

Process redesign to improve delivery reliability

IEM Bachelor thesis

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Preface

Dear reader,

This thesis is written to conclude my Bachelor of Industrial Engineer and Management at the University of Twente. The research period of this thesis lasted from February 2024 until July 2024.

I would like to start by thanking the hosting company Reinaerdt Deuren for allowing me to perform this research. I have always felt welcome there, and I have gotten great assistance from many different employees over the research period. More specifically I would like to thank my company supervisor Maarten Voogt, and Elske Weerman for always being open to help and by giving me great insights into the company.

Furthermore, I would like to thank my academic supervisors Dr. Dennis Prak and Dr. Patricia Rogetzer for the time they have taken to read my thesis, and the insightful feedback that I have received from them to improve on my thesis. Dennis has also proved to be very thoughtful and the different perspectives and discussion that he has offered during the supervisor meetings have really helped me a lot.

Kind regards,

Dave Schouwenaars

(August 2024)

Management summary

Problem context

Reinaerdt Deuren is a company specialized in the production of high quality doors. The problem which Reinaerdt is looking to address, is to improve their delivery reliability. The selected core problem to address for this is the problem of the processes of Reinaerdt being outdated, since Reinaerdt changed to a new Enterprise Resource Planning (ERP) and configurator systems a few years ago. Because of the outdated processes, the employees do not properly know how the processes work, and have low process insights. The problem scope which was selected for this thesis is: the processes of the sales and planning & purchasing departments, with a focus on the sales of bigger projects.

Approach

The selected approach to solve this problem is to use the Business Process Management (BPM) cycle, consisting of the following five phases: I) initiation, II) analysis, III) redesign, IV) implementation, and V) monitoring. Even though the implementation and monitoring phases fall outside of the research period, considerations and suggestions for these phases are still discussed in this thesis.

The analysis phase starts with the creation of a global process map, and the selection of relevant processes to redesign, looking at the criteria: dysfunctionality, importance and feasibility. The relevant processes are then analysed, resulting in the identification of problems in three categories: delivery reliability, lead time, and communication. Even though the problem Reinaerdt wants to address is only the delivery reliability, all three of these problem categories are looked at, as problems in the other categories may also affect the delivery reliability. Next, in the redesign phase, literature is used to find solutions for these problems, and to identify the implementation barriers of: employee resistance, lack of focus on the future, governance, and budgeting. With the literature search done, the found solutions are compared against the criteria of costs, implementation time, and amount of ERP customisation required, in order to find the solutions which are relevant to implement for Reinaerdt. The selected relevant solutions are: 1) Participating in two-way communication between supplier and buyer, 2) Pre-ordering every type of material with a delivery time of more than six weeks, 3) Actively changing the parameters used for the delivery time quotation, 4) Better managing of the customer expectations, 5) Better informing other departments about the quotation, and 6) Setting up formal communication channels. With these solutions the new processes maps are then made. With the new processes ready to be implemented, a plan is made on how to deal with the identified implementation barriers, and what possible errors can be expected. Lastly, KPIs, and the way to collect them, are identified for the monitoring of the new processes. These KPIs are: Average process durations, number of rescheduled production orders, number of on-time deliveries, numbers of orders won, and delivery reliability.

Recommendations

Because of data limitations, the values of the identified KPIs cannot currently be measured. Therefore, recommendations are made for Reinaerdt to first make some relatively simple system adjustments in order to start collecting data, before the new processes got implemented. Other recommendations that are made include a priority list for ERP customisations that Reinaerdt should implement in the future, and other tasks that can be addressed in order to further improve on the processes of Reinaerdt.

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1. Introduction

This chapter introduces this thesis and the context around it. Section 1.1 starts with an introduction of the company around this thesis. Section 1.2 introduces the action goal of the company and the different problems which they are facing, followed by the selection of the core problem addressed in this thesis. In section 1.3 the used framework for the solving of this core problem, and the selected research questions are discussed, introducing the structure for the rest of the thesis.

1.1 Introduction to Reinaerdt

The company for which this thesis is written, and where the research is conducted is Reinaerdt Deuren. Reinaerdt is part of the VolkerWessels concern and is a company that specializes in the production of doors (and frames) since 1982. Reinaerdt builds the doors in their factory, based on the requirements of the customer. These requirements are often very specialized, e.g. soundproof qualities, or burn resistant up to x minutes. The types of orders they receive also vary a lot, from selling a few doors to a dealer, to supplying (and assembling) doors for bigger projects like the construction of a housing complex or a hospital (Reinaerdt, 2024).

Reinaerdt has two production locations, one in Haaksbergen, The Netherlands (NL) and one in Saterland, Germany (DE). Together these produce around 250,000 doors per year, and have around 220 employees (Reinaerdt, 2024). However, for this thesis only the production location in NL is looked at, as the used processes and procedures differ significantly between both locations.

1.2 Problem context

One of the problems that Reinaerdt wants to address in 2024 is their delivery reliability because currently too many orders get delivered late, leaving the customers dissatisfied. Within their systems Reinaerdt uses two delivery dates, the requested delivery date by the customers and the agreed upon delivery date by Reinaerdt. The requested delivery date by the customer is important to keep in mind for Reinaerdt as this keeps the customer happy, but this is often unrealistic and cannot reliably be reached. Because of this, the expected delivery date will not be looked at when considering delivery reliability. The agreed upon delivery date can however be used to determine the delivery reliability, as this is a more reliable date that gets confirmed a little later in the process after the order has been entered into the system. This is why when talking about delivery reliability in this thesis, the reaching of the agreed upon delivery time is meant. This leads to the following problem statement to be used: "Reinaerdt Deuren wants to decrease the number of orders that get delivered past the agreed upon delivery time".

Figure 1 depicts the problem cluster used in order to assess the problems around the action problem of having a low delivery reliability. In this problem cluster two core problems which affect the action problem can be found at the start of the causal chains: Software problems, and outdated processes. In the context of this thesis, the definition of processes that gets used is as defined by Conger (2011): a repeatable set of activities which accomplishes a specific function. Both of the found core problems are mainly caused by the introduction of the new Enterprise Resource Planning (ERP) system, and configurator system about one to two years ago. The software problems are the technical issues or limitations which have not yet been resolved. These are issues along the lines of software bugs, certain

functions not working reliably, or new options which have to be added to support different workarounds.

The outdated processes are a result of the change in processes being overlooked during the implementation of the new software. Because of this the currently used processes are not clear, and the steps used often differ per employee. Employees often take old process steps, and combine these with new steps that have to be done in order to use the new ERP system. This results in extra work because steps get done inefficiently, and outside of the new system.

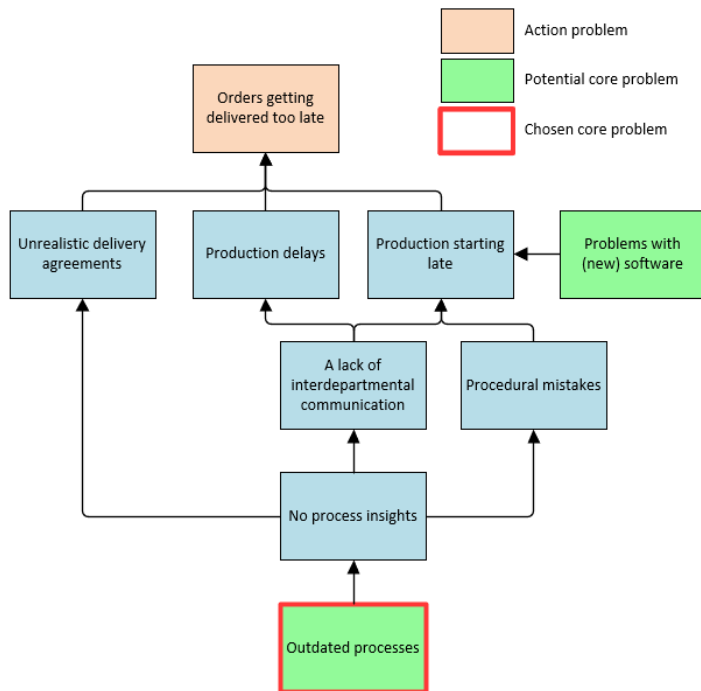


Figure 1: Problem cluster

The core problem which is chosen to be addressed in this thesis is the problem of “outdated processes”. Out of both core problems this problem has received minimal attention from Reinaerdt, while they are constantly working on trying to solve the software problems. Furthermore, the importance of solving this problem also becomes clearer the more software issues get resolved. In order to solve the selected problem, this thesis looks at the current processes and redesigns these to improve on the action problem. The aim for the new processes is to have a clear structure in order to remove the ambiguities and to improve on the process insights, which in turn reduces the number of procedural mistakes. Furthermore, clear interdepartmental communication lines are also defined, in order to improve further on the remaining processes.

Because most of the problems regarding delivery reliability center around the bigger sales projects and not the smaller sales to dealers, the processes for the sales of projects are the ones looked at in this thesis. However, because of the time constraints it is impossible to look at all the processes within the company, and an even more specific research scope has to be defined. Reinaerdt has already looked at the production processes multiple times, resulting in some improvements in this area. The pre-production processes of the sales and the planning & purchasing departments have however not

yet been looked at, and are therefore selected. This results in the final research scope of this thesis being the sales and planning & purchasing processes for the sales of projects within Reinaerdt.

1.3 Research design

This section introduces the framework on which this thesis is build, and which is used to address the core problem. Based on this framework, the different (sub) research questions that are answered during this thesis are identified, together with the structure of the subsequent chapters of this thesis.

1.3.1. Methodological framework

In order to solve the problem of outdated processes within Reinaerdt the framework of Business Process Management (BPM) is used. BPM is used to depict different process flows within a company, and can be used to focus on main company goals like increasing profit and decreasing costs, but it can also focus on other factors like increasing process efficiency, value chains, process consistency, and working conditions (Singh, 2012; Kasim et al., 2018). The BPM framework which is used in this thesis consists of the following phases:

Initiation

The BPM process is usually initiated with the need for a process redesign being voiced, which is best done through higher management (Kasim et al., 2018). Before a company decides to initiate BPM, the problems are often already well known. However, the scope of the problem and the processes to look at often still need to be defined before the next phase can start (Dumas et al., 2013).

Analysis

With the processes and problem scope defined, the current business processes are mapped and analysed in order to find improvement points. In this thesis qualitative analysis methods are looked at, resulting in multiple redesign options which should be looked at closely in order to make an informed choice. This is especially important because the analysis and the redesign phase that follows are closely interwoven (Dumas et al., 2013).

Redesign

With the process analyses done and the redesign options known, the next part entails the identifying, evaluating and choosing of the possible solutions. With the different possible solutions selected, recommendations and the new process maps are then made.

