BACHELOR THESIS

IMPROVING AN INTERNAL PROCESS USING A SUPER LEAN METHODOLOGY

J.F. Messelink
Student Industrial Engineering and Management
University of Twente

FIRST UNIVERSITY SUPERVISOR
Dr. Lucas Meertens
Faculty BMS, IEBIS

SECOND UNIVERSITY SUPERVISOR
Dr. Renata Guizzardi-Silva Souza
Faculty BMS, IEBIS

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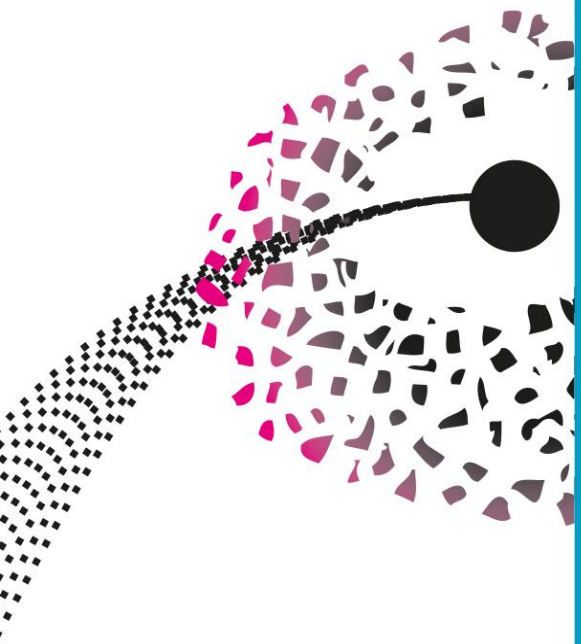

UNIVERSITY OF TWENTE.

PREFACE

Dear reader,

This report named “Improving an internal process using a SUPER lean methodology” presents research and analysis conducted on the improvement of an internal process within Company X over a period of ten weeks. The company specializes in manufacturing of industrial equipment in the field of air technologies and noise control.

The objective of this research is to solve current internal problems at Company X using the integration of existing methodologies. This will give valuable insights for theory on how to improve processes within Small and Medium sized Enterprises (SMEs). Through investigation and examination of the problem, the aim is to provide a comprehensive understanding of the topic and its implications.

I would like to thank everyone who works at Company X for helping me in every way possible during this research. I would like to thank my company supervisor especially for guiding me through this research. Everyone was always open to answer any questions I had regarding their work. It was a pleasant first real-life working experience outside conducting the research.

Furthermore, I would like to thank my first supervisor Lucas Meertens who guided me through thesis preparation and the actual research. In the beginning, progress of the preparation and the research ran into a couple of difficulties, but he was always there if I needed to ask a question. All the feedback that was provided really helped me get to this point. I would also like to thank Renata Guizzardi-Silva Souza for being my second supervisor.

Lastly, I want to thank my family and friends who supported me throughout this graduation period.

Frank Messelink

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MANAGEMENT SUMMARY

Introduction and problem statement
In the busy hallways of modern workplaces, the heartbeat of productivity resonates in the harmonious rhythm of effective internal communication and process efficiency in the office. Yet, despite the technological progress and coordination of this digital age, the challenge persists: how can internal communication and process efficiency be elevated to facilitate and activate structure and standards in the office?
This thesis explores the opportunities of a small manufacturing company with a problem internally. We dive deeper into the problem with the use of sub questions. One of the sub questions considers the theoretical frameworks for process optimization and analysis. This question was answered by proposing a methodology to enhance the structure of processes before production of Company X.

Methodology
The research is based around a proposed methodology. After literature review it was decided that Business Process Reengineering (BPR) and Continuous Process Improvement (CPI) is central to this research. This methodology is called the SUPER methodology. The company wanted their process to follow lean principles. So, the proposed methodology which is central in this research will be called the SUPER lean methodology. The combination of these methods is centred around five steps.

1. Select the process.
2. Understand the process.
3. Process measurement.
4. Execute process improvement.
5. Review the process.

First, it was necessary to select the process. After talks with the company employees and observations, it was determined that the most problems are present before production. So, the broad process from customer order request until work order was selected. Then, it was necessary for the researcher to understand the process. This was done by analysing the problems. After the outcome of the problem statement, a value stream map of the current process has been created. This map shows all the different processes in the chosen process for research. It is necessary to measure the cycle times and lead times of the processes while mapping the process in a value stream. This automatically brings the research to the third step.

Solutions
After the third step of the methodology, it is time to come up with solutions. Information from interviews and observations together with the insights of the current stream map is used to create a future stream map. While creating the future stream map, the question of where to add value and eliminate waste will arise. This will result in a list of solutions. There are some key points which have been identified within Company X:

1. The structure in process management has room for improvement. Optimizing operational processes can result in a more efficient environment within the company. This adjustment has the potential to increase the overall effectiveness of the organization and improve performance, which in turn can lead to strengthened competitive position.
2. The internal communication throughout the entire process from customer order request to work order can be enhanced. Implementing a more streamlined approach in the office can increase efficiency and facilitate more effective collaboration among employees. Improved internal communication will result in clarity, confidence, and a positive working environment within the office.

The following solutions and recommendations are proposed for tackling these issues:

1. **Redesign the quotation process**: The creation of quotes is an important part of the process from customer order request to work order for Company X. They spend a lot of time and effort making the quotes. Setting up quotes with standard building blocks could eliminate a lot of time in the creation of a quote. Also introducing a structured follow-up process after sending a quote to a potential customer is implemented to ensure that customers respond timely.
2. **Standard operating procedures**: At Company X, efforts were made to establish more streamlined office procedures. However, due to the departure of several employees at Company X, this task did not receive the attention it deserved in subsequent periods. This presents the company with an opportunity to revisit and enhance this aspect. The implementation of standard operating procedures ensures consistent expectations for all employees, fostering clarity and enhancing comprehension of assigned tasks. Hence, internal communication could improve.
3. **Kanban board**: The utilization of a Kanban board facilitates the visualization of workflow, thereby enhancing clarity regarding ongoing activities both the office and the workshop.
4. **Regular meetings**: Company X should implement regular preparatory and evaluation meetings to enable two-way communication and elaborate on past experiences. This will improve the internal communication and will enable continuous improvement on all aspects of the operations.
5. **Implement JIT**: Just-In-Time management could give Company X the opportunity to eliminate waste throughout the entire process from customer order request to work order.
6. And other solutions such as eliminating waste in documentation and adding value by making more use of Order Direct (ERP system).

Conclusions

Through this research, it can be concluded that the SUPER Lean methodology can serve as a guideline for improving the efficiency of internal processes in an SME. However, the methodology also comes with its challenges. These challenges can all be overcome through the implementation of a lean communication framework. This framework consists of eight steps that optimize the flow of information sharing within the organization, utilizing tools such as a Kanban board and the use of SOPs. The framework provides a comprehensive solution for SMEs to implement, enhancing internal communication and efficiency within the organization. Following the implementation of such a framework, other solutions can be implemented more quickly and easily. Therefore, it can be concluded that methods have been found to optimize processes within Company X, thereby structuring and standardizing the way of working. It is recommended to use this report as guidance for the initial implementation of SUPER Lean practices. Subsequently, it is necessary for Company X to continuously monitor and improve these practices, while also exploring where they can provide further value. In this way, Company X can ultimately distinguish itself from its competitors.

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1. LIST OF ABBREVIATIONS

Abbreviation	Description
SME	Small and Medium sized Enterprise
LE	Large Enterprise
BPB	Business Process Benchmarking
CPI	Continuous Process Improvement
BPR	Business Process Reengineering
KPI	Key Performance Indicator
MTO	Make-To-Order
CT	Cycle Time
WIP	Work In Progress
JIT	Just-In-Time
SOP	Standard Operating Procedure
ERP	Enterprise Resource Planning
FIFO	First In First Out

2. INTRODUCTION

The business environment inequality is an object of many scientific research fields. SMEs (Small and Medium sized Enterprises) have mostly definite characteristics related to their size, level of diversification, capital strength, and risk. Despite all these, and many other difficulties, the SMEs are known for their flexibility. The company that is central in this research paper is Company X.

Company X was founded in 1996 and they were focussed on making air ducts and pipelines from the beginning. Through the years the company specialized more and more. Today, the company is a specialist regarding complex issues about industrial air technologies and noise control. The company develops and produce total solutions with a skilled team. Furthermore, many companies know where to find solutions at Company X for making plate and steel constructions. The company is specialized in handling large serial orders as well as providing customized solutions. To make optimal use of the knowledge required by the team, they invest heavily in their machinery. Therefore, many assignments can be carried out at the same time.

In this world of producing industrial machinery, having skilled employees in the workplace and streamlined processes form the backbone of any successful enterprise. The dedication and expertise of the workforce directly contribute to the innovative solutions that drive industries forward in the fields of industrial air technologies and noise control. However, an often-overlooked dimension lies within the activities of the office, where untapped potential and efficiency gains are waited on to be discovered.

This paper will explore further on the operational core of a small manufacturing company. And while the technical insight of the workforce and manufacturing processes have been raised to a commendable level, this thesis sheds light on the unexplored opportunities within the office activities. By recognising and addressing the complexities inside the office, the aim is to discover hidden opportunities that could contribute to the improvement of internal operations. Further elaborations on the choice of problem statement will be done in Section 3.

3. PROBLEM IDENTIFICATION

In this chapter, the problem identification is stated. The action problem and the core problem are identified. Different problems are identified and mapped into a problem cluster. After that the norm and reality are discussed.

3.1 ACTION PROBLEM

Identifying the action problem is the first step towards a research question. By having a few conversations with the company where the research will take place, it quickly became clear that there are a few shortcomings in the process from customer order request to job completion. The company believe that they arrange the process well after the work order is created, but that there is a lot to gain before production. There is room for growth and development through the implementation of standardized procedures within this process. It was also discussed that the procedures were standardized a few years ago when someone who worked there organized this process. But since no one else on the office staff kept track of what exactly they were doing, it became difficult to pick it up when they suddenly left the company. Thus, it becomes evident that there is room for improvement in implementing structured and standardized processes within the order process from customer order request to work order, and this will also be the actionable issue. Several (core) problems can be identified from this action problem.

3.2 PROBLEM STATEMENT

The identification of the action problem ensures that multiple (core) problems can be identified. All the problems are formulated and are depicted in a problem cluster. The problem cluster can be seen in Figure 1.

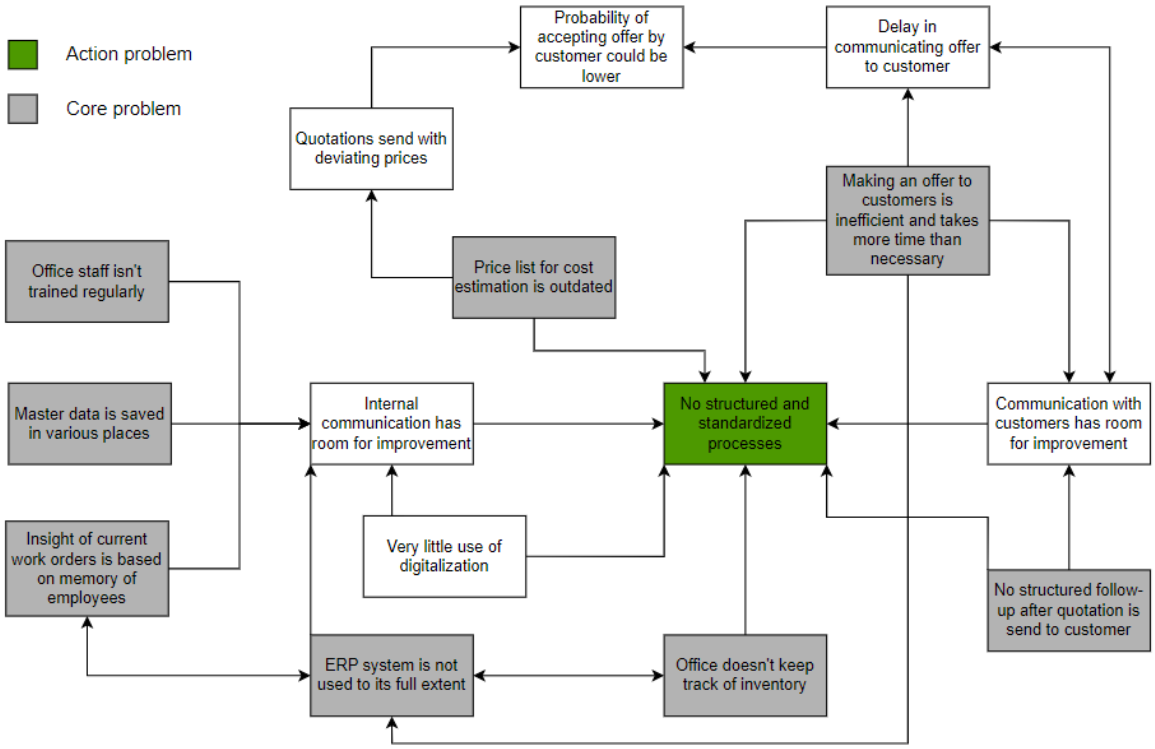


Figure 1 Problem cluster.

