengineering the S2C-process is its measurement indicators to tell whether the process has gotten more effective and efficient based on the most crucial areas for improvement identified after the implementation of changes. LMOs need to avoid the pitfall of going back to the old routines after these changes have been made.
8 Discussion

In this chapter, the thesis’s theoretical and practical contributions are highlighted. This is done by discussing the methodology, validity and reliability of results followed by what future studies should examine.

8.1 Methodology discussion

The research approach of this study followed the five-step BPR methodology to give the CSC recommendations on how to reengineer the S2C-process. Another model that could be deemed as fitting for this thesis is business process improvement that focuses on gradually improving a process after implementations have been made. Even though BPR and business process improvement are both striving to streamline processes, standardization, provide superior quality to serve the customer, increase the employee morale and respond to changes in the marketplace, the BPR methodology was chosen because of the needs at the CSC to do radical changes to later on be gradually improved. For instance, based on the recommendations, the CSC should consider implementing a new role, meaning that the responsibilities in the S2C-process will be different, followed by how the process can be continuously improved. However, the BPR was not thoroughly executed because the CSC performed the first two steps before this thesis, and the solutions for the most crucial areas for improvements were not implemented in the S2C-process, just recommended. Thus, the two last steps of the methodology: implementing and following up after the implementation was not executed. Instead, it was suggested what and how effectiveness and efficiency measurements could be used if the solutions were to be implemented. Although all steps in the BPR were not thoroughly executed, the course of action of this study has been successful. Firstly, the study suggests practical implications for LMOs in what methods and factors could be used when analyzing their S2C-process to identify PIAs and get a solid understanding of the process. Secondly, it highlights the most crucial areas for improvement in the S2C-process and its best practices for LMOs. Lastly, the study gives recommendations on how to solve the most crucial areas for improvement. However, these recommendations are relatively specific for the CSC. Thus, LMOs should take part in these recommendations to get insights and potentially solve the most crucial areas for improvement that they identify.

8.2 Validity and reliability of results

This thesis takes in regard the perspective from the CSC and other LMOs to generalize what improvement areas are the most crucial ones and what best practices currently exist in the S2C-process. Thus, the external validity and reliability of what has been measured gets significantly higher than a normal case study that usually just takes one organization into consideration. However, to draw more general conclusions and increase the validity and reliability, further LMOs could have been interviewed, which was not possible in this study due to the time limitation. As of the recommendations and conclusions in this thesis, they are primarily given for the CSC due to BPR’s nature of being specific for one organization and not several. Therefore, other LMOs could take advantage of this thesis approach when reengineering their S2C-process.

The qualitative part of this thesis consisted of interviews with tactical purchasers at the CSC and purchasing managers at LMOs. Since LMOs did not have the capacity to participate in in-depth interviews, it was decided to interview managers, which negatively affects the study’s reliability. However, because the managers possessed a holistic view of the S2C-process, it was
more efficient to gain insights from them regarding what areas are the most crucial ones to improve compared to the tactical purchasers as fewer resources were required. Preferably, this study would have included more interviews with purchasing managers, strategic, tactical, and operative purchasers at several LMOs to get further insights into the best practices and the most crucial areas for improvement.

8.3 Future studies

This thesis gives insights for LMOs regarding best practices and the most crucial areas for improvement in the S2C-process. The findings might be of interest, especially for LMOs with tactical purchasers with inefficiencies, unclear roles, and responsibilities in their S2C-process. Since this study was delimited to the S2C-process, it would also be of interest to examine processes that the S2C-process has an impact on, for instance, the P2P-process. Further studies could also address how to pursue an efficient cost-benefit analysis in the BPR methodology as a result of implementing digitalized solutions such as RPA, ML, and SWF.

Currently, literature covers the most essential theoretical parts of BPR. However, literature does not provide sufficient guidelines on how the BPR methodology could be utilized practically. Thus, this study aims to suggest practical implications for how LMOs can utilize the developed five-step framework of the BPR methodology, especially the third step, to analyze and potentially reengineer its S2C-process. Future studies could aim to suggest further practical implications in the first, second, fourth, and fifth steps of the BPR methodology because they have only been briefly touched upon in this thesis and as there barely exists any guidelines on how to work practically with BPR in current literature.
9 References


Lewin, K. (1948). Resolving social conflicts; selected papers on group dynamics.


### 10 Appendix

#### 10.1 Appendix 1

Table 15: Interview B.