Implementation

With the new processes designed they can be implemented, but some considerations still have to be made. This part of the cycle will not be addressed in detail, as the actual implementation of the new processes happens outside of this thesis. However, there are some considerations to be made for this phase. Conger (2011) emphasizes the importance of error-proofing the new processes, which not only removes problem potentials that may arise, but also looks at how different problems could be identified, in case they do occur. Furthermore, Kasim et al. (2018) warn that some of the implementations may require changes in organisational structure or require significant financial resources which may not always be possible or available. In these cases, companies may choose to only implement the elements that do not meet these requirements, but not fully committing to the redesigning can mean losing out on a significant part of the desired effects.

Monitor

After the implementation of the redesign the processes should be monitored using measures or metrics in order to be able to correct mistakes, identify future redesign needs, and improve continuously. Singh (2012) also explains that the monitoring of the new processes may help to improve relationships with customers or suppliers by being able to better connect different processes.

1.3.2 Research questions:

The main question which this thesis aims to answer is: "How to redesign the current processes to improve delivery reliability?". In order to be able to answer this question, several research questions are set up which are answered in the rest of this thesis. These sub research questions each cover a chapter of this thesis, and are all based on the mentioned phases of the BPM cycle.

1. Where in the processes does the delivery reliability get affected?

This research question covers the analysis phase of the BPM cycle and is discussed in the second chapter of this thesis, the current situation. However, in order to answer this question, the question is further split into the further sub research questions of:

- a. What are the current process flows?

This question looks at all the current processes of the company, within the research scope, and leads to mapped out process flows.

- b. What are the problems within these processes?

With the different processes known and mapped out, they are analysed in order to find several problems in the processes, both those directly influencing the delivery reliability, but also other simple problems which could be solved with the redesign.

2. What options are available for the new processes?

This research question covers the identifying part of the redesign phase of the BPM cycle and is discussed in the third chapter of this thesis, the literature review. This question is further split into the two sub research questions:

- a. What are possible solutions to the found problems of the processes?

This question focuses on the identifying of several solutions which can be used to solve the problems within the processes.

- b. What are barriers to be addressed?

Besides just looking at possible solution, this question focuses on the identification of different barriers which are likely to be found when implementing the found solutions. Knowing these barriers can thus help with the selecting of solutions for the new recommended processes.

3. What are the new recommended processes?

This research question covers the solution evaluation and selecting part of the redesign phase of the BPM cycle, and includes some considerations that have to be made for the implementation phase. This question is discussed in the fourth chapter of this thesis, solution design, and is split into the following sub research questions:

- a. Which solutions are the most relevant for Reinaerdt?

This question looks at the found possible solutions and selects the solutions to be implemented, that best match the needs of Reinaerdt.

- b. What is the new recommended situation?

With the solutions to be implemented selected, the new recommended situation can be created, and new process maps are made to display this new situation.

- c. How to address the implementation barriers?

This question looks at the identified implementation barriers, and addresses how these should be dealt with when the new situation gets implemented.

4. How to measure the impact of the implemented solutions?

Lastly, the research question that covers the final phase of the BPM cycle, monitoring, which is discussed in the fifth chapter of this thesis, solution monitoring. To answer this question, several Key Performance Indicators (KPIs) that can be used to monitor and measure the performance and changes in the processes are identified.

1.4 Conclusion

In this chapter the company Reinaerdt and their action problem of too many late deliveries have been introduced. The selected core problem to address this issue is to redesign the current outdated processes, and the BPM framework and research questions required to do this has been identified. The setting of the scope to the sales and the purchasing & planning departments for the project sales concludes the first phase of the BPM, initiation. Chapter 2 of this thesis covers the second phase of the BPM, analysis. In this chapter the different processes of the selected scope are looked at in more detail, and the problems of these processes are analysed.

2. Current Situation

This chapter covers the analysis phase of the BPM cycle, and answers the research question of: “Where in the process does the delivery reliability get affected?”. Section 2.1 looks at the current process flow for the sales of projects on a global level, and shows the processes which fall within the selected research scope. Section 2.2 looks at all of the processes within the selected scope, and finds the most relevant ones which should be redesigned. Section 2.3 then further zooms in on these relevant processes, and looks at the different problems which are found in these processes.

2.1 Current process flows

With the initiation phase of the BPM cycle completed, the analysis phase can start. To start, the current processes within Reinaerdt are mapped in order to find several improvement points. According to Vizzon et al. (2020) the research into the mapping of processes should be done with the process stakeholders and Ünğan (2006) states that interviews are usually sufficient to gather information for non-complex processes. This is why interviews with the different employees involved in the processes are the chosen method in order to gather information about the current process flows. For the sales department, interviews were held with one project manager, two account managers and two office staff employees. For the planning & purchasing department, one employee who focuses on the planning, and two employees who focus on purchasing were interviewed. During these interviews the different steps and decision points that get taken within the processes are discussed and mapped. Besides just knowing the different steps, attention is also paid to fully understanding the reasoning behind the different processes. Knowing why things are done in a certain way is crucial to fully understanding a process (Ghicajanu, 2020).

During the interviews sometimes employees within the same function would contradict each other, or steps and decisions turned out to be unclear. In these cases, the most common and logical order of steps were discussed and chosen to be mapped. After the interviews, the process maps were finalised. Within the process maps the sales department is split into the roles of office staff and account manager, in order to clearly show the actions and responsibilities of the different roles. The role of project manager which also falls under the sales department is left out since their process steps fall outside of the research scope.

The first process map looks at the entire project sales process from a macro level, and uses only the main processes. Figure 2 depicts the legend for the map, which uses the Business Process Modeling Notation (BPMN), and Figure 3 depicts the found global process. In the global process map, all of the processes which fall outside of the research scope are grouped into the “other” swimlane, and are simplified in order to save space and to keep the map from being unnecessarily cluttered.

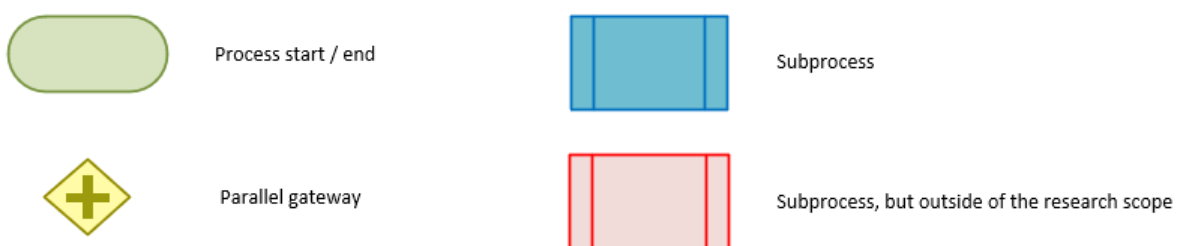


Figure 2: Global process map legend

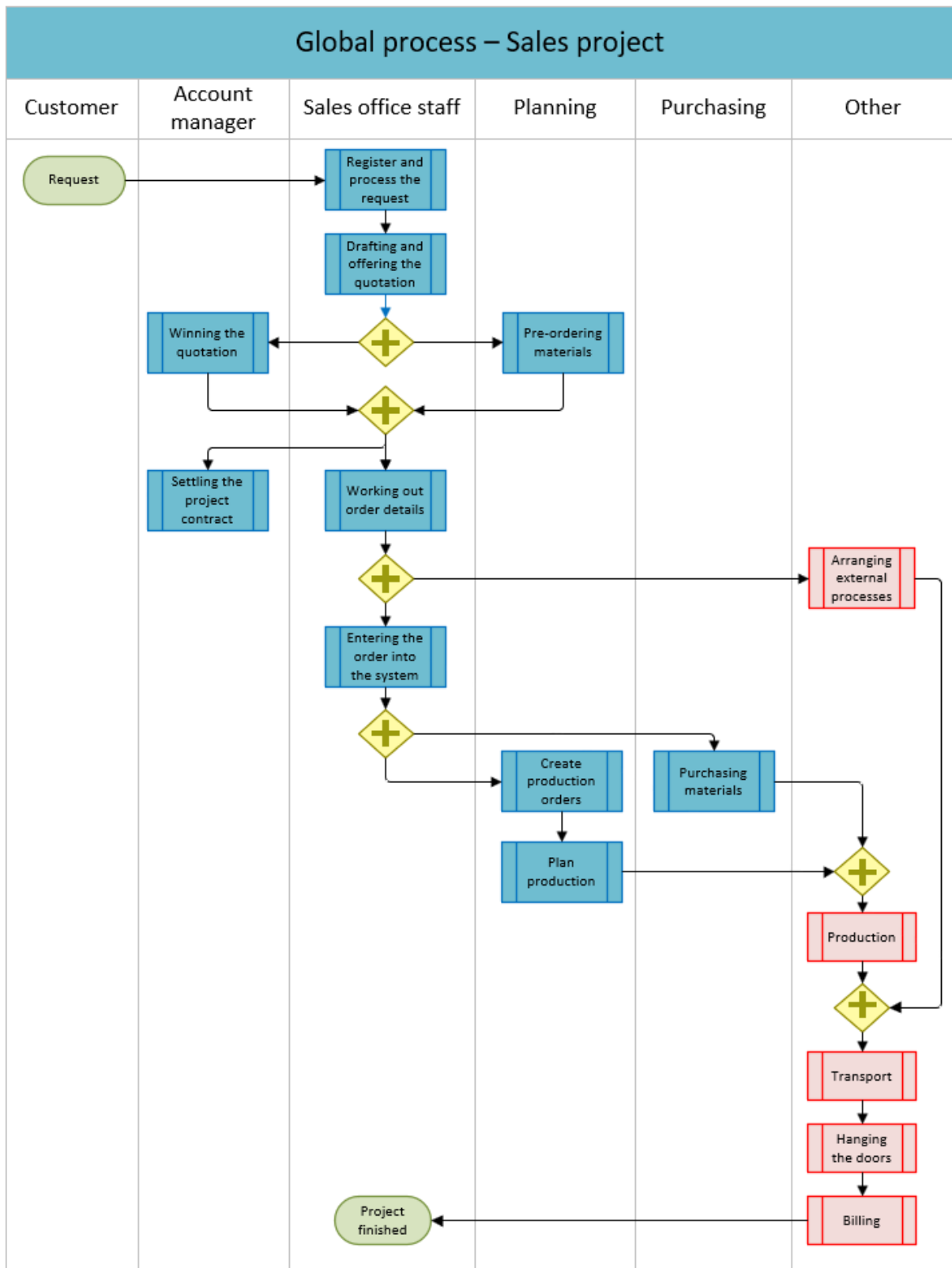


Figure 3: Global process mapped on a macro level

2.2 Relevant processes

Each of the processes in the global process map can potentially be zoomed into, however not all processes are equally relevant to do so. Even processes within the research scope may not all be relevant. Besides relevancy it is often also undesirable to redesign all of the processes within an organisation simultaneously, therefore Bhaskar (2018) mentions the following three criteria for selecting processes to be redesigned:

1. Dysfuntionality, which processes have the biggest problems?
2. Importance, which processes have the greatest impact on the customers?
3. Feasibility, which processes are the likeliest to be redesigned successfully?