Office staff isn't trained regularly.

The office staff may sometimes have to deal with questions from customers to which they do not know the answer. Those questions almost always go to the owner of the company, which means he is dealing with multiple tasks at the same time. Although this problem is present, it is beyond the scope of this research. However, it can be given as a recommendation to regularly schedule a training.

Master data is saved in various places.

Data of customers, work orders, quotations and so forth are stored into different places. Some of this information is saved in the ERP system and some of the information is stored in local documents on the computer. Looking up data on customers can therefore be challenging and confusing.

Insight of current work orders is based on memory of employees.

Creating insights into the current work orders can assist office personnel in being better informed. The schedules currently are memory based and a consequence is that information on orders cannot be communicated properly to customers.

ERP system is not used to its full extent.

There are a lot of functions of the ERP system that is not being used such as creating a quotation and using it as a storage place for inventory and warehousing.

Internal communication has room for improvement.

A problem is the communication in the office. This is a direct consequence of three other problems and thus solving those problems can indirectly solve this problem as well.

Very little use of digitalization.

Although the company makes use of an ERP system, all work orders are still printed. On the desks are work order with extensive notes. These orders are printed and divided on all the desks. This makes it easier to forget tasks or actions regarding work orders.

Office doesn't keep track of inventory.

Inventory is not being tracked. When something is ordered, the order is saved locally per company where it is bought. But which parts are in the warehouse in not kept track of.

Price list for cost estimation is outdated.

The price list in the Excel file for price calculations is outdated. This means that the quotations prices of their products are not accurate. The consequence of this problem is that quotations are being send with deviating prices which also affects the acceptance rate of quotations.

Quotations send with deviating prices.

As described above, this is a direct consequence of the outdated price list in Excel, and it could potentially reduce the likelihood of customers accepting the quotations.

Making an offer to customers is inefficient and takes more time than necessary.

The quotations are made with a couple of standardized Word documents. But often the creation of the offers takes a lot more time than necessary. Furthermore, since the products could be very

different from each other, it can be challenging for the office staff to easily make an offer. This problem can cause the delay of communication to customers.

Delay in communicating offer to customers.

This issue highlights an opportunity for optimization, involving streamlining the quotation preparation process and improving customer communication. This problem may affect the acceptance rates of quotations. And that may lead to a loss of business opportunities, as customers might turn to competitors with more prompt responses.

Probability of accepting offer by customer could be lower.

This is directly and indirectly a consequence of multiple problems. The probability of a low acceptance rate of quotations poses challenges as it directly impacts revenue generation, resource utilization, and profit margins. Addressing the root causes of, for example, unclear quotations or inadequate follow-up procedures is crucial to improving this problem.

Communication structure with customers has room for improvement.

Organized communication to customers is vital for several reasons. Firstly, organized communication ensures that customers receive accurate and relevant information, reducing the likelihood of misunderstandings. And secondly, it facilitates timely responses to inquiries or concerns.

No structured follow-up after quotation is send to customer.

A follow-up after a quotation is send is important for the acceptance rates of the quotations. There is not a structured follow-up for this now. Again, quotations send are memory based and they call back whenever they feel to.

3.3 NORM AND REALITY

The reality is that the company has room for improvement in terms of standardized processes. This is caused by different factors, such as the ERP system not being optimal and the price list in the calculation programme not being up to date. Eventually, what the company wants is that the processes will be standardized, and that the instability fades away. This will optimize the order request to work order process and will give more clarity to the office staff.

4. RESEARCH DESIGN

4.1 RESEARCH QUESTION AND KNOWLEDGE QUESTIONS

This section will outline the main research question and the sub-research questions that must be answered to ultimately answer the main research question. The main research question is formulated as follows:

"What are the most optimal ways to enhance the process from customer order request to job completion for the purpose of standardizing and structuring the way of working?"

There are a few sub-research questions that must be answered for being able to answer the question above. These questions relate to the main research question and the problems stated in Section 3. The sub-research or knowledge questions are formulated as follows:

"What problems does the employees experience about the current process?"

It is essential to know what the employees think about the process right now and what problems they are facing. This way, solutions can be created and implemented. The method that is going to be used to achieve this is interviewing (Fontana & Frey, 2000) the office staff of Company X. This method is descriptive and thus qualitative data is received. Another method to get the information to answer this question are observations (Morgan, 2017), which is a form of qualitative data.

"What does the current customer order request to job completion process look like and what are the desires for the future?"

This is a descriptive research question. The question gives insight in the current process from customer order request to job completion. Using a value stream map, the information flows of the process are mapped together and give great insight into the current situation of the process. This will be used to identify weaknesses and non-value-added activities in the process. The information that is used in the value stream map will be found by conducting interviews with the employees. Again, this method is descriptive and thus qualitative data is received. Furthermore, after analysing the current state map, a future state map is constructed which visualizes the desired situation.

"What theoretical frameworks are existent and could be used for process optimization and analysis and what framework best fits this research?"

Literature research will be done to answer this question. When the theoretical framework has been studied, the one that's chosen will give inside into the optimization methods for this process. Solutions can be deducted from the theoretical framework together with the flaws in the process which are deduced from the value stream map of the current situation. After reviewing the literature, a proposed methodology is constructed which is going to be used in this research.

"What solutions and recommendations can be made using the research that has been conducted?"

From the research that has been done, solutions and recommendations are made for the company to improve their current process. A list will be made with explanations why these solutions should work for Company X. Ultimately, there will be an elaboration on how to implement the solutions. A choice will be made on which solutions to implement during the given time frame for this research.

“How could the solutions be implemented to improve the current process?”

After the list of solutions and recommendations is made, the question of how to implement the solution still exists. An implementation plan will be made, that can be used by the company. If time permits, the solution will be implemented during the research period.

The next table shows a summary of the research design as described.

Question	Research method	Data collection	Data analysis	Deliverable	Duration
1	Qualitative	Semi-structured interviews and observations	Grounded theory	Problem cluster	1 week
2	Qualitative	Interviews and observations	Grounded theory and value-added analysis	Value stream map	3 weeks
3	Descriptive	Secondary data collection	Literature review	List of possible frameworks	1 week
4	Qualitative	Interviews and observations	Observational and value-added analysis	List of possible solutions	2 weeks
5	Qualitative	Interviews and observations	-	Implementation plan	3 weeks

Table 1 Research design

4.2 LIMITATIONS

The first limitation of the research design is that solutions and ideas could be subjective since the research is mainly based on qualitative data and especially observations by the researcher. The researcher may unintentionally interpret, and record data based on its own preconceived beliefs. This bias could also happen while conducting interviews with employees. This bias may affect the reliability of the data.

Another limitation of conducting interviews is the social desirability of the respondents. Employees who are interviewed may provide answers they think are socially acceptable or expected rather than expressing their true opinions about a subject.

5. LITERATURE REVIEW

A description of the problems and corresponding research questions have been formulated, and thus the theoretical framework could be determined. It becomes clear that, to formulate a solution, process analysis techniques and process improvement/optimization techniques are needed. Furthermore, to map the current and desired process situation of the company, a value stream map is made.

5.1 PROCESS OPTIMIZATION

Business process improvement methodologies are systematic approaches used by organizations to enhance their business processes, increase efficiency, and achieve better outcomes. These methodologies aim to identify, analyse, and improve existing processes to ensure they are effective, efficient, and aligned with organizational goals. There are a couple of commonly used process improvement methodologies. In this chapter, the methodologies which are commonly used are outlined. Furthermore, an explanation is given which methodologies are suitable for this research. The methodologies which are commonly used are (Rashid & Ahmad, 2013):

- Model-based integrated process improvement methodology (MIPI)
- Super methodology
- Benchmarking methodology
- PDCA methodology
- Six sigma methodology
- Lean thinking methodology
- Kaizen methodology
- Total quality management (TQM)

After the systematic literature review of the theoretical frameworks about process improvement, the chosen methodology used in this research is the super methodology. The super methodology is a proposed methodology which combines business process reengineering (BPR) continuous process improvement (CPI), and business process benchmarking (BPB) (Lee & Chuah, 2001). It is proven that this methodology can make significant improvements for small to medium sized enterprises (SMEs) (Mosimtec, 2021). The case presented in this paper is regarding an SME and therefore the logical choice for this research. Organization structures in a manufacturing enterprise can be complex and involve many different processes. The needs of these processes might be quite different, therefore CPI, BPR, and BPB's usefulness and applicability may not be universal; one combination of the two or three may be more appropriate. This will be further analysed in this thesis and a choice will be made of which approaches to use. Furthermore, after talks with the office staff of the company, the desired situation is that the internal process becomes leaner. After literature review, there has not been found an article or paper where the three methodologies from the SUPER methodology is combined with lean thinking. Therefore, proposed methodology is called the "SUPER lean methodology".

5.2 VALUE STREAM MAP

Value stream mapping is diagramming every step involved in the material and information flows needed to bring a product from order to delivery. In this research, the flow in the map is the order request going from beginning to the end. The value stream mapping tool is a fundamental tool used in continuous improvement to identify and eliminate waste (Lean Enterprise Institute, 2022). There are various mapping zones in a lean value stream such as the information flow, different process boxes, and different process data boxes. The information flow tells each process what to make or do

next and when to do it. The steps of product or service delivery in a value stream are in the process boxes. The process box stops wherever processes are disconnected or stops the flow. Process data boxes could contain several data types e.g., cycle time, lead time, uptime, changeover time, and availability.

The steps taken to make a value stream map are selecting the process, creating the current state map, analysing the current state, designing a future state map, implementing improvements, and continuously review and improve the process. In this research, begin with selecting the process from customer order request to job completion. After this, create the current state value stream map. Map out the current state of the process by identifying each step, including value-adding and non-value-adding activities. Use symbols and annotations to represent different elements. When the value stream map is complete, begin with analysing the map. Evaluate the efficiency of the current map, identify bottlenecks, and pinpoint areas of waste. The analysis helps to understand the existing challenges and opportunities for improvement. When the challenges and opportunities are identified, begin with mapping the desired future state map. This map ultimately serves as a blueprint for improvement efforts. Based on the insights of the future state map, implement changes to improve the current state process. This may involve redesigning the process, technology implementation, automation, or a change in the practices of work. And lastly, continue to review and improve the process. Continuously monitoring the performance of the improved process will lead to even better results. There are a couple of benefits to value stream mapping. For this research the most optimal beneficiaries are the following:

- Waste reduction.
- Improved efficiency
- Enhanced visibility
- Better decision making

5.3 PROCESS ANALYSIS

Process analysis techniques are systematic methods used to examine, evaluate, and improve various processes within organizations or systems. These techniques are valuable for identifying inefficiencies, bottlenecks, and opportunities for enhancement in a wide range of contexts. There are a lot of different process analysis techniques that could be used, but there are five techniques that are mostly used. They are gap analysis, value-added analysis, root cause analysis, observation analysis, and examining the experience (McClintock, 2023). In this section, these analysis techniques will be explained and evaluated if these are relevant for this research.