<table>
<thead>
<tr>
<th>Key areas</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feedback on initial mapping</strong></td>
<td>Does the mapping somewhat represent your overall day-to-day activities?</td>
</tr>
<tr>
<td></td>
<td>Do the mapped activities come in the right order? Anything in particular that needs to be changed?</td>
</tr>
<tr>
<td><strong>Gather information based on triggered need</strong></td>
<td>What communication medium is used to receive and send information to other departments and why?</td>
</tr>
<tr>
<td></td>
<td>When a request is received from other departments, what do you do if not enough information is received to proceed with?</td>
</tr>
<tr>
<td></td>
<td>Are there certain software that is dedicated to a specific department where the information can be collected from?</td>
</tr>
<tr>
<td></td>
<td>Is there documentation available that shows how you can work efficiently in different parts of the process?</td>
</tr>
<tr>
<td><strong>Selection of supplier(s)</strong></td>
<td>What software is used to contact, send RFQ’s and, evaluate potential suppliers?</td>
</tr>
<tr>
<td></td>
<td>How do you identify suitable supplier(s) based on the initial need that is triggered?</td>
</tr>
<tr>
<td></td>
<td>What do you do if you do not know any suitable supplier(s)?</td>
</tr>
<tr>
<td><strong>Contract with supplier(s)</strong></td>
<td>How do you handle a contract with the selected supplier(s)?</td>
</tr>
<tr>
<td></td>
<td>What do you usually include in the contract?</td>
</tr>
<tr>
<td></td>
<td>Are there certain software you use to handle the contract?</td>
</tr>
</tbody>
</table>
Table 16: Interview C.

<table>
<thead>
<tr>
<th>Key areas</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feedback on previous mapping</strong></td>
<td>Are the activities in the right order and somewhat similar to your day-to-day activities in the S2C-process?</td>
</tr>
<tr>
<td></td>
<td>Are there further issues or problems that you can come up with based on this mapping?</td>
</tr>
<tr>
<td></td>
<td>What kind of problems and how do you proceed to solve those?</td>
</tr>
<tr>
<td></td>
<td>Are there some areas that you consider non-value adding?</td>
</tr>
<tr>
<td><strong>Potential areas of improvements</strong></td>
<td>If you could change anything you wanted, what would that be?</td>
</tr>
<tr>
<td></td>
<td>In what areas do you see potential improvements?</td>
</tr>
<tr>
<td><strong>Disturbance areas</strong></td>
<td>Is there anything in your day-to-day activities that bothers you?</td>
</tr>
<tr>
<td></td>
<td>Would it be possible to remove these areas in a certain way?</td>
</tr>
</tbody>
</table>

Table 17: Interview D.

<table>
<thead>
<tr>
<th>Key areas</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feedback on previous mapping</strong></td>
<td>Are the activities in the right order and represent your day-to-day activities in the S2C-process?</td>
</tr>
<tr>
<td></td>
<td>What activities have to be removed or added?</td>
</tr>
</tbody>
</table>
Table 18: Interview E.

<table>
<thead>
<tr>
<th>Key areas</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roles and responsibilities</td>
<td>Based on the mapped activities, who is responsible for what activity?</td>
</tr>
<tr>
<td></td>
<td>Who approves the activity?</td>
</tr>
<tr>
<td></td>
<td>Who gives support?</td>
</tr>
<tr>
<td></td>
<td>Who needs to be informed?</td>
</tr>
<tr>
<td></td>
<td>Who needs to be consulted?</td>
</tr>
<tr>
<td>Discussion of PIAs</td>
<td>Based on the areas that we have discussed, we have found the following improvement areas. How would you prioritize these?</td>
</tr>
<tr>
<td></td>
<td>What activities do you consider as the most valuable to improve? Thus, where do you see most potential in reducing the time spent in the S2C-process to focus on more value-adding activities?</td>
</tr>
<tr>
<td></td>
<td>How frequent do the issues occur?</td>
</tr>
<tr>
<td></td>
<td>Are there some improvement areas that could be clustered according to you?</td>
</tr>
<tr>
<td></td>
<td>Why?</td>
</tr>
<tr>
<td></td>
<td>How would you prioritize these clusters?</td>
</tr>
</tbody>
</table>

10.2 Appendix 2

Table 19: Interview F.