Bhaskar (2018) explains that the most dysfunctional processes which need to be redesigned are often well known within the company. Symptoms for dysfunctionality include: Redundant information exchange, a lot of non-value added work, work that is being repeated, and complexity. The importance of the processes depends on the impact to these processes have on the customer and what they care about. The importance of the processes of Reinaerdt are gauged by looking at the process lead times and the process impact on the main problem of delivery reliability, as these are both criteria which have a significant impact on the customers. Lastly the feasibility, the feasibility of a process looks at the chance of a successful redesign. Different factors which increase the likelihood of a successful implementation should be looked at, which are: cost, employee commitment, and the process scope, as bigger projects usually have a bigger chance of redesign failure.

All processes which fall within the research scope have been looked at based on these three mentioned criteria. The following processes, in no particular order, have been selected as relevant for redesign within this thesis:

- Winning the quotation

This process is dysfunctional because it consists of a lot of repeated work, where the quotation often has to be adjusted many times before the quotation phase ends. The process matches with the importance criteria as it generally has a high lead time, impacting the waiting time for the customer. The high lead time of this process is caused by all of the repeated work with the quotation adjustments. Lastly, the process is also feasible to be redesigned as it is a process with a limited number of steps (when they do not get repeated), and is fairly straightforward.

- Pre-ordering materials

The dysfunctionality for this process comes from the fact that there is a redundant information exchange, where the office staff asks purchasing to check the delivery times of materials. This information could be made available through the ERP system, or through file sharing, and would save a significant amount of time. The importance of this process comes from the process having a high impact on the delivery time, since some materials have a high delivery time of over 50 days, and not pre-ordering often results in production delays. The redesign for this process is also feasible, as the process is small. Furthermore, the employees are also committed to the change, as this process being important to change has been mentioned by both the interviewed office staff employees.

- Working out order details

The dysfunctionality in this process stems from the repeated work that is done when gathering information, trying to finalise the order. There is also an important step where the account managers

have to settle additional contracts based on prices changes, which is often forgotten and causes complexity further along the process. The process has a high importance because it is, on average, the longest process within the research scope. The feasibility from the process is based on the employee commitment of the account manager, because they expressed an interest towards improving on the settling of additional contracts.

- Purchasing materials

The dysfunctionality of this process comes from the complexity and the number of steps in this process. The process also contains repeated work when the deliveries by suppliers are postponed. This process is important because the purchasing of the materials directly influences the delivery reliability. When this takes too long, or is not done correctly, the assigned delivery date cannot be reached. This process does not contain any factors which increase the feasibility of a successful redesign, but it does not have any factors decreasing the feasibility either.

- Creating production orders

The dysfunctionality of this process comes from the repeated work that has to be done. Inside the process itself there is not really a lot of repeated work, however, when an unrealistic delivery time gets assigned, the entire process has to be repeated. The importance of this process comes from the fact that this process is where the agreed upon delivery date gets assigned, which directly influences the delivery reliability. The feasibility of a successful redesign is based on the fact that the process itself is simple with a low number of steps, and contains no complexity.

Relevant processes	
Process	Selection criteria
Winning the quotation	<ul style="list-style-type: none"> • Dysfunctionality – Repeated work • Importance – Long process duration • Feasibility – Low number of process steps
Pre-ordering materials	<ul style="list-style-type: none"> • Dysfunctionality – Redundant information exchange • Importance – High impact on the delivery time • Feasibility – Small process • Feasibility – Employee commitment
Working out order details	<ul style="list-style-type: none"> • Dysfunctionality – Repeated work • Dysfunctionality – Unnecessary work (when steps are forgotten) • Importance - Long process duration • Feasibility – Employee commitment
Purchasing materials	<ul style="list-style-type: none"> • Dysfunctionality - Relatively complex process • Dysfunctionality – Repeated work • Importance – High impact on the delivery time
Creating production orders	<ul style="list-style-type: none"> • Dysfunctionality – Repeated work • Importance – Directly impacts the delivery reliability • Feasibility – Low number of process steps

Table 1: Relevant processes selection

Table 1 depicts the selection criteria which lead to the above-mentioned processes being selected for redesign. The processes that have not been selected all have exclusion criteria which clash with the selection criteria as described by Bhaskar (2018). These processes are:

- Registering and processing the request

This process is simple and only consists of basic steps required to register the request within the ERP system. This process only gets a bit more complex when there are new customers that have to be created within the ERP system, but this rarely happens.

- Drafting and offering the quotation

This is a straightforward process with minimal process steps, leaving not much to be redesigned. The process lead time is also already short and stable.

- Settling the project contract

This process gets performed in parallel with the other processes and thus has no real impact on the delivery reliability. Furthermore, the interviewed managers do not seem interested in changing this process a lot because they claim the process is good in the current state.

- Entering the order into the ERP system

This is also a simple process without any noticeable dysfunctionality. The steps performed in this process are mostly necessary steps in order to properly enter the order into the ERP system. If this process were to be redesigned, this would require a complete redesign of the ERP system, with high costs, and likely employee resistance.

- Planning production

This process also contains a lot of steps that are required to be performed in a particular order, leaving not much room for a redesign. The current particular order of steps makes sure that the ERP system properly functions, and there are no mistakes made in the later production processes. This process also has a low feasibility for redesign because this would also require a lot of ERP customisations.

Irrelevant processes	
Process	Exclusion criteria
Registering and processing the request	<ul style="list-style-type: none"> • This process only gets complex when customers have to be created within the ERP system, but this rarely happens
Drafting and offering the quotation	<ul style="list-style-type: none"> • Straightforward process with minimal steps to be redesigned. • Short (stable) lead time
Settling the project contract	<ul style="list-style-type: none"> • This gets done outside of the other processes and has no impact on the delivery reliability • Account managers do not seem interested in changing this process
Entering the order into the system	<ul style="list-style-type: none"> • Straightforward process without noticeable dysfunctionality • Most steps are required for the ERP to work properly and changing these steps would require significant ERP changes
Planning production	<ul style="list-style-type: none"> • Most steps are required for the ERP to work properly and changing these steps would require significant ERP changes

Table 2: Irrelevant processes selection

Table 2 depicts the processes which are deemed irrelevant, and their exclusion criteria. These processes will not be looked at further in this thesis, and will not be redesigned. Section 2.3 continues the analysis phase by taking a closer look at the selected relevant processes. These processes and their problems are further explained and analysed, resulting in the identification of multiple redesign options.

2.3 Problem analysis

There is not one single correct way to analyse processes, and many different examples can be found within the literature. Dumas et al. (2013) differentiate between qualitative and quantitative analysis. The qualitative analysis consists of value analysis, waste analysis, stakeholder analysis and root-cause analysis, and the quantitative analysis consists of flow analysis and queue analysis which tend to be used for the modelling of processes. Conger (2011) on the other hand does not specify between analysis types and mentions the following three types of process analyses that can be used: 1) Leaning analyses, which includes value analysis, waste analysis and cost of quality analysis. 2) Cleaning analyses, which includes statistical analysis, variance analysis and root-cause analysis, and 3) Greening analyses, which focuses on the outsourcing and co-production options in order to minimise the environmental impact.

Not all of the above-mentioned analyses are relevant to look at. The quantitative analysis, the statistical analysis and variance analysis will be excluded because for Reinaerdt not a lot of quantitative data is available, and therefore a more qualitative research approach is taken in this thesis. Furthermore, the greening analyses, value analysis, and the cost of quality analysis are excluded because these analyses are more relevant for production processes which this thesis does not look at. Lastly the stakeholder analysis is excluded because the redesigns are focused on the internal processes of Reinaerdt, with the most important stakeholder, the customer, and their needs already defined.

The analyses that are used to improve on the processes for Reinaerdt are the waste analysis and root-cause analysis. The waste analysis looks at the process, and look for any unnecessary steps that are redundant or non-value adding that can be removed. The root-cause analysis looks at the causes of specific problems within a process. This is important because the proper understanding of the causes might give insights into which changes are required to improve on the process.

Winning the quotation

The process map for this process can be found in Figure A2. In this process the company waits for the customer to decide on the offered quotation. If they are interested in the quotation, the account manager follow up with a meeting in which the quotation and the possibilities are discussed. If this meeting leads to any adjustments to the initial quotation being required then the office staff adjusts the quotation and offers it to the customer again, who will either accept, decline, or request even more adjustments.

Looking at this process from a waste analysis viewpoint, the first issue that stands out is that there is a lot of wasted time, when waiting for the customer to reply. Secondly, there is repeated work being done when the quotation gets adjusted (too) often, which further increases the wasted waiting time. The main problem for this process is therefore “too many quotation adjustments”. One possible cause for this could be that the account manager does not have enough information regarding the quotation, and cannot properly inform the customer. Another possibility could be that the account manager does not properly manage the expectations of the customer, in the meeting where they discuss the

quotation. This can in turn also be caused by not the account manager not having enough information about the quotation. Figure 4 depicts the relationships between these found issues and causes.

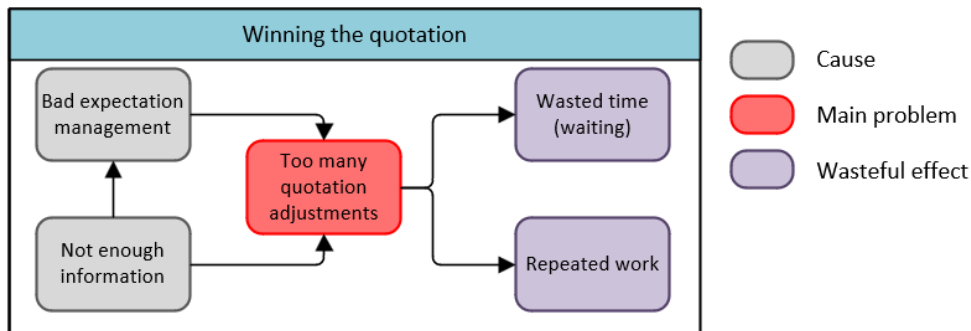


Figure 4: Cause & effect diagram for the problems found in the “Winning the quotation” process

Pre-ordering materials

The process map for this process can be found in Figure A3. The pre-ordering of materials happens in parallel to the winning of the quotation, often before the quotation is fully accepted by the customer. If the quotation contains doors that use order specific materials like High Pressure Laminate (HPL) or veneer, then the office staff requests the delivery times for these specific materials from purchasing. If these materials have a delivery time of more than eight weeks then they can be pre-ordered, but only if the customer signs a written agreement to agree to the usage of those materials. This is necessary because depending on the material, until the customer officially accepts the final quotation or signs the financial & technical agreement, the usage of those materials would otherwise not be confirmed and opens Reinaerdt up to risks of purchasing materials that are otherwise not used.