5.3.1 Gap analysis

A gap analysis is a method of assessing the current performance of a business and the ideal state of the business. It helps to determine how to achieve business goals. A gap analysis highlights shortcomings and opportunities for improvement. “A gap analysis, which is also referred to as a needs analysis, is important for any type of organizational performance. It allows companies to determine where they are today and where they want to be in the future” (Hayes, 2023). A gap analysis could be useful for this research, because during the beginning of the research, the current situation is depicted. The SUPER lean methodology is used to get the desired situation. However, due to the scope of this research, a gap analysis will not be used.

5.3.2 Value-added analysis

"Value-added analysis is a process in which the essential benefits and attributes of a product or service are realized. Those attributes or benefits which are more customer-appealing are retained and improved, while the others are eliminated or reduced" (Team, n.d.). There are three different classifications of value-added activities:

- Real-value-added activities (RVA): this activity contributes directly to improving customer's perception and satisfying their expectations regarding a product or service.
- Business-value-added activities (A): this activity contributes to satisfying business requirements.
- Non-value-added activities (NVA): this activity neither contributes to business requirements nor to customer's perceptions or expectations. They can be removed from the process without affecting the end-product.

This analysis could be useful during this research, because the benefits and attributes of a product or process are determined with the use of the flow chart. All steps of the process are visualized within the flow chart, and it can be determined whether the attributes or benefits are appealing for the process. If this is the case, those attributes will be retained and improved. If it's not the case, the attributes will be reduced or eliminated from the process. A value stream map is made according to the internal process that is analysed and hence a value-added analysis is used.

5.3.3 Root cause analysis

Root cause analysis is a useful process for understanding and solving a problem. This analysis figures out which negative events are occurring. After identifying the problems and the key points of failure, determine solutions to address these points, or root causes (Mindtools | Home, n.d.). There are five steps to a root cause analysis. These are:

1. Define the problem.
2. Collect data.
3. Identify causal factors.
4. Identify root causes.
5. Implement solutions.

A root cause analysis would be relevant for this research. From the flow chart, it can be determined what the negative events are in the process. Identifying these problems gives key points of failures which can be addressed after that by going through the five given steps. Multiple root cause analyses should be conducted for this research, because there are various problems and thus more root caused to those problems. Given the time frame of this research, it is outside the scope, and hence, this analysis is not used.

5.3.4 Observational analysis

Observational research is research technique where participants and phenomena are observed in their most natural settings. Researchers are enabled to see their subjects make choices and react to situations in their natural environments. Observational research is typically associated with qualitative methods, where the data require reorganization and analysis. Direct observation has been described as the gold standard among qualitative data collection techniques (Murphy & Dingwall, 2007). An observer may operate under one of two modes:

- **Passive observer**: This type of observer avoids interacting to keep the process natural and unaffected.

- **Active observers:** This type of observer jumps in with questions and may participate in the process for real-time insights.

This method will be used in this research. Finding the problems and ultimately finding the solutions to those problems require observations made by the researcher, because the researcher need to understand everything that happens in the process in a natural setting. The researcher wants to know people's actions and behaviours. So, this method will be useful during the period of this research.

5.3.5 Experience examination analysis.

Experience examination analysis captures the process mastery of old-time employees. Unlike observation that collects information from the researcher's point of view, experience examination uncovers lessons learned by experienced staff. Targeting experienced employees enables teams to find information on things like:

- What powers high-level performance in the process?
- What leads to faulty practices within the process?

This kind of analysis can dig up the vital links between root causes and non-value-added activities. In this research, the process of a manufacturing SME is investigated, where only a few people work from day to day. The office staff almost all have at least ten years of experience in their line of work. Hence, this analysis technique is indirectly used during the period of research.

6. PROPOSED METHODOLOGY

In Chapter 5.1, it is explained that the SUPER methodology together with lean thinking is combined. In this chapter, this proposed combination of methodologies is constructed. Eventually, solutions are made based on the constructed methodology.

6.1 SUPER METHODOLOGY

The SUPER methodology is a method created by using BPR, CPI, and BPB. The researcher decides whether to combine all three methods for business process improvement or whether to combine two. That depends entirely on the specific case the researcher is dealing with (Lee & Chuah, 2001). SUPER is an acronym and describes the five phases that the methodology must go through (Nugroho, 2005): **(1)** Select the process, **(2)** Understand the process, **(3)** Proceed with process measurement, **(4)** Execute the process improvement, and **(5)** Review the improved process. The selected process in this research is the customer order request to work order process. The research will be conducted at an SME and according to (Lee & Chuah, 2001), the SUPER methodology is a suitable framework and works best in an SME. As earlier stated, the SUPER methodology is constructed with combining three different business improvement frameworks. In the next three sub chapters, these frameworks will be further assessed, and a choice is made about which frameworks best suits this specific case and will be used.

6.1.1 Business process reengineering

BPR is a management strategy which involves a radical redesign of certain business processes to achieve improvements in fields like cost, quality, efficiency, etc. BPR consists of four different concepts, where the first one is already assessed, namely, radical change. It is critical for organizations to know that they need change, because modifications can lead to innovations, technology, and improvements (Harika et al., 2021). The three other concepts of BPR are innovative thinking, process function, and organizational development and performance. The causes and impact of BPR are investigated by many, and one of the primary reasons for implementing BPR is to increase internal efficiency (Gunasekaran & Kobu, 2002). The goal of this research is to increase internal efficiency in a manufacturing SME, which makes this management strategy ideal to use.

However, there could be issues and challenges regarding the implementation of BPR. The most common issues influencing business process reengineering are (Harika et al., 2021):

- Inadequate knowledge
- Wrong direction and irregularity in implementation
- Insufficient and incorrect placement of resources unsound analysis and lack of support

In this case, ultimately, solutions are made according to the methodology and all these problems and issues could come to light. Therefore, the implementation plan must include specific instructions on a given time frame for the office staff. Otherwise, the implementation of BPR could go in the wrong direction because of inadequate knowledge. The last issue with BPR is, probably, not going to be a big issue in this case, because the office staff ranges from 4 to 6 people, so it wouldn't be difficult to place the resources correctly in the process. The first two issues are the most concerning for this project.

6.1.2 Continuous process improvement

CPI is a management strategy and a systematic approach to regularly making improvements to a service or process. The goal of this research is to make the process more efficient. To measure this, the cycle and lead times are considered. To maintain efficient life cycle logistics, continuous process improvement is a necessary form of planning and optimization (Institute for Defense & Business,

2020). CPI is a proven prevention and improvement system built on a couple of principles (Robson, 2010):

- Problems must be prevented rather than reacted to.
- Results must be measurable and directly related to business plans and goals.
- Team ownership of a process is essential.

In this case, the third principle is present. There is a clear team owner in the process. The first two principles are not yet achieved in the process. The problems the company faces are reacted to and not prevented. Also, there are no measurable performance indicators present in the process.

This performance improvement strategy requires the collaboration of employees to analyse, assess and enhance the performance of the business' current state and offerings. In this case, the current state is depicted with a value stream map. Furthermore, KPIs could be established to track the impact of changes and identify further opportunities for improvement. So, the CPI concept relies on evaluation on the behalf of performance indicators and employees (Kregel, 2019). The KPIs can be evaluated and analyzed on whether to change aspects in the process, and employees can evaluate with each other about how the workflow is flowing through the process. As the communication is one of the core problems of this research, evaluating the process with each other could be a great guide to improving communication in the process. Just like BPR, CPI has attributes that could lead to improvements in the process of the specific case presented in this research paper. That's why these two methods are certainly considered.

6.1.3 Business process benchmarking

Business process benchmarking is a strategic management tool that involves comparing an organization's processes, performance metrics, and practices against those of industry leaders or competitors. This way, opportunities of improvement could easily be identified. The goal is to adopt the best practices and achieve improvements in performance in areas such as efficiency and quality. However, due to the scope of this research, comparing this case company to different companies in the same field is not possible.

So, the SUPER methodology will not contain BPB, and the research will continue with combining BPR and CPI in the SUPER methodology. A depiction of this methodology is made and is visual in Figure 2.

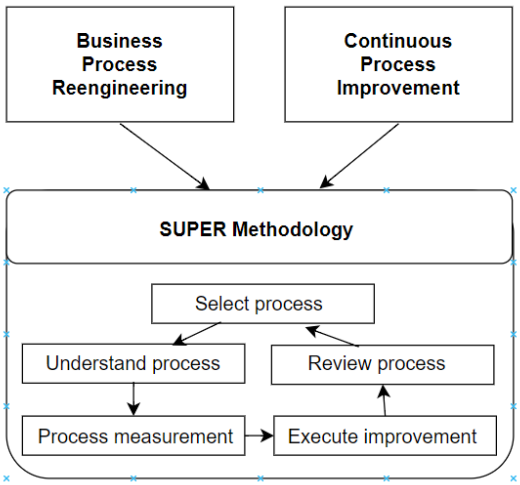


Figure 2 Diagram of SUPER methodology.

6.2 LEAN THINKING

Lean thinking is a well-known principle in LEs, but limited evidence of lean implementation in SMEs can be found in the literature (Yadav et al., 2019). It aims to reduce factors such as process waste and unnecessary movements of operators. The cause for limited evidence of lean implementation in SMEs is that smaller companies frequently lack critical factors that determine the success of lean practices implementation (Valente et al., 2019). Financial capability is one of those factors and it is essential for the successful implementation of lean. For example, practices that stimulate employee involvement require financial incentives on training. But there are far more impacts of lean transformation on operational, financial, social, and environmental scope.

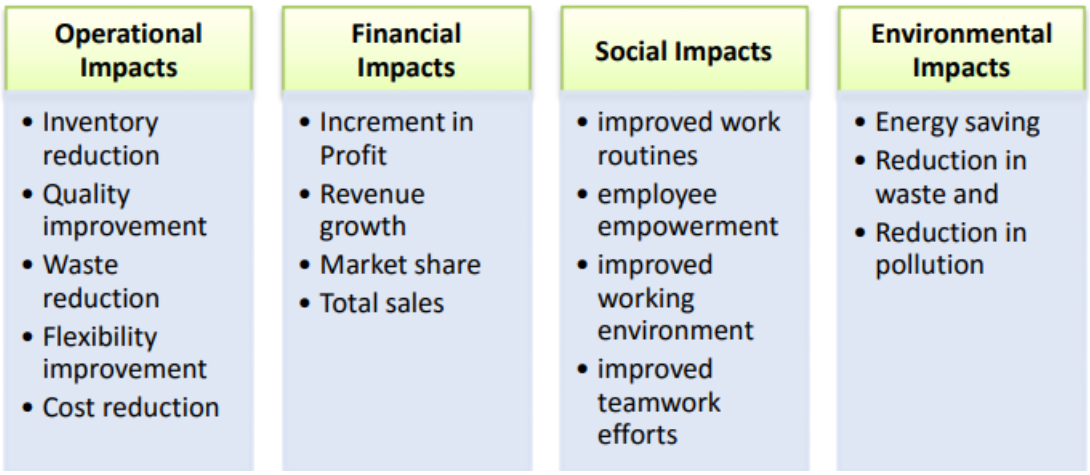


Figure 3 Impacts of lean transformation (Yadav et al., 2019)

Lean practices are used to mainly tackle impacts in the social field in this research. The problems of the company relate the most to the improvements in Figure 3 under “Social Impacts”.

Focusing on the social impacts of lean transformation is a strategic choice that recognizes the pivotal role of the workforce in the success of organizational change. By emphasizing the human aspects of lean, the research aims to foster a workplace culture that not only drives operationally well, but also ensures resilience of the organization in the long run. While the social impacts of lean transformation can bring positive change it can also be a challenge to implement. The full involvement of all employees is required to successfully implement lean (Chiarini, 2013). Employees may resist changes in their established work routines, especially if they perceive these changes as disruptive. The existing organizational culture may be deeply ingrained and introducing a new way of working may face resistance from employees who are accustomed to their traditional ways. Addressing such challenges requires a thoughtful approach with a focus on employee engagement, communication, and commitment from leadership throughout the transformation journey of lean management.