<table>
<thead>
<tr>
<th>Key areas</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate measurements</td>
<td>Based on the following prioritization, what performance indicators would harmonize with the process (related to effectiveness and efficiency)?</td>
</tr>
</tbody>
</table>
### 10.3 Appendix 3

**Table 20: Interview G.**

<table>
<thead>
<tr>
<th>Key areas</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Initial questions</em></td>
<td>Is this process somewhat similar to your current process?</td>
</tr>
<tr>
<td></td>
<td>Are there any activities that you wish to remove or add?</td>
</tr>
<tr>
<td><em>Gather information based on triggered need</em></td>
<td>From what departments are your internal requests mainly coming from?</td>
</tr>
<tr>
<td></td>
<td>How are the internal requests communicated between the different departments and the purchasing department?</td>
</tr>
<tr>
<td></td>
<td>Is the information shared between the departments usually enough for the purchasers?</td>
</tr>
<tr>
<td><em>Selection of supplier(s)</em></td>
<td>How is the purchasing department finding suitable suppliers for the internal request?</td>
</tr>
<tr>
<td></td>
<td>Do they use any software or database where the suppliers are sorted by material groups?</td>
</tr>
<tr>
<td></td>
<td>How are the purchasers sending out RFQs to suitable suppliers?</td>
</tr>
<tr>
<td></td>
<td>If a software is used to send out RFQs, will it also help the purchasers with supplier assessment?</td>
</tr>
<tr>
<td><em>Contract with supplier(s)</em></td>
<td>Are there cases when there is an open contract when a customer order is received?</td>
</tr>
<tr>
<td></td>
<td>Is the process for closing a contract and its documentation analog or manual?</td>
</tr>
<tr>
<td><em>Discussion of PIAs</em></td>
<td>Where do you see the biggest opportunities in your process to make improvements?</td>
</tr>
<tr>
<td></td>
<td>Do you consider the dedicated software for a purchaser to be well-integrated (if not discussed)?</td>
</tr>
</tbody>
</table>
# Appendix 4

Table 21: RASIC matrix 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Process step</th>
<th>Explanation</th>
<th>Head buyer</th>
<th>Constructors</th>
<th>Logistics</th>
<th>Market sales</th>
<th>Colleagues</th>
<th>Other dep.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Source</td>
<td>When a need from someone occurs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Check for IPN</td>
<td>The purchaser gets a request from someone, the person who sent the request is responsible</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Is enough information provided by the person who sent the request?</td>
<td>R</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td>4</td>
<td>Gather information</td>
<td>If not enough information is provided, the purchaser has to gather this information</td>
<td>R</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td>5</td>
<td>Supplier(s) available?</td>
<td>If enough information is provided, the purchaser can see whether they know suitable supplier(s) for the specific request or not</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Find supplier(s)</td>
<td>If the purchaser do not know what supplier(s) to choose, they have to find supplier(s) that seems suitable</td>
<td>R</td>
<td>S</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Send RFQ</td>
<td>When the purchaser knows suitable supplier(s), they gather the information they have to send RFQ’s to the supplier(s)</td>
<td>R</td>
<td>S</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Supplier(s) satisfied?</td>
<td>Sometimes the supplier(s) are not &quot;satisfied&quot; with the information provided from the purchaser</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No.</td>
<td>Process step</td>
<td>Explanation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>--------------</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>[Communicate with involved stakeholder(s)]</td>
<td>If the supplier(s) are not satisfied, the purchaser have to communicate with the person that sent the request to find a new solution</td>
<td>R S - S - S - S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>[Select supplier]</td>
<td>The supplier that is evaluated with the highest score gets selected</td>
<td>R - - - - - -</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>[Formal contract needed?]</td>
<td>Depending on the volumes, prices, and other factors a formal contract might be needed</td>
<td>R - - - - - -</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>[Contract negotiation]</td>
<td>If a formal contract is needed, the purchaser needs to negotiate</td>
<td>R S - - S S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>[Open contract?]</td>
<td>When a customer order is received, a contract have to be updated if it is open</td>
<td>R - S - - -</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>[End]</td>
<td>If the contract is closed, purchasers can buy the product or service</td>
<td>R - - - - - -</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>[Selected supplier?]</td>
<td>Is the contract relatively new but outdated and can the previous supplier be selected or is it a need to look for other supplier(s) that might be more competitive?</td>
<td>R - - - - - -</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>[Update/close contract]</td>
<td>Close the contract with the supplier to make the product available for purchase</td>
<td>R - - - - - -</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>[Create/Change Documentation]</td>
<td>Document what changes have been made or create a new documentation</td>
<td>R - - - S - -</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>