The step to be improved on for this process, looking at the waste analysis, is the fact that the office staff always has to ask purchasing for the delivery times of materials, resulting in wasted time. The cause of this problem of “delivery times have to be requested from purchasing” is that the information is not currently available within the ERP system, and neither is there a shared file which both purchasing and the office staff can access. Another problem in this process, which has been identified in the interviews is that there are sometimes materials with a temporary problematic delivery, which should be pre-ordered, but these are not pre-ordered. The problem of “not all problematic materials are pre-ordered” is caused by the office staff not having a clear overview of the materials that have a problematic delivery period. Figure 5 depicts the relationships between these found issues and causes.

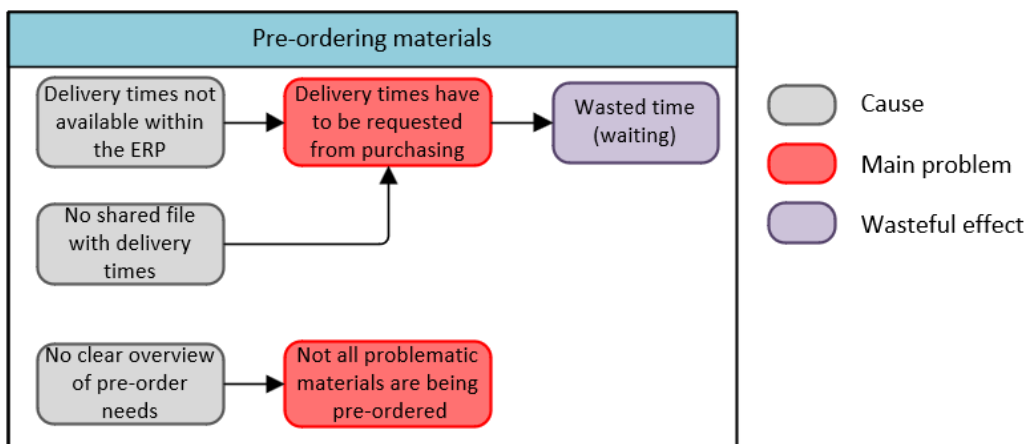


Figure 5: Cause & effect diagram for the problems found in the “Pre-ordering materials” process

Working out order details

The process map for this process can be found in Figure A4. During this process the office staff further works out the order after their quotation has been accepted. There are many details that have to be worked out during this phase, e.g. exact door measures, or where certain holes in doors have to be placed, but also some exact specifications like the doors being sound proof up to x decibels. While working out these details sometimes changes with regards to the agreed upon quotation arise, either by the customer or as suggestions from the office staff. When this happens, these changes have to be properly discussed and agreed upon before the process can be continued, since any changes made likely fall outside of the already made agreement. When the order is fully worked out and the customer agrees to it, a financial & technical agreement is signed. While the order is being worked out, the account managers settles the project contract with the customer, based on the values in the quotation. Because of this, any changes to the order during this process have to be taken up in additional contracts, and the changes have to be processed in the administration.

Looking at the wasteful steps of this process, the unnecessary step is the fact that the account manager and the project administration have to be informed about the need for an additional contract. This is considered wasteful because it would be easier to display the need for additional contracts within the ERP system. However, because the account managers do currently not use the ERP system, and the account managers and the company agree that this is not necessary for now, this is not further addressed in this thesis. A problem that is addressed is the problem of “additional contracts not always settled”. When the account managers do not settle the additional contract, issues may arise later on in process, e.g. during the billing period when the customer does not agree on the amount that has to be paid for the project. The likely cause for this problem is the fact that the account managers are not always informed by the office staff about the need for the additional contracts. Figure 6 depicts the relationships between these found issues and causes.

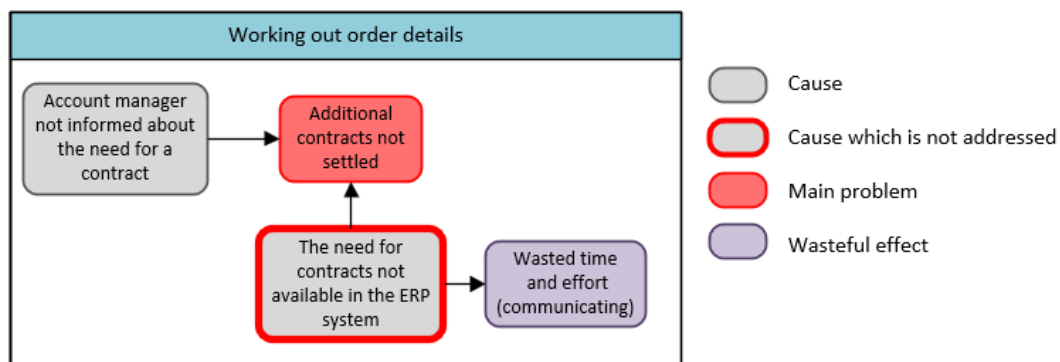


Figure 6: Cause & effect diagram for the problems found in the “Working out order details” process

Purchasing materials

The process map for this process can be found in Figure A5. In this process the order-specific materials for the door production (that have not been pre-ordered) get purchased. Once the orders get loaded into the system the material requirements for production are visible, and the employees can determine whether or not purchasing is required. They also check whether or not there are any unexpected delivery issues with the materials that have to be purchased. If there are unexpected delivery issues then the situation is be discussed with the office staff, who in turn discuss with the client. The client can then choose between possible alternative materials or the material that has delivery problems, and agreeing to move up the agreed delivery time. If the agreed delivery time gets

moved up this is not looked at as failing the delivery reliability within this thesis, since the customer opts in with this choice. However, whether or not the actual delivery falls within this newly agreed upon time is still relevant.

Looking at possible wastes within this process, the found issue is the fact that a lot of work gets repeated whenever the problem of “material shipments get postponed by the supplier” occurs. If this happens this can significantly delay the production, and cause late deliveries. A possible cause for this problem could be the fact that there are no clear contracts being used with the suppliers. Another problem of this process is “no internal feedback when material shipments get postponed”. When this happens, purchasing does not inform planning about the late deliveries. Planning only notices the delay later when the production gets scheduled and the materials are not available, however, this can take up to a few weeks, in which the customer is not notified of the possible later delivery. A possible cause for this could be that there is no clear communication system set up when this happens. Figure 7 depicts the relationships between these found issues and causes.

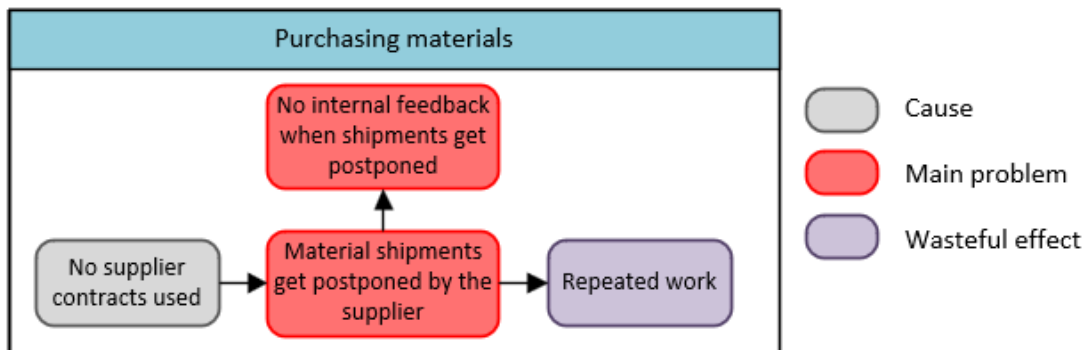


Figure 7: Cause & effect diagram for the problems found in the “Purchasing materials” process

Creating production orders

The process map for this process can be found in Figure A6. The creation of production orders is a relatively small and straightforward process. Once the order is entered into the ERP system by the office staff, a planning proposal is made in the system. If there are any issues for production, which would cause delivery problems for some doors, then these doors are added to a list which gets sent to the office staff weekly. After this check the production orders are made and the delivery time is assigned to the order by the configurator system. This is the officially agreed upon delivery time which Reinaerdt then communicates to the customer.

The wasteful step in this process is the step to share the deficiency list with the office staff on a weekly basis, as this causes wasted time and effort compared to always having this data available through a shared file or within the ERP system. However, since this is a newly introduced step by the company, they want to first test this out and not change this yet. Therefore, this problem will not be looked at in this thesis. The problem of this process which has been identified through the interviews, is the problem of it being “unclear how realistic the assigned delivery time is”. None of the employees know exactly which parameters the configurator system uses for the assigning of the delivery times, and how or when this is updated. Figure 8 depicts the relationships between these found issues and causes.

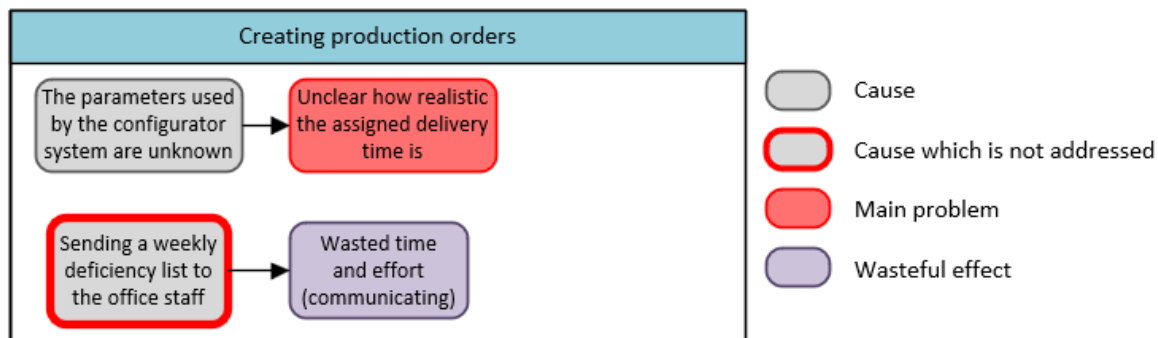


Figure 8: Cause & effect diagram for the problems found in the “Creating production orders” process

With all of the selected relevant processes looked at, the problems within the processes are known. The found problems can be split into three problem categories: delivery reliability, lead time and communication. Table 3 depicts all of the discussed problems, in their respective category. The problems in the delivery reliability category are the most important to solve as these directly influence the delivery reliability and therefore the action problem of this thesis. However, the other problem categories are also important to address. Reducing lead times may not only reduce costs, but can also increase the capacity available to spend on other processes (Dumas et al., 2013). Furthermore, the solving of communication problems and thus improving the internal coordination between different departments can cause an increase in planning and process efficiencies (Swink & Schoenherr, 2014).