6.3 “SUPER LEAN METHODOLOGY”

De SUPER lean methodology is a combination of lean thinking, BPR, and CPI. Lean thinking and BPR as well as lean thinking and CPI have been combined multiple times and proven to be solid improvement strategies for manufacturing companies (De Oliveira et al., 2017; Timans et al., 2014; Gurumurthy et al., 2014; García-García et al., 2021). Furthermore, the methodologies have individually demonstrated their effectiveness in enhancing organizational performance. After the literature review together with the observations made and interviews conducted the integration of methodologies has emerged as a strategic imperative. Through the convergence of these methodologies, organizations can navigate the complexities of modern business environments,

encouraging a culture of innovation, efficiency, and steady improvement. At the core of the integration lies BPR, advocating for a radical change of established processes to achieve considerable outcomes of transformation. Complementing BPR, CPI focuses on iterative enhancements to existing processes. Through ongoing evaluation and adjustment, organizations can adapt to changing landscapes and fine-tune operations incrementally. A cornerstone in the integration, lean thinking draws inspiration from the Toyota Production System (Chiarini, 2013). Emphasizing waste reduction and the addition of value, lean tools facilitate streamlined processes.

The integration is not only a sum of its parts. Instead, it forges a new paradigm where BPR provides the strategic vision, CPI ensure ongoing adaptation, and lean thinking introduces a culture of efficiency. Together, the methodologies create a dynamic framework for organizational evolution. The strategic cohesion guarantees a synchronized operation of each methodology, taking advantage of the unique strength of one another. And it's not just a methodology, it's a mindset that positions the organization as a dynamic entity capable of developing amongst the complexities of the modern business environment. This means that the organization does not position itself as a passive responder to change but as an active participant in shaping its future. It embraces change, encourages innovation, and pursues a culture of resilience and continuous improvement.

7. CURRENT SITUATION AND FUTURE SITUATION

In this chapter, the current situation of the process is depicted and analysed for bottlenecks and opportunities for improvement. The opportunities for improvement will later be depicted in the future improved value stream map in Chapter 7.2.

7.1 LEGEND OF A VALUE STREAM MAP

In the next two subsections, value stream maps of the current situation and the future situation will be depicted. Value stream maps can look complicated and hence a legend of all the arrows, pictures, and other figures is given in Table 2.

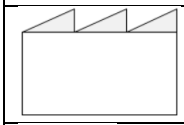
Symbol	Explanation
	Process – This symbol represents a step in the process and shows the flow of the process steps required to complete a stream. The number to the right of the symbol in the box reflects the number of employees that are participating in the process step.
	Customers/suppliers – This box contains either customers or suppliers
	Go see production – Gathering of information through visual means.
	Push arrow – This arrow depicts a push movement between process steps
	Pull arrow – This arrow depicts the pulling of movements between internal steps.
	Inventory waiting queue – It depicts an inventory waiting queue between process steps. Usually with the number of, in this case, order requests below the symbol.
	Electric information arrow – This arrow represents the stream of information gathering through electronics such as e-mail or phone.
	Truck shipment/logistics – Shipment using external transport.
	Improvement star – The star will be placed in the future state map where the improvement will take place. The method for improvement will be inside the star.

Table 2 Legend of symbols for a value stream map.

7.2 CURRENT STATE MAP

Customers are classified into two groups, one that require a fast and simple product and second that requires a complex product. The company receives several requests throughout the week that are very different. The price of these requests is calculated using a simple design in Microsoft Excel, inserted in a quote, and send to the customer via the quotation. The company has some standard quotation templates for a couple of standard products. For simple orders, no quotation is drawn up. Only the price is quickly calculated. After all, this will take too much time for what it ultimately delivers. Quotations consist of a brief description of the product, a technical specification of the product, and possibly a visualization of the product. The calculated price in the quotation consists of

the material usage, the expected hours worked required for the various activities, and possibly the assembly costs of the product. There are several Excel files per type of product, but the same one is often used for calculation and actual costing. Once the prices have been calculated, a quote can be made. This is then documented under a quote number and sent to the customer. The customer then must decide whether to accept the offer. This could mean that the customer does not agree with the offer. When this is the case, the process returns to checking the request, after which a new quotation is made. If the customer needs are all adequately documented in a new offer and the customer accepts, the process moves to the next phase and the order intake is confirmed. A work order is made, and the order goes to the draftsman. He makes a technical drawing of the product that is important for the work that must be done in the workplace. Ultimately, only materials need to be purchased. After this, the work order may be manually edited by the draftsman according to the drawing. Then, the work order will go to the workplace and eventually end up with the customer.

The value stream map can be seen in Figure 4. The cycle times are determined by measuring how long the specific task takes from start to finish. Since the products of Company X can vary considerably, when making the quotation, for example, a rough estimate is made of the average of the different orders. Requests for products can be made online, but also physically by visiting. Approximately, 25 requests are made per week, so the assumption will be that 5 requests are made per day. WIP was obtained as a snapshot of a regular day. Data for the value stream map is collected by measuring over a month. Waiting times of WIP are calculated by dividing the WIP numbers by the daily requests. The total lead time will be created by adding the waiting times of WIP.

There are also two repetition loops visible in the map from the sixth to the first activity (from the customer decision for quotation to checking the request) and from the fourth to the third activity (from the documentation control back to creating the quotation process). Customer communication determines what requirements the quotation still needs to meet and then a new one is sent based on that information. This mainly occurs with larger orders, as this is where the most details need to be processed. During the documentation check, the project manager/owner looks at the quotation that has been created. He checks the offer and sees if anything needs to be changes. If nothing needs to be changed, the process continues to step 5, otherwise it goes back to step 3.

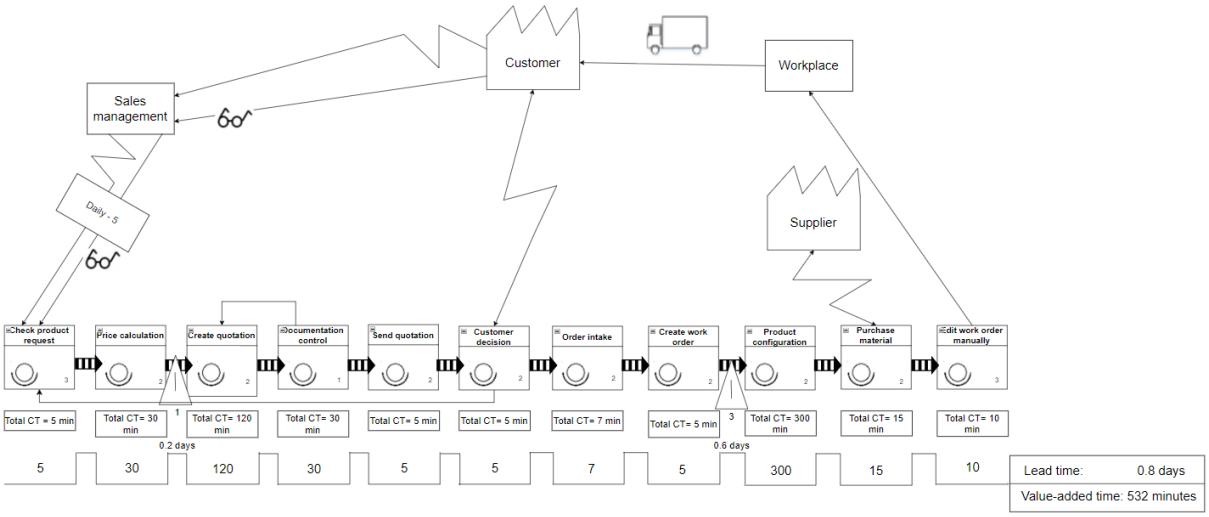


Figure 4 Current value stream map.

The current state value stream map can also be seen in Appendix A.

7.3 FUTURE STATE MAP

Now that the current value stream map gives insights in the entirety of the process and its bottlenecks, the future state map could be created. A proposal for improving the process from order request to work order is created by reengineering the quotation process and introducing lean concepts into the process. The restructuring of the quotation process is further elaborated upon in Section 8.1.1. It could significantly save time and costs for the process. Cycle times can be reduced with 30 minutes where it would be likely that WIP is erased from the quotation creation process removing the lead time in that phase of the process. Furthermore, the push arrows in between process steps are changed to FIFO arrows. At present, Company X partially employs a pull strategy, particularly with large projects, although orders are frequently pushed through as well. This practice can lead to accumulation of work and result in heightened ambiguity and stress among employees. Within the context of lean manufacturing, it is preferable to utilize pull strategies, wherein products are metaphorically drawn through the process by the customer, and a FIFO system is employed. This approach serves to eliminate the ambiguities and stress among employees, consequently reducing the occurrence of unnecessary errors – an immediate objective of the lean tool Poka Yoke. Poka Yoke states that unnecessary errors can be prevented by focusing on one task at a time.

However, one potential drawback of a pull system is the inconsistency of customer orders, making them challenging to predict. While some customers may place consistent orders, Company X also deals with a significant amount of customization, resulting in complex inquiries necessitating tailored solutions. Nonetheless, a pull system could offer numerous advantages essential to Company X's case. Such as enhanced communication due to high flexibility, reduced waste, and lower inventory levels.

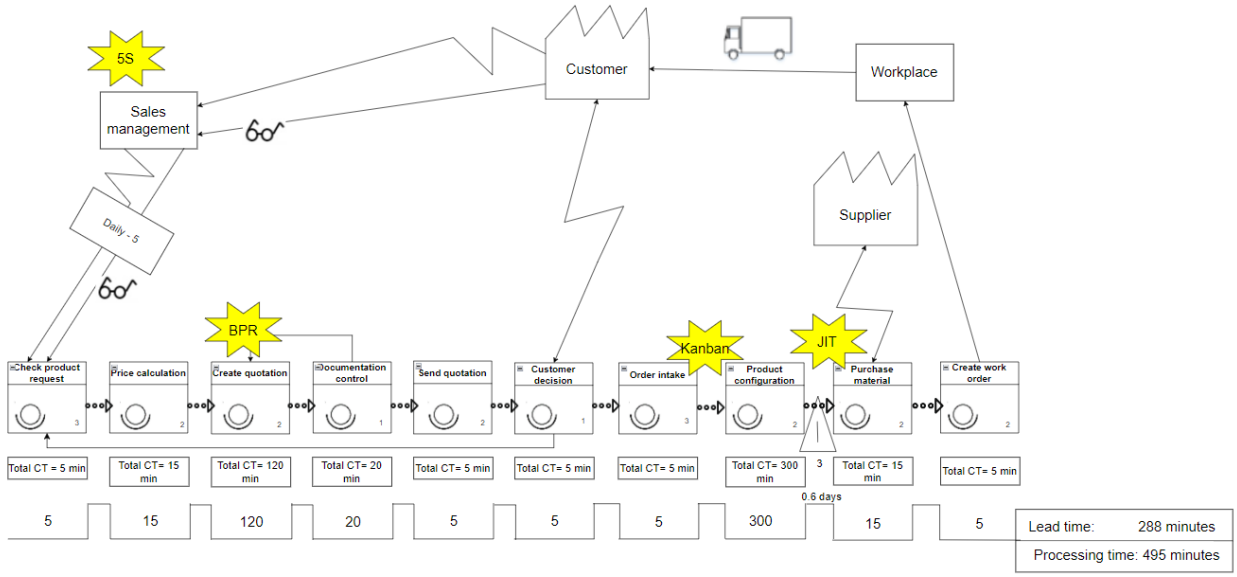


Figure 5 Future value stream map.

The future state map (Figure 5) also features several yellow stars, each depicting a methodology, indicating areas for potential improvement and the methods by which such improvements can be achieved. The procurement process can be enhanced through JIT, the quotation creation phase through Lean BPR, and processes within sales management and office operations through the utilization of the 5S tool. Chapter 8 delves deeper into these methodologies and improvement areas. The Kanban method can aid in order intake. By implementing this method, the work order no longer needs to be created and printed; instead, it can all be stored in a Kanban board. Consequently, a

process step is eliminated from the value stream map. Further explanation of the Kanban board is provided in Section 8.2.1. The future state map can also be seen in Appendix B.

8. PROPOSED SOLUTIONS

In this chapter, the list of solutions is given. Solutions are constructed according to the proposed methodology together with the observations made. Various solutions are proposed regarding the quotation process, internal communication, the purchasing process, and other possible solutions.

8.1 QUOTATION PROCESS

Think of the price quote like the first handshake in a business deal. It's the moment when a seller puts on the table what they are offering – the cost, terms, and conditions – to a potential buyer. It's often regarded as the initial point of formal interaction; the quotation process plays a crucial role in influencing the direction of future business negotiations. After conducting interviews and doing observations, it was clear that the quotation process could be improved. The structure of the quotes and the follow-up process of the quotation process are regarded in the next subsections.

8.1.1 Structure of quotes

As can be seen in the current value stream map, the current cycle time for creating a quotation takes 150 minutes on average. By observing the creation process and talking to the employees the assumption is made that this can be reduced to 120 minutes if the structure of the creation is different. Company X now possesses a hard drive containing various foundational files, including a set of roughly ten standard Word documents for creating quotations for some of their products. In some instances, standard Word documents are incomplete, providing an opportunity to supplement them with relevant content.

This solution comprises two components. The first involves consolidating all standard text elements – such as salutations, closings, and blocks containing addresses and customer details – into a single standard Word document. In Word, it is possible to create standard text blocks that can be inserted into documents with a single click. To accomplish this, an extensive review of most quotations is required to formulate the most comprehensive standard text for all aspects of the quotation per product. Additionally, employees have the capability to create and save texts as building blocks within Word themselves. Consequently, they spared the necessity of rephrasing the same text repeatedly across various quotations, as it can be inserted into the document with a single click, potentially requiring minor additions. All these texts will also be stored in a single document to prevent loss. Furthermore, a document is made available for the employees with a stepwise guide on how to save standard texts and how to implement those building blocks into a document.

The second component of the solution involves integrating the standard texts into the ERP system. Within the ERP system, it is possible to create standard texts that can be directly added to a quotation in Order Direct (the utilized ERP system). This also means that all quotations are stored in a central database and can be viewed collectively. Presently, quotations created in Word are saved in Order Direct under the associated project, but there is no overview available based on, for instance, the date when the quotation was sent. Such an overview would enhance clarity for office staff and addresses an internal communication issue discussed in Section 8.2. However, a limitation of creating quotations in Order Direct is the inability to alter the formatting of the quotation. Since Company X employs text, tables, and images, creating quotations in the ERP system diverges from their standard practice. This can be rectified by purchasing additional modules of the ERP package, a topic to be further discussed in Section 8.4.1.

Hence, by reengineering the quotation creation process, not only can cycle times be reduced, but also clarity for office personnel can be enhanced. The clarity can be further improved by utilizing the ERP system, but combining various standard templates into one, the process also becomes more

transparent. Consequently, waste is eliminated from the process, allowing office personnel more time to engage in activities that add value.

8.1.2 Follow-up process

In today's ever-changing business environment, the quotation process is a critical moment that requires strategic planning. It is of the utmost importance to follow up on a quote that has been sent. Three main reasons can be described why a follow-up process is important. Firstly, client engagement and relationship building. A way to keep clients engaged is through a well-organized follow-up process. It reinforces commitment to customer satisfaction and facilitates the development of strong relationships. A systematic follow-up process demonstrates dedication to their needs beyond the initial proposal. Secondly, a structured follow-up process allows businesses to address any uncertainties or concerns that may arise after the customer has reviewed the quote. The approach not only contributes to transparency but also provides an opportunity to clarify details of the product and potentially even mitigate misunderstandings. Lastly, implementing a systematic follow-up process can give a competitive advantage. In a commercial centre immersed with choices, organizations that demonstrate attentiveness through follow-up activities stand out. This professionalism may influence customers' perceptions, which therefore increases the likelihood of securing the deal over competitors.

Currently, Company X has no structured follow-up process after the quote has been sent. It is fully memory-based, which could lead to forgetting to follow-up on the sent quotation. This gives a wrong signal to the customer. Furthermore, customers could forget to answer the quote, because they are either busy or the E-mail, which contains the quote, end up in their spam folder. Not following up on the quotation could potentially lead to low acceptance rates. So, a structured follow-up process is necessary for Company X to maximize their acceptance rates and customer satisfaction level. In Outlook, an automatic calendar notification can be implemented to follow up on the quotation. This moves the process from memory-based to a structured process that requires minimal effort to implement. Therefore, it adds value to the existing process, and the process is reengineered from memory-based to a structural process. Also, by implementing a robust follow-up process, Company X could continuously collect feedback from customers about their quotes. This way, they can identify areas for improvement and refine their approach to better align with client expectations. In Figure 6, the desired follow-up process is depicted. This can also be seen in Appendix C.

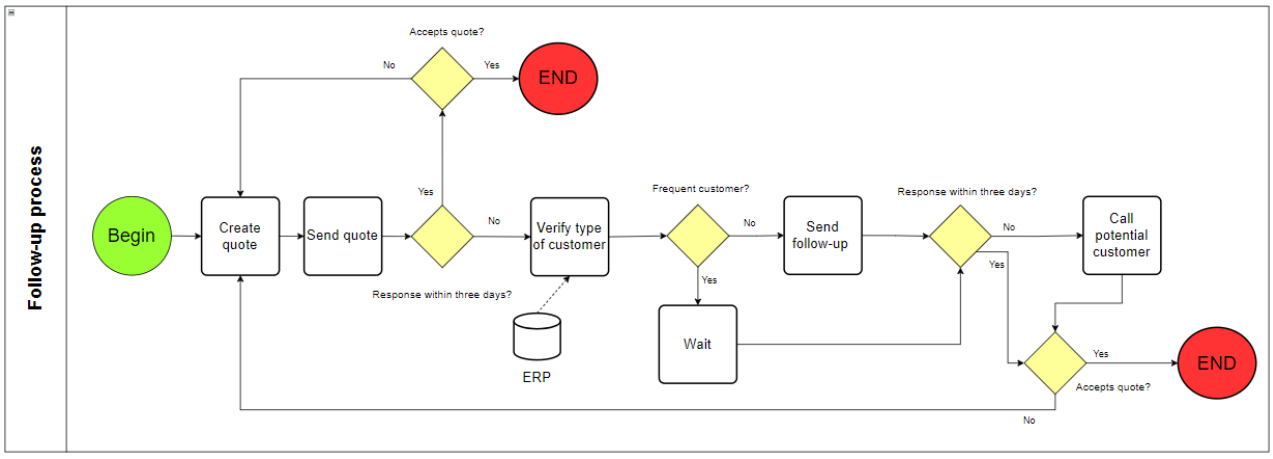


Figure 6 Structured follow-up process.

The steps in this process are easy to follow and therefore easy to implement. The automatic notification in Outlook should be scheduled on Monday and Thursday. This means that a notification

is seen every three (work)days. A standard E-mail template is made and is customized to the standards of Company X. So, when the first three days are expired, it takes minimal effort to send the potential customer a follow-up. Only new customers will receive a follow-up e-mail when the response to the quotation is not within three days. After talks with the project manager, it was pointed out that the company didn't want to "stalk" their loyal and frequent customers. After six days of not answering, the process continues with calling the potential customer. It does not matter in this process step whether it concerns a frequent or new customer. The follow-up process for quotation is ended when the customer agrees with the terms and costs of the quote. When the customer is not satisfied with the current quotation, the process goes back to the beginning and starts with sending a renewed quote.

Following Section 8.1.2, the follow-up process could potentially be easier using the ERP system. When quotes are saved in a central database like the ERP system, the quotes can get exported into an Excel file where quotes are sorted on date of creation. This way, it's easy to see which quote was send when and on which quote to follow up.

8.2 INTERNAL COMMUNICATION

Effective communication stands as a cornerstone for the success of organizations (Verčić et al., 2012). Small enterprises are no exception to the critical importance of internal communication. Unlike large enterprises, these small companies often operate within a tighter resource constraint, which places more emphasis on streamlined communication and efficient information distribution. In this situation, there are opportunities for improvement in communication. With the implementation of regular project meetings and a clear structure for internal communication, insight into the production process on the work floor can be enhanced, thereby promoting collaboration and transparency. In this subsection, solutions are given to improve the internal communication of Company X.

8.2.1 Kanban board

Kanban is a concept from lean manufacturing and is a system to signal when a process step needs further development and where it currently is in the process. The system is used to control the logistic production chain and is aimed to achieve continuous improvements in process management (Damij & Damij, 2022). Kanban is constructed with two Japanese words – kan and ban – which means "a visual card" and originates from Toyota. The Kanban board will visualize the workflow in columns and give insights what projects are currently being dealt with. Kanban also encourages the use of feedback loops to adapt and improve. This can involve regular meetings to discuss status of work, identify issues, and adjust the process. This will be further elaborated on in Section 8.2.2. The board will improve internal communication during the project planning process. Furthermore, it will increase the efficiency of customer communication. The office employees could answer questions regarding the projects of customers more adequately and accurately with the use of the Kanban board.

The implementation of the Kanban board is done through using the free project management software Trello. Other free software could also be used but the company chose this software for implementation. The board must be constructed in columns and represents a timeline of the phases a project must go through. In this instance the columns represent the names "Concept cards", "New projects", "In progress (office)", "In progress (workplace)" and "Done". The cards consist of the project number, the customer, the order intake date, and the expected delivery date. The desires of the company are that the orders could also be shown in a calendar template and that they would get a message when the projects delivery date is within 2 weeks. This is possible via an automation in the

board as well. It is also possible to assign employees and mechanics to a project by employing labels. Each coloured label represents a product group or external activity and can be linked to a card, thereby indicating what work should be done to the order. In this manner, the work preparation department can better schedule the orders. The work preparation department is aware of the specialization of mechanics in various product groups and can therefore plan the work accordingly. Upon the creation of a new project, a date must be added to the card, enhancing insights into project scheduling and delivery times. During the evaluation meetings, which is discussed in Section 8.2.2, the board can be utilized to assess whether the objectives regarding delivery times have been met and whether they need to be adjusted for each project.

The board template includes three card templates at the forefront, featuring card labels and projects. During order intake, the template with the projects is completed and dragged under the "New projects" column. Subsequently, when the new project is initiated in the office, the card is moved to the "In progress (office)" column. Upon the completion of all office tasks and the commencement of production, the card is moved to the "In progress (workplace)" column. Once the workplace tasks are finished, the card is automatically transferred to the "Completed" column when the card's date is clicked. This additional automation feature enhances board functionality. Furthermore, the "To Do" list is added in the board. If the employees find a task important but can't do it at this moment, a card should be made and transferred to this list.

The above serves as a brief description of how the board should be utilized, resulting in error reduction and minimizing misunderstandings. Given Company X's status as a small company, the free version of the software is adequate for achieving clarity and organization. The board template can be seen in Appendix E.

8.2.2 Preparation and evaluation meetings

It is important to promote two-way communication, since it can build trust among employees, aligns company goals, and customer satisfaction (Mero, 2018). Company X sporadically holds work meetings on Thursday which is lacking structure. With two-way communication, information is sent back and forth where feedback is invited and offered. This will increase the likelihood for continuous improvement. Therefore, implementing regular preparation and evaluation meetings is recommended. Multiple benefits can be derived from these meetings.