Delivery reliability	Lead time	Communication
<ul style="list-style-type: none"> Material shipments get postponed by the supplier Not all problematic materials are being pre-ordered Unclear how realistic the assigned delivery time is 	<ul style="list-style-type: none"> Delivery times have to be requested from purchasing Too many quotation adjustments 	<ul style="list-style-type: none"> No internal feedback when material shipments get postponed Additional contract not always settled

Table 3: The different problems found in the relevant processes

2.4 Conclusion

The main research question which this chapter aimed to answer is: “Where in the processes does the delivery reliability get affected”. In order to answer this question, first the relevant processes to be looked have been selected. These processes are: 1) Winning the quotation, 2) Pre-ordering materials, 3) Working out order details, 4) Purchasing materials, and 5) Creating production orders. These processes have been looked at and analysed, resulting in 7 found main problems. These problems can be found in Table 3, split into the three categories of: delivery reliability, lead time, and communication. The problems affecting the delivery reliability are a direct answer to the main research question, however, the other problems can also indirectly influence the delivery reliability and are therefore also looked at in this thesis. Chapter 3 looks at the literature in order to find possible solutions to the found problems in this chapter.

3. Literature review

This chapter starts the redesign phase of the BPM cycle, which starts with the identification of possible solutions. The research question which gets answered in this chapter is: “What options are available for the new processes?”. Section 3.1 looks at the literature in order to find solutions that can be used to address the problems found in chapter 2. Section 3.2 identifies different barriers which can prevent the successful implementation of a newly designed process, and addresses how these barriers can be dealt with.

3.1 Possible solutions

The problems which are discussed in this section are grouped into the found problem categories of delivery reliability, lead time and communication as mentioned before. The found problems already have some possible causes identified in section 2.3. The literature is searched both for solutions to the possible causes of these problems, but also for other possible causes (and their solutions), which have not yet been identified.

Delivery reliability problems

Material shipments get postponed by the supplier

When suppliers postpone material shipments this does not always directly cause issues, especially when the materials have a generally short delivery time. However, for products which take several weeks to be delivered this is more problematic and can significantly impact the production start. One possible solution in order to negate supplier generated risks is through the use of contractual agreements with suppliers (Tenhiälä & Salvador, 2014). Sakhare et al. (2023) suggest the usage of a reward-penalty mechanism within contracts in order to encourage suppliers to improve on their delivery performance. Without this mechanism suppliers are, besides some reputation damage, relatively immune to the effects of late delivery. This mechanism could entail rewards like e.g. a certain minimal order sizes/amounts or a percentage of the profit, against penalties like e.g. a fee to be paid when delivery is late or not complete. Dai et al. (2016) warn however, that in realistic scenarios it may be a challenge to develop a suitable contract to balance and coordinate the different expectations and needs of both parties. In cases where contractual agreements are not realistic there are also alternative solutions. Prahinski and Benton (2004) mention that the use of clear two-way communication with the supplier can already grant benefits to both parties. Communications like this entails the buyer to clearly listen to the different suggestions the supplier may have to improve the supply chain performance, where the buyer also clearly states their objectives and evaluation procedures and results. This leads to an improved supplier perception regarding the commitment of the buyer, and may have a positive effect on the supplier performance.

Not all problematic materials are being pre-ordered

Pre-ordering materials with high delivery times might be required for companies to ensure the production starts on time, which makes it likelier for a company to delivery their products on time. Furthermore, lowering the pre-ordering requirements to products with a slightly lower delivery time, increases the chances of always being able to start production on time even more. However, pre-ordering comes with a downside. When materials get pre-ordered, and the order ends up being cancelled, the company is either stuck with the materials or has to eat higher storage costs. This can

be solved by having the customer agree to the usage of the materials, and holding them responsible for the pre-ordering costs if the order is cancelled, however this significantly impacts the customer freedom, and customer experience (Roy et al., 2020). The exact impact of this depends a lot on the types of goods, or the industry. Because of this, management should clearly follow the impact of the made pre-ordering choices from the customer perspective, in order to generate a good customer experience (Keiningham et al., 2015).

Unclear how realistic the assigned delivery time is

Companies often quote lead times for customers, for when the product or service can be expected. Slotnick (2013) explains how these lead time quotation should not be set in stone but that it depends on the situation, and when a company deals with factors like a high backlog, the given delivery quotation should also be higher. Furthermore, Slotnick (2013) mentions that the quoted delivery time depends on market characteristics of e.g. sensitivity to reputation for on-time deliveries or the duration of the quoted lead-time. This results in the actual given delivery quotation to be a balancing act between lower lead times to keep customers interested (depending on the current reputation), and longer lead times in order to preserve/increase the reputation.

Lead time problems

Delivery times have to be requested from purchasing

When information is not available within a shared system like an ERP system, but has to manually be requested from different departments, this can cause a lot of wasted time when employees have to wait for results. Some information, like delivery times, which are more volatile and susceptible to changes, can be more difficult to have stored in a shared system. A company can choose to still do this and spend time to systematically check and update this data when necessary. However, a better solution would be to use supplier communications, as mentioned by Prahinski and Benton (2004), as a solution for materials shipments being postponed by suppliers. This would mean that the suppliers actively inform the company when there are relevant changes within the supply chain, thus increasing the end-to-end visibility of the supply chain. This can significantly increase the supply chain performance, although this would require further research into which other types of information sharing, from both parties, is required in order to best benefit the entire chain (Kaipia & Hartiala, 2006).

Too many quotation adjustments

When a quotation has to be adjusted too many times, it is possible that the customer and client have a different view of the requirements and possibilities. This can be solved by better managing the customer expectations. Nicolae et al. (2013) describe that in order to have an influence on the expectations of a customer, that they should be clearly and truthfully informed about why certain choices were made and why certain parts are required. They also state that it may help to identify some basic expectations and ensuring that these are met, before suggesting any changes. However, any unrealistic expectations the customer may have should be cleared up as soon as possible so these do not get firmed up.

Besides customer expectation management, the improving of internal communication between departments and roles can also decrease the amount of work that is needed. Ryyänen et al. (2013) discuss the significant impact of internal communication on the early stages of sales projects. There should be clear internal communication guidelines making it clear what has to be communicated and with who, with an important note that the communication lines do not necessarily follow the hierarchical structure of the company. Ryyänen et al. (2013) also explain how focusing on the usage of efficient documentation and the openness of the communication has the benefit of a better customer experience as this often leads to better and more sophisticated solutions for the needs of the customer.

Communication problems

No internal feedback when material shipments get postponed

Material shipments being postponed is not an uncommon issue, but it does not always cause problems. However, when this occurs it is important to communicate this to other departments. Tenhiälä and Salvador (2014) explain that proper intraorganisational communication channels can help the relevant decision makers from different business functions to best deal with these types of organisational glitches. Furthermore, Tenhiälä and Salvador (2014) explain that the use of informal communication channels, which are often more spontaneous and consist of simple emails or calls, can be an easy solution to deal with this. However, the use of formal communication channels which use protocols for communicating specific information to the corresponding decision makers has an even greater impact on the organisational performance when glitches like late or postponed deliveries occur. Furthermore, a lack of intraorganisational communication may also lead to a lack of interorganisational communication towards the customer. Durugbo et al. (2014) state that a bad delivery-related information flow towards the customer can result in customer dissatisfaction and a loss of future business. Therefore, organisations should focus on the integration of information flows by focusing on understanding process durations and the corresponding communication oriented coordination.

Additional contracts not always settled

One possible solution for the forgetting of things that have to be taken care of is by setting up of (in)formal communication channels as mentioned by Tenhiälä and Salvador (2014) as a solution to the other communication problem. Another solution for this could be to address this organisational misfit by customising the ERP system (Hustad et al., 2016). This could add an option in the ERP system to show whenever something has to still be done.

A summary of the found solutions for the different problems which have been discussed in this section can be found below in Table 4. However, not all of these solutions are relevant for Reinaerdt to be implemented. In chapter 4 these solutions are evaluated based on different solution criteria of Reinaerdt, and the final solutions to be implemented are selected.

Problem	Solutions	(Main) source(s)
Material shipments get postponed by the supplier	Settling contractual agreements with suppliers	Tenhiälä and Salvador (2014)
	Participating in clear two way communication between supplier and buyer	Sakhare et al. (2023)
Not all problematic materials are being pre-ordered	Pre-ordering every type of material with a delivery time of more than eight weeks	Prahinski and Benton (2004)
	Decreasing the pre-order requirement to six weeks	Interviews
Unclear how realistic the assigned delivery time is	Actively changing the parameters made for the delivery time quotation	Interviews
Delivery times have to be requested from purchasing	Having all the estimated product delivery times available within the ERP system	Slotnick (2013)
Too many quotation adjustments	Better managing of the customer expectations	Prahinski and Benton (2004)
	Better informing the account manager about the quotation	Nicolea et al. (2013)
No internal feedback when material shipments get	Setting up formal communication channels	Ryynänen et al. (2013)
Additional contracts not always settled	Setting up formal communication channels	Tenhiälä and Salvador (2014)
	Showing the need for additional contracts within the ERP system	Hustad et al. (2016)

Table 4: Summary of solutions found to the different problems

3.2 Barriers for implementation

Before the solutions and new processes can be implemented, it is important to address the different barriers which arise during the implementation phase of the BPM. Looking at the literature the biggest barrier which has to be dealt with during the implementation of new processes is the resistance to change by employees. This resistance can have many different causes like fear of failure, a lack of information, or employees not feeling in control (Proctor & Doukakis, 2003). In order to reduce the fear of failure within employees, management should openly support the change from the top, which helps to create an understanding for the change (Vizzon et al., 2020). Besides just supporting the change, management should also clearly communicate the need and goal of the redesign (Singh, 2012). By involving people early and taking away the ambiguity of the changes, employees may be more motivated to accept the changes (Proctor & Doukakis, 2003). Convincing and involving employees can be a significant challenge, however it is especially important because employees that are not convinced or involved in the need for redesign, are more likely to resist the changes or even obstruct them (Bhaskar, 2018).

Another important barrier for a successful redesign is the lack of focus on the future, as often the attention goes to just the implementation of the made changes. Conger (2011) points out that the different processes which are redesigned should be looked at for possible errors that may occur before the implementation happens. These errors should then be looked at, and a plan should be made to deal with them. Besides looking at future process failures, management should also be focused on future changes to the process (Ghicajanu, 2020). One way to do this is explained by Kasim et al. (2018) as this can be addressed by involving employees into the improved processes, and allowing them to propose any changes to the process. This can be useful because managers often lack knowledge or information about the actual process itself, but employees often lack the authority or incentive to propose or address any changes.

The next barrier which should be addressed is the governance of processes. Conger (2011) emphasizes on the importance of identifying clear process owners for the processes. The process owners should be involved in any improvement actions within the process, for e.g. future improvement recommendations, but also in the plans to deal with possible errors after the implementation. Furthermore, Kohlbacher and Gruenwald (2011) explain how process owners are responsible for the performance of the processes and the improvement of any metrics, which is looked at in the monitoring phase of the BPM.

The last found barrier which has to be addressed is the budgeting. Kasim et al. (2018) point out that the implementation of BPM can require significant financial resources and should be budgeted for within an organisation. Of course, not every process redesign is equally expensive, and the final costs also depend on the redesign options which get chosen to be implemented. Some solutions can be relatively cheap, where as some more complex solutions which require e.g. ERP customisations may lead to increased costs. (Hustad et al., 2016).

Barrier	Solution	(Main) source
Employee resistance	Management support from the top	Vizzon et al. (2020)
	Management communicating the needs and goals of the change	Kasim et al. (2018)
	Involving people early and taking away ambiguity	Proctor and Doukakis 2003
Lack of focus on the future	Error proofing processes	Conger (2011)
	Involve employees into the further improvement	Kasim et al. (2018)
Governance	Identify process owners	Conger (2011)
Budgeting	Identify the (future) costs and pick the right solutions matching the budget	Hustad et al. (2016)

Table 5: Summary of the found barriers and solutions

3.3 Conclusion

The research question which is answered in this chapter is: “What options are available for the new processes?”. These found options are split into the different solutions found for different problems, which are summarized in Table 4, and the different solutions for implementation barriers, which are summarized in Table 5. Knowing these options finalises the identifying part of the redesign phase in the BPM cycle. Next the evaluating of the solutions in order to create new recommended processes can start, which is discussed in chapter 4.

4. Solution design

This chapter continues the redesign phase of the BPM cycle by answering the research question of: “What are the new recommended processes”. Section 4.1 looks at the solutions found in section 3.1, and evaluates these based on the criteria relevant for Reinaerdt. With the relevant solutions selected, section 4.2 answers the research question by creating the new recommended process maps for the relevant processes. Section 4.3 looks at the implementation barriers found in section 3.2 and discusses the plan for Reinaerdt to address these barriers.

4.1 Relevant solutions

In order to select the most relevant solutions for Reinaerdt, the solutions found in section 3.1 are compared against criteria which are the most important for Reinaerdt. Currently the most important criteria for Reinaerdt are, in order of importance: 1) Costs, as there is currently not a lot of budget available for the implementation of solutions. This covers both the implementation costs and the costs of using the solution, 2) Implementation time, as the delivery reliability is a problem they want to address as soon as possible, and 3) ERP customisation needs, as there is currently already a lot of work being done on the ERP system, and having to rework and customise a lot of existing infrastructure can be difficult.

Every solution is rated on a five-point scale, with 1 being the lowest influence. Since the actual influence of these solutions depends on many different factors, this may be hard to estimate. The way this is done was by, where possible, looking at the literature where the solution was found to see if any indication was given if the solution is costly or takes a while to be implemented. However, for the most part the ratings have been determined in a group session. This group session contained the head of the sales department, one purchasing employee, one planning employee, one IT (/ERP) engineer, and myself.

The given ratings have been combined using the following formula: $(1 * \text{cost rating}) + (0.75 * \text{implementation time rating}) + (0.5 * \text{ERP customisation rating})$, which is based on the order of importance for these ratings. Three solutions have a combined rating of over 6, resulting in them being removed as potential solution. The scores per criteria for these solutions can be found in Table 6. The removed solutions are:

- Settling contractual agreements with suppliers
- Having all the estimated delivery times available within the ERP system
- Showing the need for additional contracts within the ERP system

Solutions	Criteria rating			Total rating
	Cost	Implementation time	ERP Customisation	
Settling contractual agreements with suppliers	3	4	1	6.5
Having all the estimated product delivery times available within the ERP system	3	3	3	6.75
Showing the need for additional contracts within the ERP system	3	4	5	8.5

Table 6: Criteria ratings for the solutions that have been excluded

Contractual agreements with suppliers

This solution has one of the longest implementation times. This is because it can take long in order to draft contracts and to find ways to convince the suppliers to agree to these contracts. If reward/penalty mechanisms are chosen as a way to convince the suppliers, then this may take even longer as research into the proper reward/penalties has to be done first. Besides the implementation time, this solution also has one of the highest costs and with the use of reward/penalty systems these costs may increase even more.

Have all the estimated product delivery times available within the system

This solution has been excluded because it scores significant on all the criteria ratings. Currently it is not possible for the ERP system to display the delivery times of products, therefore, this solution would require a decent amount of ERP customisation. Furthermore, it takes a lot of time and effort to update this data regularly, which also brings costs. In the future, once Reinaerdt has more experience with client communication and possibly even started with contractual agreements, Reinaerdt can reassess implementing this solution and make agreements with suppliers to share the relevant information like changes in delivery estimates. This would keep the costs down and makes this a more relevant solution to implement.

Show the need of additional contracts within the ERP system

This solution scores high on all of the criteria, but especially on the ERP customisation and implementation time. Besides the changes to the ERP itself, this also requires changes to who can and should use the ERP system, because the account managers who would need this information do currently not use this. Furthermore, if done and used well, the usage of clear formal communication channels would have nearly the same impact with less costs, implementation time and need for ERP customisation.

With these three solutions being excluded, the following list, in no particular order, of relevant solutions for Reinaerdt to implement remains:

- Participating in clear two-way communication between supplier and buyer
- Pre-ordering every type of material with a delivery time of more than eight weeks
- Decreasing the pre-order requirement to six weeks
- Actively changing the parameters made for the delivery time quotation
- Better managing of the customer expectations
- Better informing the account manager about the quotation
- Setting up formal communication channels

Table 7 depicts the individual and combined ratings for these solutions. Section 4.2 looks at how the current processes have to be redesigned in order to implement these solutions.

Solutions	Criteria rating			Total rating
	Cost	Implementation time	ERP Customisation	
Participating in clear two-way communication between supplier and buyer	1	2	1	3
Pre-ordering every type of material with a delivery time of more than eight weeks	2	3	2	5.25
Decreasing the pre-order requirement to six weeks	2	3	2	5.25
Actively changing the parameters made for the delivery time quotation	2	3	2	5.25
Better managing of the customer expectations by the account managers	1	2	1	3
Better informing the account manager about the quotation	1	1	1	2.25
Setting up formal communication channels	2	2	3	5

Table 7: Criteria ratings for the solutions that are implemented

4.2 New processes

For each of the solutions that has been selected, the required changes both within and outside of the processes are discussed. The new process maps which include these changes (displayed with a green border) can be found in Appendix B Figure B1 to B4. The process map of the “create production orders” process has not been updated, since none of the chosen solutions impacted this process flow directly.

Participating in clear two-way communication between supplier and buyer

For this solution Reinaerdt has to participate in meetings with their supplier in order to communicate their needs. Since this happens outside of the existing process flows, these meetings are not shown in the process maps. However, in order to have effective meetings it can be useful for Reinaerdt to start keeping track of the supplier performances, as these are currently not known in detail. Therefore, in the purchasing materials process, a step is added where the supplier performance gets documented. To start this can be done in e.g. a simple Excel file, where per supplier can be kept track of the number of postponed deliveries, the delivery reliability, the quality of the shipment, etc. However, in the future this would preferable be done automatically through the ERP system whenever an order is rescheduled, or marked as received.

Pre-ordering every type of material with a delivery time of more than eight weeks

Currently the only materials that get pre-ordered, are HPL and veneer, since they are the likeliest to have delivery times of over eight weeks. For this solution, all the materials are checked for high delivery times. In the process map this changes the step to check whether HPL or veneer gets used, to checking whether or not any materials are used which have a delivery time of more than eight weeks. In order for this to work, the office staff has to be aware of which materials are facing delivery problems, and have higher delivery times. One option could be to add another step to the process

where purchasing is first asked what the current problematic areas are, however since this would require another communication line between the office staff and purchasing, this may increase the process lead time. Therefore, it is recommended that until it is possible to have all delivery times available within the ERP system, a list of all the current problematic materials is shared with the office staff, on a weekly basis, so they can check whether or not these are included in the quotations.

Decreasing the pre-order requirement to six weeks

This solution is very straightforward and just requires the pre-ordering materials step of checking for materials with a delivery time of more than eight weeks to be reduced to six weeks.

Actively changing the parameters made for the delivery time quotation

Currently in the “create production order” process the parameters which decide the assigned delivery time are not being adjusted based on the current situation at Reinaerdt. In order to quote more realistic delivery times, this parameter is changed. The exact change depends on factors like how many backlog orders there are, or how many priority batches are in production. Since it can be time consuming having to adjust these parameters for every order, the solution of setting this parameter on a (bi)weekly basis is selected and the process flow does not change. In order to find the perfect adjustments some deeper research into the exact impact of these different factors on the production delays has to be done, however, this falls outside of the scope of this thesis as this requires more in-depth detail of the production processes. Nevertheless, these parameters can be estimated, and adjusted based on experience and measurements.

Better managing of the customer expectations by the account managers

This solution does not impact the “winning the quotation” process map as this already contains the step where the account manager has a meeting with the client to discuss the quotation. The only difference with this solution is that the meeting itself should be more structured towards expectation management where the customer is truthfully informed about why choices were made, and any unrealistic expectations are cleared up.

Better informing the account manager about the quotation

This solution adds the step in the process where the office staff informs the account manager about the quotation and explains certain choices that were made for the quotation, right after they sent the quotation to the customer. This should help the account manager to better manage the customer expectations during the meeting where they discuss the quotation.

Setting up formal communication channels

This solution impacts both the processes of “working out order details” and “purchasing materials”. The process of working out order details currently contains the step where the account manager and the project administration have to be informed when there are changes compared to the initial quotation. For this step there is no specific protocol and this is often done with just a simple email, which can be overlooked. The chosen way to better structure this is to also inform a third person, like the (to be appointed) process owner, in addition to the account manager and the project administration. This third person can then keep track of which orders require changes or additional contracts. Afterwards when the account manager has settled the additional contract, they have to

inform the process owner. If they have not done this, the process owner has a clear overview of which orders still need additional contract to be settled, and can prevent these steps from being neglected.

For the purchasing materials process the communication channels that are recommend are set up between purchasing and planning. Whenever purchasing receives a new delivery time from a supplier, they link this to the placed order and then always communicate with planning to see whether or not this causes issues. This way the customer can be informed on time when production delays occur, and no production slots get planned for orders that do not have all the required materials available yet. It would be best to create a way for purchasing employees to be able to easily see if a delayed delivery causes problems but this would require a lot of customisations to the ERP systems, and is currently not feasible.

Process	Changes	
	Within the process map	Outside of the process maps
Winning the quotation	<ul style="list-style-type: none"> Informing the account manager better about the quotation 	<ul style="list-style-type: none"> Better expectation management during the quotation meeting.
Pre-ordering materials	<ul style="list-style-type: none"> Pre-ordering all materials with a high delivery time (of more than eight weeks) Reducing the pre-ordering requirement (to six weeks) 	<ul style="list-style-type: none"> Purchasing sharing a list of problematic materials with a high delivery time, on a (bi)weekly basis
Working out order details	<ul style="list-style-type: none"> Also informing a third person (process owner) about the need for additional contracts Account managers informing the third person (process owner) when the additional contract is settled 	
Purchasing materials	<ul style="list-style-type: none"> Purchasing communicating with planning when material shipments get delayed Informing the customer about the delay 	<ul style="list-style-type: none"> Participating in meetings with suppliers (to communicate needs) Keeping track of supplier performance
Creating production orders		<ul style="list-style-type: none"> Changing the parameters used to assign the delivery times, on a (bi)weekly basis

Table 8: Changes the solutions bring, inside and outside of the process maps

Table 8 depicts the discussed changes, both those which influence the process maps, and those who happen outside of the process maps. With these changes and the new process maps known, the redesign part of the BPM cycle is concluded. However, before these changes can be implemented, section 4.3 discusses the different barriers that should be addressed.