During a preparation meeting, the objective can be established. This objective is determined through two-way communication, and everyone will be aware of their expectations following the preparation meeting. Preparation meetings also aid various aspects such as resource allocation and planning, continuous improvement, and understanding customer requirements. The recommendation would be to schedule preparation meetings with the office staff and some mechanics before a 'large' order which requires much customization. To give structure to these preparatory meetings, the following bullet points should be discussed:

- Tasks and allocation.
- Project details and deadlines.
- Customer details.

Mechanics need to know which tasks they must do at what time and what deadlines those tasks have. Furthermore, project details such as the scope, materials and resources, and quality standards need to be discussed. By discussing these project details, the company can proactively address potential challenges and ensure the successful execution of the project. Moreover, for internal

communication purposes it is recommended that customer details are discussed during the preparation meetings.

After an order is completed and ready to be assembled at the external location, it is time to internally evaluate the project. The exact timing may vary per product because of the project's scope and duration, but ideally the meeting should be planned immediately following project completion. In case of long-term or multifaceted projects, intermediate evaluation meetings should be held at critical moments to assess progress and make corrections during course of action. But regardless of timing, the overarching goal is to conduct evaluations on time to extract meaningful insights and facilitate improvements.

The importance of evaluation meetings can be explained with several key objectives:

1. **Performance assessment**: Goals and objectives have been defined in preparatory meetings. Evaluate the goals and objectives to measure success and identify areas of improvement.
2. **Sharing experiences**: Both positive and negative experiences should be discussed to inform on future decision-making and improve project execution.
3. **Continuous improvement**: Identify bottlenecks and best practices to drive ongoing improvements in project management and workflows.
4. **Celebration of success**: In these meetings, it is also important to celebrate project successes and contributions to boost morale and motivation of the team.

The evaluation meetings also need structure. Implementing effective evaluation meetings requires careful planning, facilitation, and follow-up. Therefore, a structured agenda setting should be made before the meeting that covers all the discussion topics such as project objectives, scope, schedule, budget, risks, lessons learned, and action items.

In case of Company X, where the average number of requests per day stands at five (see Appendix A), with many of these translating into projects, scheduling a meeting after each project is not deemed feasible. Therefore, it is recommended to conduct such meeting once a week, encompassing all completed projects. Should Company X find the need for more or fewer meetings later, they may exercise flexibility accordingly. However, it is imperative for the project manager to maintain consistency in scheduling such meetings. Valuable insights are shared during these meetings, facilitating continuous improvement not only within the office but also beyond.

8.2.3 Standard operating procedure

The root cause of the issue at Company X stemmed from the sudden departure of employees who introduced structure into the process. Subsequently, the maintenance of process structure gradually diminished. It is crucial for all tasks to be carried out in nearly identical ways to minimize confusion throughout the process. An SOP contributes to clarity within the process and, simultaneously, increases the likelihood of accuracy and effective communication. It also aims to ensure that work is performed consistently and efficiently, regardless of who is performing the task. Standardization will facilitate a smoother onboarding process for new employees at Company X and ensure reliability, efficiency, and consistent adherence to quality standards. However, it is important to evaluate and modify the SOPs based on any changes that may occur within the process. In this case, SOPs need to be developed for the quotation process, follow-up process (Section 8.1.2), purchasing process, and the process of using the Kanban board.

After talks with the employees and problem owner, a standard operating procedure is wanted for the entire process from quotation creation until end of production. The company didn't want to have multiple SOPs for all different processes, however Company X aimed to have an overview of the

entire process. They were concerned that otherwise, it would be reported on in too much detail and specificity. The flow chart of the SOP can be seen in Figure 7.

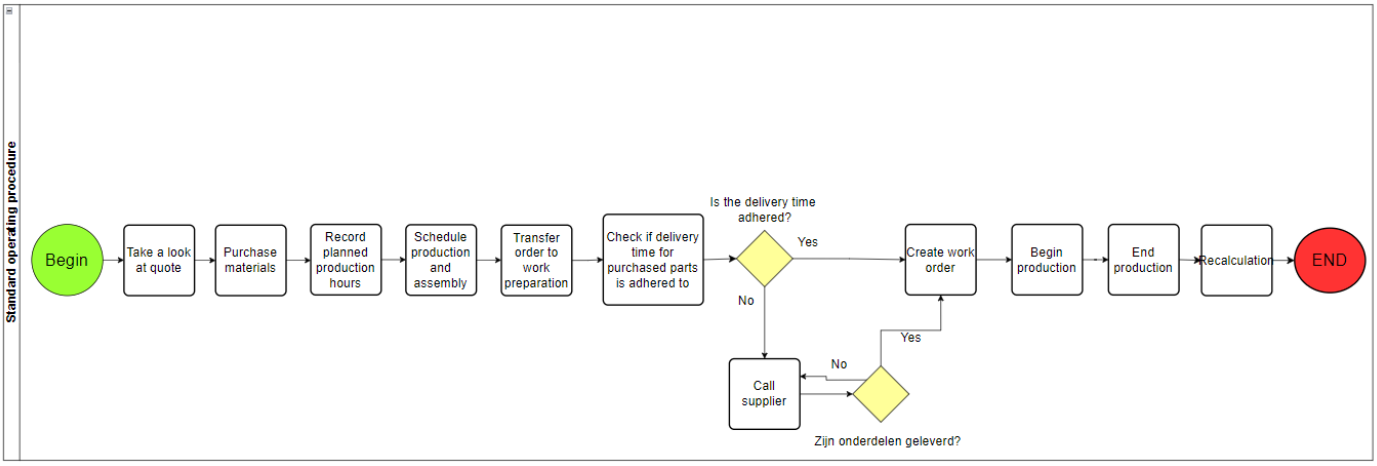


Figure 7 Standard operating procedure of process from quotation creation to end production.

The SOP have been reviewed with office personnel, and its clarity has been assessed. This facilitated any necessary adjustments to the SOP in a comprehensible manner for office personnel. Just like the follow-up procedure, the SOP can be seen in the Appendix.

8.2.4 Lean communication framework

Now that the solutions for better internal communication are known, a structured approach to implement lean communication is created. This will contain a stepwise guide that enables the company to operate more efficiently, collaborate effectively, and continuously improve the communication practices. The goal of the lean communication structure is also to reduce waste, make flows simpler (Redeker et al., 2019), and give insights into how to implement lean communication. A simple framework of the steps is given in Figure 8.

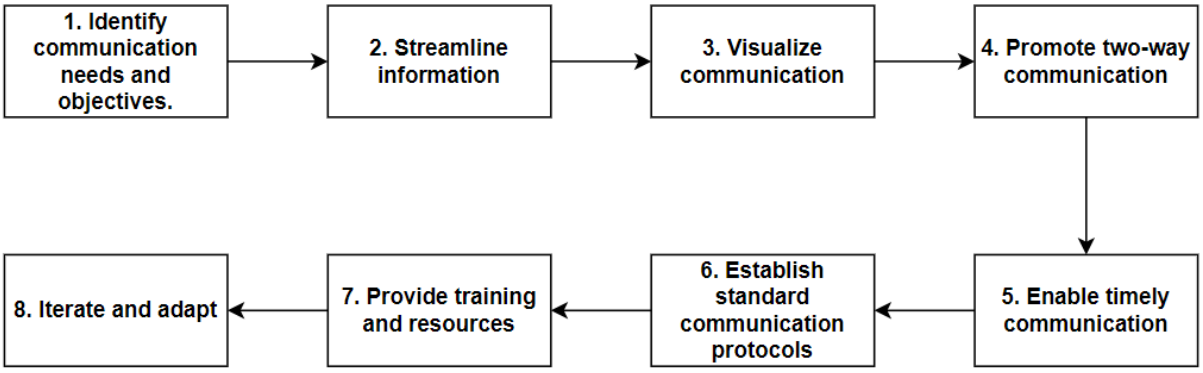


Figure 8 Stepwise guide for implementing Lean communication.

Step 1: Identify communication needs and objectives.

The success of implementing lean communication begins with identifying the needs and objectives. Clearly defining the purpose of communication helps to understand the information that needs to be conveyed. It starts with assessing the current communication practices within the organization. Identify areas where communication breakdowns occur and determine specific needs and objectives for improvement. In this instance, communication breakdowns could occur during the entirety of the process. Introducing a communication structure can help reduce any disruptions and promote a smoother flow of information. So, what the company needs is a communication structure which adds

value to the process. Furthermore, there is no insight into the current workflow, which is also a need of the company.

Step 2: Streamline information.

The second step is to eliminate unnecessary details and focus on essential information. This can be achieved by developing guidelines or templates for communication to ensure that messages are clear, concise, and relevant. In this case, it is of paramount importance to effectively disseminate the available information to the relevant individuals. Occasionally, a lack of internal communication was observed within the office, which presents opportunities to enhance the flow of information. The emphasis is primarily on effectively converting essential information. Successfully accomplishing this task can potentially help avoid confusion.

Step 3: Visualize communication.

As described in step 1, there are no insights of the current workflow which can lead to unnecessary questions being asked and mistakes. After the current workflow and information is streamlined in step 2, communication needs to be visualized. The Kanban board, which is explained in Section 8.2.1, is the perfect solution to visualize the current workflows of the company. A simple template ensures that employees can easily get started with the Kanban board.

Step 4: Promote two-way-communication.

In step 4, it is necessary to foster active two-way communication. Encourage open dialogue during project preparation and evaluation meetings, and one-on-one discussions. Implement the regularity of these meetings and organize a feedback mechanism to ensure that communication is truly two-way. During the meetings, also utilize the Kanban board. Reflect on what went well and what could be improved going forward. Subsequently, discuss these points during the preparation meetings for projects. This is important for continuous improvement and better decision making following enhanced collaboration.

Step 5: Enable timely communication.

Set expectations for response times to emails, messages, or requests for information. Encourage employees to prioritize urgent communication and provide guidelines for what constitutes an urgent matter. Monitor response times and address any issues in a timely manner. This will reduce any confusion within the office.

Step 6: Establish standard communication protocols.

This step starts with outlining how information is shared, responsibilities, and expected frequency of updates. This can be achieved by defining SOPs for communication, but also for processes such as purchasing, customer communication, and work preparation. A standard operating procedure has already been made for the follow-up process of a quotation (see Section 8.1.2). The protocols need to be distributed to all employees together with providing them with training where needed.

Step 7: Provide training and resources.

Implementing lean practices is proven to come across difficulties which cause are especially human-related (Subramanian et al., 2023). Providing training sessions or workshops on effective communication skills for employees of the organization will decrease the failure rate of implementation of lean practices.

Step 8: Iterate and adapt.

The preceding steps only function effectively when continuously monitored. Adhering to these steps once may result in short-term improvement; however, in the long run, their efficacy may diminish, posing a significant risk of reverting to old habits. Regularly review and evaluate communication processes by gathering feedback and adapting to evolving needs will improve the process efficiency continually.

This procedural framework serves as a general guideline for SMEs to implement lean communication practices within the office environment and is based on the 5S lean method. The 5S method is considered as a basic lean concept and creates and maintains well organized, clean, high effective, and high quality in the workspace (Filip & Marascu-Klein, 2015). The steps of the 5S tool are:

- **Sort** – going through all items in the workspace and removing unnecessary items. It's about distinguishing between essential and non-essential items. Setting goals and objectives and discarding unneeded items.
- **Set in order** – Once unnecessary items are removed and goals have been sorted, the next step is to organize the remaining items in an efficient manner. This involves streamlining and arranging tools, equipment, and materials so that it is easy to use and find.
- **Shine** – The focus is on cleanliness. The workspace is thoroughly analyzed and cleaned on a regular basis. The goal is to create a working environment that promotes efficiency and safety.
- **Standardize** – Standardization involves creating standardized processes and procedures for maintaining the first three steps.
- **Sustain** – The final step is to sustain the improvements achieved by using this method. Fostering a culture of continuous improvement is essential in this step.

In the lean communication framework step 1 represents Sort, step 2 and 3 represents Set in order, step 3, 4, and 5 represents Shine, step 6 represents Standardize, and step 7 and 8 represents Sustain. The solutions derived from the lean communication framework are consequently pertinent to Company X as well. Previous subsections have elaborated upon these solutions.

8.3 JIT PURCHASING

In the future state map, the JIT method is stated as an improvement star at the purchasing process step. JIT means "Just in Time" and is an inventory control method which is used by businesses to minimize inventory and expedite purchases. In essence, it entails the procurement of materials only when they are needed. At Company X, this is already practiced to some extent. The implementation of JIT principles serves to reduce inventory and eliminate this waste. This can offer substantial benefits to Company X and could indirectly enhance customer satisfaction by reducing lead times.

However, the successful implementation of JIT is not without its challenges, as both difficulties and successes depend on management factors (Ezzahra et al., 2018). Therefore, careful organization is essential within the office setting. Key areas such as inventory management, production planning, supplier collaboration, and quality control require increased attention and monitoring within the office environment.

Given that the successful implementation of JIT relies on near-perfect coordination within the office, it is recommended to initially implement solutions such as the lean communication framework in conjunction with the Kanban board. Additionally, the implementation of a robust inventory system for tracking inventory (Section 8.4.1) is advised to precede the implementation of JIT. Once these two

solutions are in place, JIT implementation can be pursued, significantly increasing the likelihood of successful outcomes.

8.4 OTHER POSSIBLE SOLUTIONS

After observations, it became clear that other case specific solutions could be implemented to enhance the structure of the office environment. This subsection delves into two other possible solutions for Company X to implement.

8.4.1 ERP system

Order Direct is an ERP system for SMEs. Company X currently makes use of the standard variant of the system but doesn't use all the different functionalities. For the company, the standard variant should suffice to introduce certain structure and digitalization into the company. Currently, not all basic functionalities of Order Direct are being utilized. An example of a basic function includes the creation of quotations. If creating a quotation in Order Direct, as explained in Section 8.1.1 is feasible for Company X, it could contribute to consolidation as it would no longer be necessary to store the data elsewhere. Additionally, Order Direct offers various modules that can be added to the standard package. Modules that may be of interest to Company X include scheduling and inventory management.

An accurate inventory management practice provides clarity on available items and their quantities, optimizes production planning, minimizes unnecessary reordering, and contributes to controlling inventory costs. Filling in inventory management in the ERP system can be a solution to all these problems. However, it is important to address any associated problems during the implementation phase of the solution. These problems may include difficulty in counting the inventory, discrepancies between administrative and actual inventory, and unnecessary reordering due to incorrect inventory information. Therefore, it is important to address these possible issues before implementing the solution. To start, current inventories are counted and stored in Order Direct. To solve all the possible problems, it is advisable to count inventory monthly based on product groups such as stainless steel, galvanized steel, or black steel. This ensures that the inventory remains up to date.

As previously discussed in Section 8.1.2, the follow-up process works better in conjunction with quotations that can be stored by date in Order Direct. However, the issue arises with Company X's complex quotations containing extensive text, tables, and images. It is not possible to implement images into the quotation in Order Direct, nor is it possible to add different types of tables. Only text and a table with various prices can be added to the standard quotation template in Order Direct. Nevertheless, centrally storing quotations can contribute to the structure of the process. Therefore, it is recommended for further research to explore the possibility of changing the standard template to the template currently used by Company X in a Word document. This template should include various types of images and tables.

8.4.2 Documentation

Smooth operations are one of the benefits of efficient document management. In this case, there is room for improvement in document management to enhance efficiency. Company X's hardware consists of a folder with a vast number of folders and loose documents. The loose documents are sometimes duplicated and added to one of the folders as well. Problems with the folders exist such as the folder consists only of documents which are more than 10 years old; some folders have different names but are almost the same in what their content is; and empty folders. This situation presents opportunities for optimization to reduce the likelihood of errors and promote clarity. Implementing lean BPR principles could lead to the elimination of loose documents and folders, and

better organization by rearranging the folders in a hierarchy. The company needs to undertake the following actions to tackle the problem:

- Conduct a thorough analysis of existing document management practices, including folder structure and naming conventions.
- Redesign the hardware data repository with a logical hierarchy folder structure based on product categories, specifications, and document types.
- Establish periodic reviews and controls to ensure manageability with the reengineered document management structure and identify further opportunities for optimization.

These actions will ensure that chaotic and inefficient documentation will not exist. During the time span of this research, the first two steps has already happened. With the thorough analysis of the documents and redesigning in a logical hierarchy, the number of folders and loose documents can be reduced considerably. The same steps could be taken for the remaining folders in the general folder. The contents of those folders are less chaotic but could also be rearranged to increase the efficiency of the documentation.

9. CONCLUSIONS

This chapter outlines conclusive findings and reflection drawn from the analysis conducted throughout this report. This section emphasizes key insights and provides a summary of the main outcomes. By revisiting the research questions posted at the beginning of the report, this chapter offers a comprehensive overview of the contributions to the theory, recommendations, a discussion, and possibilities for further research.

9.1 CONCLUSION

The SUPER lean methodology is an innovative way to help SMEs improve their performances on internal communication and structure. It has the potential to continually help businesses in a competitive environment. In this study, it has been found that this methodology provides a robust framework to assist small businesses in enhancing the efficiency of their internal processes. The methodology has yielded general solutions applicable to any SME, with a deeper investigation into the case of Company X. Through frequent discussions with employees, both in group settings and individually, the solutions developed have been validated. The conclusion encompasses addressing the main research question through the subsidiary questions.

This research was structured around one main research question and five subsidiary questions. The objective of this study was to answer the main research question through the subsidiary questions. The main research question is formulated as follows:

> "What are the most optimal ways to enhance the process from customer order request to work order for the purpose of standardizing and structuring the way of working?"

This question has been addressed utilizing qualitative data obtained from interviews and observations. Firstly, a problem statement was formulated based on the information gathered from the interviews and observations. The research identified two overarching issues: the lack of internal communication and structure, leading to various problems within the organization. The aim of the research is to address and analyse these issues to arrive at optimal solutions that enhance process efficiency.

Various theories could be applied to address organizational problems. In this research, an integration of methods was chosen after literature review and considering the company's needs. This integration is referred to as the SUPER lean methodology. Using this methodology and the problem statement, solutions were developed throughout the process from customer order request to work order.

Effective communication can be promoted by implementing more structured meetings for project preparation and evaluation. Furthermore, fully utilizing an ERP system and gaining detailed insight into planning, based on shared information rather than individual memory, offer opportunities to foster clarity and reduce errors.

Company X also could strengthen its internal structure. Implementing streamlined processes can lead to more organized workflows. With clear plans and guidelines, employees could collaborate more effectively, benefiting overall process efficiency and productivity.

The current issues at Company X can be addressed. A lean communication framework has been devised to alleviate internal communication problems. Implementing the framework includes, among other measures, implementing a Kanban board and establishing standard operating procedures. Additionally, conducting preparatory and evaluation meetings is part of the framework. This framework fosters less chaos and a structured mode of communication in the office.

The structure of the quotation process and procurement process has been analysed, and solutions have been devised. Just-in-time purchasing can help the company introduce structure into the procurement process. Standardized quotations assist in structuring the quotation creation process. Additionally, a follow-up process has been devised to remind potential customers of the quotations sent. Further exploration was conducted on how the ERP package could be better utilized. Planning and inventory management are not currently monitored, while they could be within the ERP package. Centralizing all information provides greater insight and structure to the process, aiding in the elimination of waste such as unnecessary errors and inquiries.

9.2 RECOMMENDATIONS

The solutions presented have not all been implemented within the timeframe of this research. While the Kanban board and the restructuring of the quotation process have been successfully implemented, the remaining solutions have been discussed with the team but not yet put into practice. Therefore, the primary recommendation is to prioritize the implementation of the solutions outlined in this report that have not yet been implemented, aiming for short-term execution.

Furthermore, the lean communication framework discussed in Section 8.2.4 should be considered separately from the other solutions. It is imperative to recognize that all other solutions can only be effectively implemented when communication runs smoothly and in a structured manner. Progress has been initiated through the establishment of a Kanban board and the creation of SOPs along with work instructions. Effective implementation of Lean management necessitates structured communication, thus emphasizing the lean communication framework as a distinct recommendation. It is imperative to ensure the complete implementation of the framework and to continuously monitor its effectiveness.

9.3 DISCUSSION

This study bases its solutions on data derived from interviews and observations. Although it is implied that employees provided honest answers, it is possible that personal biases may have influenced their responses. During the interviews, efforts were made to create an open and non-judgmental environment, encouraging participants to provide as honest and unbiased responses as possible. This approach ultimately enhances the validity and reliability of the interview data.

One challenge of implementing the SUPER Lean methodology is that all employees must support and collaboratively implement the solutions. If it happens that employees are hesitant to embrace lean management practices, this can disrupt the implementation process. Over time, efforts were made to explain the potential benefits and collaborate with employees to achieve desirable outcomes as effectively as possible. Although some success was achieved in this regard, there were still initiatives from the SUPER Lean methodology that faced resistance and could not be reversed within the ten-week period of this study. However, it is strongly recommended in the preceding subsection of recommendations to implement these solutions where possible and address other issues not covered in this research, given the scope, using the SUPER Lean methodology.

In this specific case, several potential solutions have been outlined that could contribute to the overall process efficiency of Company X. For example, it is suggested to implement a new approach to inventory management; however, during the investigation, it was decided not to do so because it is not applicable to Company X. Due to the low purchase prices of materials, it would cost more than it would yield to manage the inventory meticulously. Another example is the Just-in-Time (JIT) purchasing process. Since Company X already employs this method to some extent in procurement, it was chosen not to thoroughly investigate the mentioned benefits described in Section 8.3.

9.4 FURTHER RESEARCH

All employee responses in the interviews have been considered in the analysis of the problem, and there has also been discussion about what should be included in the research. The scope of the study was determined at an early stage through individual conversations with employees and group discussions. However, not all the problems have been addressed in the research due to concerns about the scope becoming too large. For further investigation, the problems identified at the beginning of the study but not included in the solutions would be recommended.

Another point to consider is the pull system mentioned in the future state map. Given the significant variation in products and the need for extensive customization, it may be challenging to plan the entire process as accurately as possible. Consequently, implementing pull systems in the process may also be challenging. While this report touches on pull systems to some extent, further research would benefit from a more thorough examination. If properly implemented, a pull system could significantly eliminate waste, leading to various other benefits such as improved efficiency, increased quality, and enhanced customer satisfaction.

During the final week of the study, an addition to the product configuration system was discussed. The system could potentially calculate cutting costs directly from the workplace, which could affect the cycle time of the "price calculation" process step in the current state map. An estimate of the time reduction has been made and included in the future state map. Correspondence has already been exchanged with a company specializing in this area. These communications have been forwarded to the problem owner and are recommended for further investigation.

After all the solutions presented in this research have been successfully implemented, it is important for Company X to further explore where the SUPER Lean methodology can provide additional value. With the understanding the company now has of the methodology, it can continue to improve process efficiency.