4.3 Dealing with implementation barriers

Section 3.2 identified different implementation barriers which should be addressed before the implementation of the new processes can start: employee resistance, governance, lack of focus on the future, and budgeting. For each of the barriers is looked at what Reinaerdt can do in order to negate any issues which may arise.

Employee resistance

In order to control the employee resistance to change, the identified solutions are for management to involve the employees early, communicate the need for change and support the process from the top. This can be done by e.g. holding sessions for the different departments in which the current problems of the company get explained, and how this translates to the done work within the departments. Afterwards the new situation and the impact of the chosen solutions on the problem should be discussed, followed by an opportunity for employees to ask questions or raise concerns. Especially changes which include improving on work like “better the customer expectation management” or changes which give extra work like informing a third person are likely to have resistance to change. For these changes, the problems and the goal of the change should be discussed even more, to make sure that the employees are on the same line as the management.

Governance

The governance barrier has to do with the governance of processes, and this can be dealt with by identifying process owners for the different processes. The process owners are responsible for the performance of the processes, and can also function as a talking point for employees who may have questions or concerns about process changes. The identified process owners for the processes are the department heads: the head of purchasing for the “purchasing materials” process, the head of sales for the “pre-ordering materials” and “working out order details” processes, and the commercial manager (head of the account managers) for the “winning the quotation” process. For the “create production orders” process no owner has been assigned yet, as there is no current head of planning. The recommendation is therefore that one of the current planning employees takes on the position of process owner, and with this role, transitions into the head of planning.

Lack of focus on the future

The barrier preventing companies from focusing on the future of the processes can be solved by getting employees to share suggestions for process improvement, especially because they are the one who actually have the knowledge about the process. This can be done by holding occasional brainstorming sessions with multidisciplinary teams that are active in a process, as this is an effective stimulus for generating innovative ideas (Doran & Ryan, 2017).

The second identified way to deal with this barrier is to error-proof the processes by identifying possible errors that may occur, and creating a plan to catch these errors. All of the changes for which possible errors were found, and the ways to catch these errors are depicted in Table 6. For the change to reduce the pre-ordering material requirement to six weeks no possible error was identified as this is a relatively simple change. Most of the found errors are along the lines of steps not being done as planned, or forgotten to be done. The ideal way to address these issues would be for the ERP system to automatically flag this, or prevent a future step from being done. However, these ERP customisations are currently not feasible and it may take some time before these are implemented, the solution of a responsible person (not always the process owner) manually checking for these errors

is selected, which can be a time-consuming solution. However, this is often only a temporary need as the probability for the errors decreases over time. Unfortunately, not all of the possible errors can be prevented. When there are different errors that occur, it is important for the employee that notices the error to inform the corresponding process owner(s). They can then decide on how to prevent that from happening again in the future.

Changes	Possible error	How to catch the error?
Informing the account manager about the quotation	The office staff forgetting to inform the account manager	Account managers have to confirm if they have the information, when planning a meeting with the client.
Check for other problematic materials to pre-order	The list of currently problematic materials is not sent to the office staff weekly	Have the lists display clear week/year numbers, so the office staff notices they do not have an up-to-date list, and can request a new one.
Also informing the process owner about changes made compared to the quotation	The process owner not being informed	The process owner should check, for each signed technical & financial agreement, if they were informed about changes, and if this was required.
Inform planning about the shipment delays when they happen	Not communicating with planning	Planning should do a weekly check to see which shipments got a new delivery time assigned by purchasing, and if this causes any production delays.
Document supplier performance	Supplier performance not documented	The process owner can compare the number of rescheduled deliveries against the documented (negative) performances.
Actively adjust the delivery time parameters, depending on the current situation	Parameters not being adjusted	The process owner checking weekly whether or not the parameters have been changed.

Table 9: Ways to address possible process errors which may occur

Budgeting

The budgeting barrier, although important, is less relevant for Reinaerdt since the solutions have already been looked at based on the cost criteria, and the more costly solutions have not been selected. Nevertheless, it is still important for Reinaerdt to start budgeting, if only for the future redesign of the processes, or the future implementation of system customisation to help with catching errors.

4.4 Conclusion

With the process changes found in Table 8, and the new process maps found in Figure B1 to B4, the research question: "What are the new recommended processes?". Is answered. However, Besides the changes that can be seen in the process maps, there are also recommended changes which are not shown in the process maps. These are still important to address, as they are often a requisite for the visible changes. With the new situation designed, the redesign phase of the BPM is concluded. The implementation phase of the BPM gets skipped in this thesis because the implementation of the new

situation happens after this thesis is concluded. However, the different barriers for the implementation phase have been looked at, and can be found in Table 9. For a successful redesign, it is important that these get addressed. Chapter 5 continues the BPM cycle in the monitoring phase by looking at how the performance of the newly designed processes can be monitored.

5. Solution monitoring

This chapter covers the monitoring phase of the BPM cycle and answers the research question of: “How to measure the impact of the implemented solutions?”. Section 5.1 starts with the identification of several KPIs which can be used to monitor the performance of the redesigned processes, and how these KPIs can be collected. Section 5.2 addresses how the identified KPIs can be used, and what a change in the values of these KPIs can mean. Section 5.3 looks at the ERP customisations which are needed for the monitoring of the KPIs, and gives recommendations based on this.

5.1 KPIs to be used

The recommended KPIs that are identified in this section are discussed per redesigned process. Unfortunately, Reinaerd currently does not collect all of the data required for the monitoring of these KPIs, and the data that is being collected is too unreliable to use (due to employee inconsistencies). Therefore, for each of the identified KPIs a way to properly collect the data is also discussed.

Winning the quotation

The goal of this process redesign is to reduce the number of quotation adjustments required. This is achieved by improving the meeting between the account manager and customer by having the account manager better informed about the quotation and better managing the expectations of the customer. Keeping track of the actual number of quotation adjustments is difficult to do, as this is often done through email, and would require a lot of manual work. Besides, this would not take into account whether the adjustments made are large or small either. Therefore, the selected KPI to monitor this part of the process is the average process duration

Currently in the ERP system, the date on which the quotation gets sent to the customer is being collected. However, the date on which the order is won is not collected. One way to start collecting this data is by looking at the moment the status of the order gets changed to quotation won. However, when using this KPI it is important that this status changes happen systematically, in a timely manner after the order is won. Currently this is not the case, and they often happen much later (or not at all).

Pre-ordering materials

This process redesign is focused on increasing the number of materials that get pre-ordered by both pre-ordering for more types of materials, and by reducing the pre-order requirement by looking at products with a delivery time of more than six weeks, instead of more than eight. The desired effect of this change is there is a good material availability, so the production does not have to be delayed and rescheduled. Therefore, the selected KPI to measure this is the number of rescheduled production orders.

Currently the number of times a production order gets rescheduled is not kept track of. This can be done by making a small change in the system when creating production orders, by adding a counter of the number of times this gets done.

Working out order details

The problem to be solved with this redesign is the fact that the additional contracts for the orders are often not settled. However, because the settling of contracts happens outside of the ERP system this is difficult to keep track of. Therefore, no metrics are identified to monitor this part of the process. Other parts of the process can, however, be kept track of. Because this process was already quite long and the selected problem-solving method added extra steps, the selected KPI to monitor this process is the average process duration.

The data of when this process starts can be found by the status change as described in the “winning the quotation” part, as the end of that process indicates the start of this process. The data of when this process ends can roughly be found in the system, as after this step the order gets entered into the ERP system, and the doors get added in the configurator. However, this is also not always fully accurate and can differ a few days from the actual moment the order was successfully worked out. The way this can more accurately be measured instead, is by also looking at the moment the status gets changed. Like the other status change measurement, it is important that employees learn to do this in a consistent manner.

Purchasing materials

For this process the redesign goals are to improve the communication between purchasing and planning employees when shipments get delayed, and to document the supplier performance. In order to keep track of the communication between purchasing and planning the selected KPI is the average duration between rescheduled customer orders. The supplier performance can be measure using several KPIs, like the number of on-time, postponed, or late deliveries per supplier.

The current duration between rescheduled customer orders is currently not kept track of. In order to keep track of this data the change that is required is for the system to instead of completely overwriting and erasing the old assigned delivery time, to store this, together with the actual moment the delivery time gets assigned. The data for the supplier performance can be gathered from the shared Excel file where the performances is documented, until this can be kept track of using the ERP system.

Create production orders

This process redesign is focused on solving the problem of whether or not realistic delivery times are assigned. This problem is solved by looking at the parameters for the assigned delivery time, and adjusting these based on the current situation of Reinaerdt. In order to measure how well these parameters are adjusted, and what the impact of this is, two KPIs have been selected: The delivery reliability and the number of orders won.

The number of orders won is relatively straightforward to collect, however, this gets looked at in certain periods with a certain parameter balance. Therefore, it is important that the actual moment of the order being won gets collected. This can best be done through the status change in the ERP system as discussed above for other KPIs. The delivery reliability is a little more difficult to collect. For

this it is important to differentiate between the initially assigned delivery time, and possible reassigned delivery times. Furthermore, as discussed in this thesis, if the customer opts in to the reassigning, before the purchasing happens, this is not considered as failing the delivery reliability. To check for this, an additional checkbox can be added to the delivery time data, which can be checked after the customer opts in to a reassigned delivery time. With this added, the delivery reliability can be assessed by looking at the assigned delivery time. If there is a rescheduled delivery with customer opt in, this date can be compared against when the shipment is sent. If there is a rescheduled delivery without this opt in, then this is always considered as failing the delivery reliability.

Process	KPI	How to collect the missing data?
Winning the quotation	Average process duration	Collect the date when the status gets changed to “order won”
Pre-ordering materials	Number of rescheduled production orders	Add a counter for every time a production orders gets rescheduled
Working out order details	Average process duration	Collect the date when the status gets changed to “order won”
		Collect the date when the status gets changed to “order complete”
Purchasing materials	Average duration between rescheduled orders	Store the previously assigned dates and the moment a rescheduling happens
	Number of on-time, postponed, or late deliveries per supplier	Gather this from the shared Excel file where the supplier performance is stored
Create production orders	Delivery reliability	Check whether or not the customer opted in to a new delivery date. If so, compare against the shipping date
	Number of orders won	Count the number of orders with the status changed to order won

Table 10: The selected KPIs to monitor the redesigned KPIs, and the way to collect these

Table 10 summarizes the identified KPIs that can be used to monitor the performance of the new processes, and how to collect the missing data required for these KPIs. Especially for the KPIs that require the ERP to check when a status is changed, it important for employees to use the ERP system consistently. Without this, the results are unreliable and the KPIs cannot be used to monitor the performance of the process.