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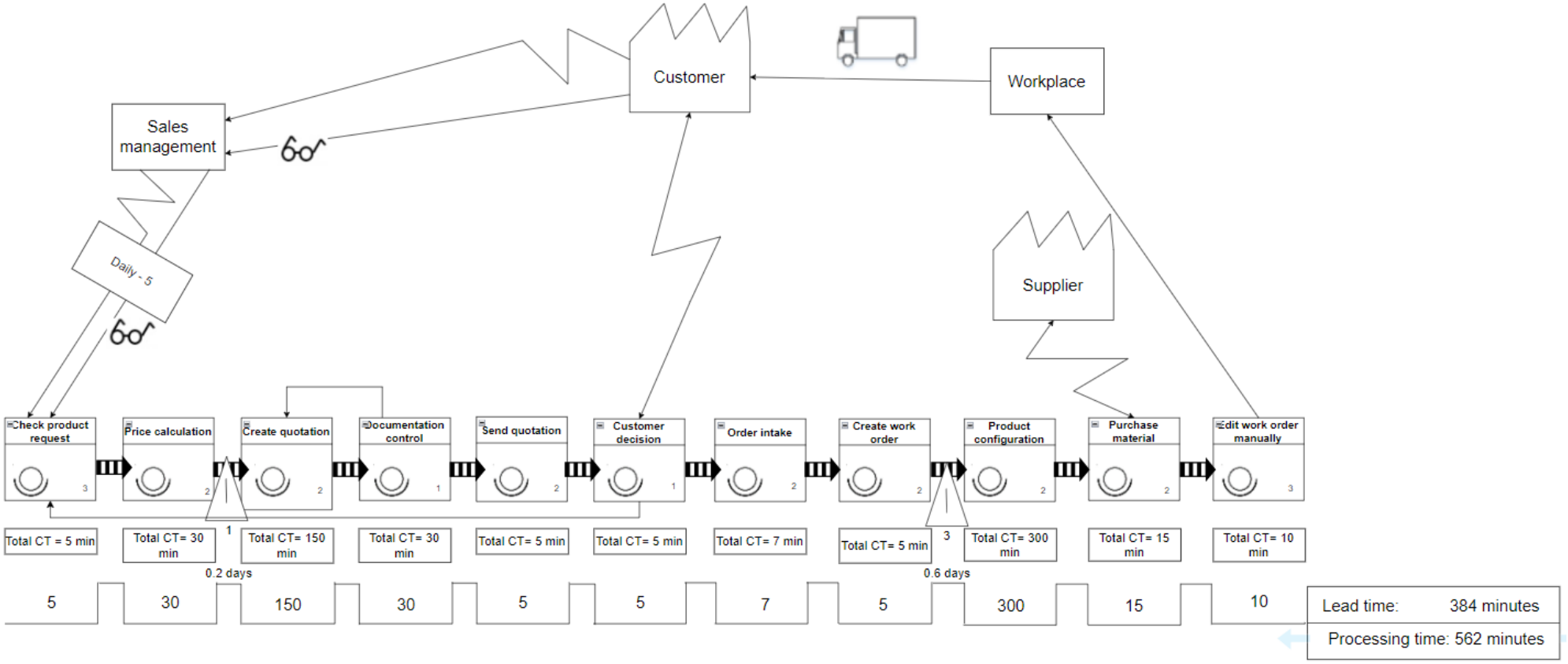
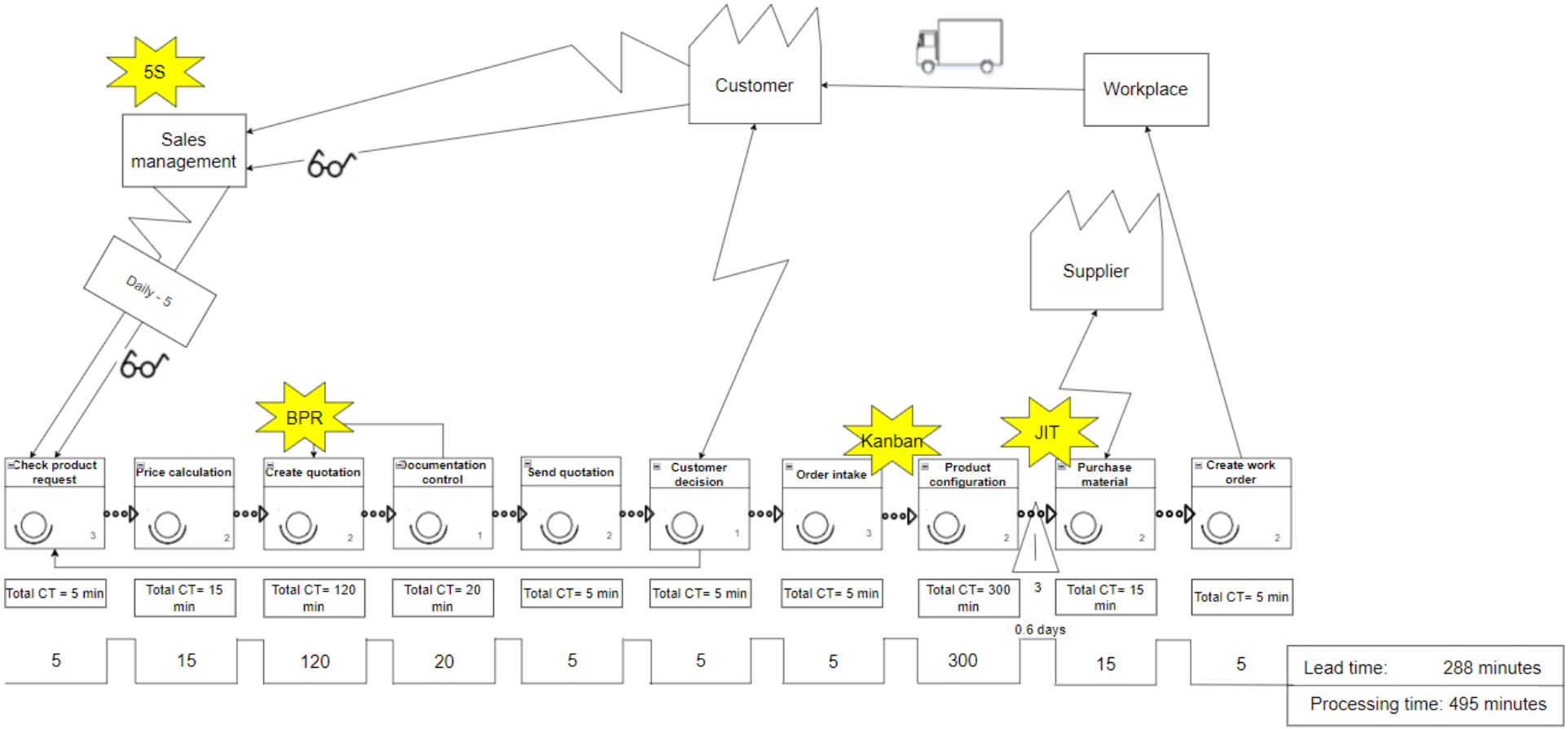
11. APPENDICES

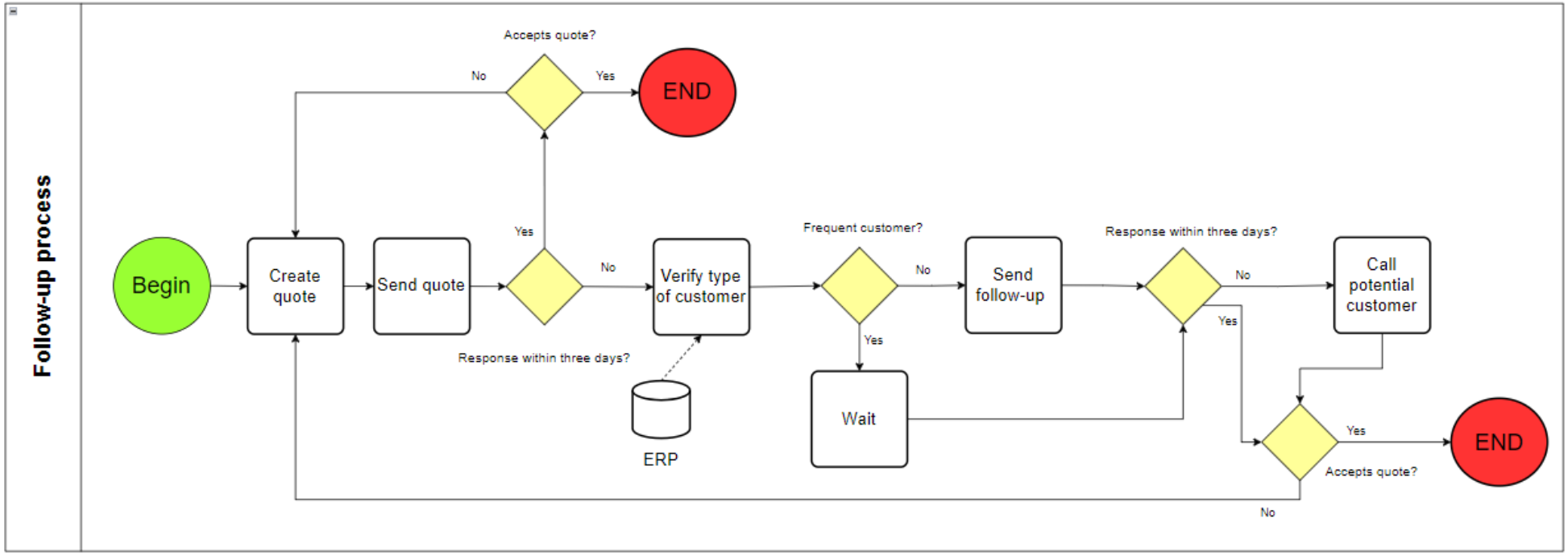
APPENDIX A | **CURRENT STATE VALUE STREAM MAP**



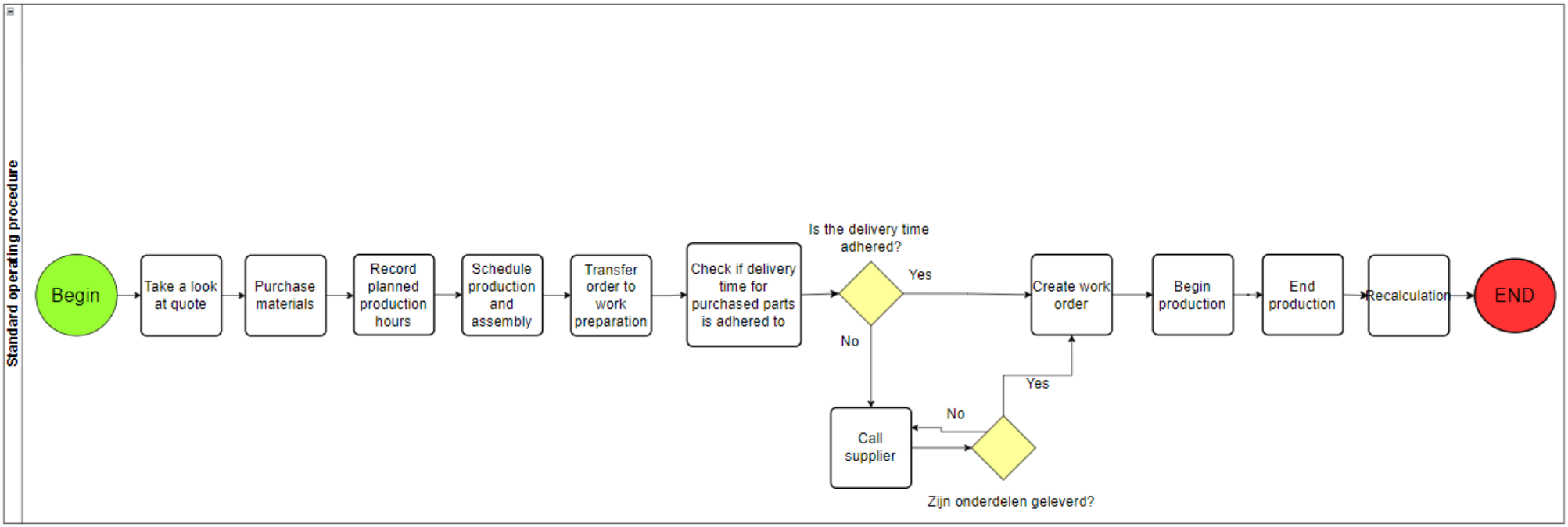
APPENDIX B | **FUTURE STATE VALUE STREAM MAP**



APPENDIX C | **DESIRED FOLLOW-UP PROCESS**



APPENDIX D | **STANDARD OPERATING PROCEDURE FROM QUOTATION CREATION UNTIL END PRODUCTION**



APPENDIX E | **VISUALISATION OF KANBAN BOARD**

This is a visualisation of the Kanban board. All the cards on this visualisation contain random data and is not a depiction of reality.