One way to improve the employee consistency would be for management to make clear why exactly this is necessary, which can be done in the meetings identified for the employee resistance barrier in section 4.3. However, since the process owners are the ones responsible for the process and the monitoring of the process, it is up to them to make sure every employee properly uses the ERP system.

5.2 Tracking the KPIs

Looking at the KPIs of processes not only helps to see how the new processes perform, but may also help identifying any future redesign needs that may arise. Because of the lack of current data, the KPIs that are identified in section 4.1. do not have a current value to be compared against during the monitoring, and thus not much can be said about the expected impact of these solutions. However, even without value to compare against, the KPIs can still be monitored, and checked for average changes over a period of a few months. Therefore, for each of the KPIs the (likely) meaning of a change in the KPI value, and the recommended actions for this change are discussed.

Average “Winning the quotation” process duration

The part of the “Winning the quotation” process which is often the most time consuming, is the quotation which has to be adjusted many times. Because of this, an average decrease in this KPI is likely to indicate that less quotation adjustments are required, meaning that the customer expectations are managed better. When this KPI increases, this is an indicator that the customer expectations are managed poorly. If this happens, the process owner has to look into what happens during the quotation meeting, and the type of adjustments that get made.

Number of rescheduled production orders

Having no rescheduled production orders may not (realistically) be possible, as unexpected issues on the supplier side cannot always be prevented. Nevertheless, with a good system this KPI should be as low as possible. A low KPI indicates that the current pre-order strategy is working, and that there is plenty of material availability. If this KPI increases then this means that either the material availability is bad, and the pre-order process has to be looked at again, or that there are problems with the actual production (planning). Therefore, the first step is to identify which of these problems is the cause for the increased KPI value.

Average “Working out order details” process duration

Because the redesign of this process added some extra steps, it is important to track the changes in duration. However, because this process is already on average the longest process, within the research scope, the changes may hard to identify and require measurements over a long period of time. Preferably this KPI should decrease, however, it is most likely that this KPI does not change based on the implemented solutions. With an increase in the KPI, it is important that the underlying reasons are identified. This could be, but is not limited to: Inefficient customer communication, none or slow customer follow ups when the wait is too long, or bad interdepartmental communication.

Average duration between rescheduled orders

The implemented solution added communication channels between purchasing and planning, making it significantly faster for planning to notice when there are production problems. This change results in the customer order being rescheduled up to a few weeks faster. A low value of this KPI is therefore likely to indicate that the communication channels are working. A high value means that there is no good communication between purchasing and planning and the communication channels are not followed. If this happens, the process owner should look into the reason for purchasing not communicating with planning when shipments are postponed.

Number of orders won & Delivery reliability.

These KPIs should be looked at together, since they should both be balanced. Having a high delivery reliability with a low number of orders won, is an indicator that the parameters for the assigned delivery time are set too high, which likely scared off customers. However, a low delivery reliability with a high number of orders won means that the customers are interested in the low lead time, but are then left unsatisfied with the low delivery reliability. Big discrepancies between these values is thus an indicator for the process owner to look into the set parameters, and adjust the way the current situation affects these parameters.

5.3 KPI recommendations

It is important for Reinaerdt to start to monitor their (new) processes as soon as possible so the current situation of the processes is known. Therefore, a priority list of ERP customisations has been made with the help of an IT engineer of Reinaerdt who helped to assess the feasibility of the changes. The following data collection customisations should be made first:

- Collect the date when the status gets changed to “order won”
- Collect the date when the status gets changed to “order complete”
- Add a counter to count the number of times an order gets rescheduled
- When rescheduling orders, store the previously assigned delivery times, and the moment of rescheduling

With these four changes, the KPIs for all of the analysed processes, except for “create production orders”, can be calculated. These changes are relatively easy to implement and should thus not take too long. Because of this it is recommended that Reinaerdt will actually work on this before the process redesigns are implemented.

The changes to measure the delivery reliability for the “create production orders” process are a bit more difficult to implement, however still manageable. Besides being more difficult to be implemented, the chosen solution for this process, to change the parameters for the assigned delivery time, is also a solution that would best require some more research. For this it is recommended that Reinaerdt does some research into the impact of production delays based on current conditions like backlogs or rush orders, so the parameters can best be adjusted based on these conditions. This research will probably take some time, and in this period the ERP system can be prepared for the data collection.

5.4 Conclusion

The research question which is answered in this chapter is: “How to measure the impact of the implemented solutions?”. For this several KPIs have been identified, including the way to collect the data for these KPIs. A summary of these KPIs and data collections can be found in Table 10. For each of the KPIs is also discussed what the values mean, and what the recommended actions are if the value moves into an undesired direction. The identified KPIs in this chapter can, however, not all be implemented at the same time as they require ERP customisations, therefore a priority list of implementations is made so Reinaerdt can start collecting this data as soon as possible.

6. Conclusion

With the monitoring phase finished, the BPM cycle is completed and the research part of this thesis is done. This chapter focuses on concluding this research and the results of it. Section 6.1 summarises what was done, and the conclusions that have been drawn. Section 6.2 looks at the limitations which have been found during the research, and what impact they have on the results. Lastly, section 6.3 looks at the recommendations that are made for Reinaerdt, and how they can best continue in the future.

6.1 Summary

The main research question of this thesis is: “How to redesign the current processes to improve delivery reliability?”. Using the BPM cycle, this question has been answered, resulting in the following recommended changes for the processes of Reinaerdt:

- The office staff informing the account manager about the quotation
- The account managers focusing on customer expectation management during the quotation phase
- Pre-ordering all of the used materials with a delivery period of more than six weeks.
- The process owners getting informed about the need for additional contracts
- Planning and purchasing communicating when material shipments get postponed, using a clearly defined communication system.
- Supplier performance getting documented
- Adjusting the parameters which affect the assigned delivery time, based on the current situation of Reinaerdt

These found changes are not ground breaking, and are often rather simple solutions. However, the difficulty of the done redesign does not lie in the cleverness of the solutions. The most difficult part of this thesis, which also took the longest, has been the defining of the current processes within the company. This is mainly because, as is addressed in the initial problem cluster, the employees of Reinaerdt had very little process insights. However, because of this, the results of these simple solutions are likely better than expected. There is a huge difference when you go from having no process insights to having defined processes, with clear (but simple) solutions to occurring problems.

Unfortunately, the data and the impact cannot really be measured as there is no reliable, quantitative data available at Reinaerdt. However, implementing the found solutions and following the given KPI collecting recommendations is a good place to start to collect necessary data.

For Reinaerdt, and similar companies, the lesson of this thesis is that it is important to keep an oversight of the processes used by the company. Processes and problems should be clearly defined and documented, as solutions are not necessarily difficult to find or implement. And lastly, data should not be collected just for the sake of collecting. If the data is not actually being used, it is likely that the data is not being collected properly and is thus not worth a lot. The question to ask first is what data is needed, and why.

6.2 Research limitations

The first limitation which this research faced is the limitation of the employees of Reinaerdt having limited process insights. This was especially noticeable during the interviews which were held to determine the current process flows. Because of this, it is possible that small mistakes have been made in the order of steps, or steps got forgotten. After the implementation it is therefore important for the process owners to look into the full accuracy of the (new) maps, and adjust these if required. With these new maps further research can then be done. Furthermore, the lack of insights also meant the resulted process maps had to be simplified a bit, and do not fully represent the reality of how all employees actually use the processes. These simplified process maps limited the redesign options, and also resulted in the redesigned process maps to then be simplified. This limits the results of this research, as there may still be complex underlying issues or problems which have not been identified, and may cause issues with some of the newly designed steps.

The second limitation which was faced in this research is the fact that there was very limited data available. If more data had been available for both the processes and KPIs, this would have led to more research opportunities. Some quantitative analyses could have been used on the processes, resulting in a better identification of problems. Furthermore, if better data regarding process lengths and resource use was available, the solutions would have been able to better fit the current situation of Reinaerdt. Nevertheless, it was known that Reinaerdt does not keep track of a lot of data. A further data limitation occurred when it turned out that the data that was supposedly collected, turned out to be too unreliable to use. This caused more problems because without this data it is nearly impossible to compare the current situation against the new situation. Neither is it possible to identify which KPIs or processes need the most attention and should be looked at closely after the implementation of the new processes.

6.3 Future recommendations

After the new processes are implemented, and the initial ERP customisations for data collection are finished, Reinaerdt can look at the next steps for their process improvements. For this, recommendations are made of what Reinaerdt should focus on.

First the recommendations with regards to the ERP customisations will be discussed, as this has been a limiting factor for the introduction of solutions. Some customisations will be able to improve the processes by flagging or preventing errors, or by making data more available, requiring less direct interaction between departments and lowering lead times. These customisations have been discussed with an IT engineer of Reinaerdt, and based on the assessed implementation difficulties the following priority list has been made:

1. Have the material delivery times available

Having this information available in the system will remove the necessity for the office staff to ask purchasing for delivery times, increasing the process speed. However, this will still require a lot of work for the purchasing staff to update this data. The amount of work can, however, be decreased with an improvement in the supplier communications.

2. Automatically store the supplier performance

This way the performance cannot be forgotten to be documented, and bad performances can quickly be flagged and addressed.

3. Prevent delivery times from being assigned, without a parameter being updated

This way it cannot be forgotten to update the parameter weekly, based on the current situation, and a reliable delivery time is always assigned.

4. Display the need for additional project contracts

The current solution introduces the step where a third person is informed about the need, so this cannot be forgotten, and there are no issues later on in the process. Showing the necessity for additional contracts in the ERP system would remove the need for the account manager, project administration, and process owner to be informed, improving the process speed and reducing complexity.

However, because these customisations will take some time to be implemented, they are not likely going to be implemented in the near future. When these have been implemented, however, the next step is for Reinaerdt to look at the then collected data of the processes, and decide if another BPM cycle is necessary for the continuous improvement of their processes. Besides this there are also other recommendations for Reinaerdt to work on:

1. Settle the supplier contracts

Reinaerdt should look into settling contract with their suppliers. As discussed in section 4.1, this may take some time before it can be implemented, and adding details like reward/penalty mechanisms complicates this even further. However, proper agreements and communication with the suppliers will have positive effects on the delivery reliability, and on the supply chain.

2. Map all of the processes

For this thesis only the global process map, and the five relevant processes within the scope have been mapped out. In order for Reinaerdt to improve even further, the other processes should also be mapped out. This goes for both the other processes within the scope of this thesis, and the processes outside of the scope like the production processes. With those processes mapped out, the requirements and inputs of those processes can then be better connected to the outputs of the currently redesigned processes.

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Appendices

Appendix A: Current process maps

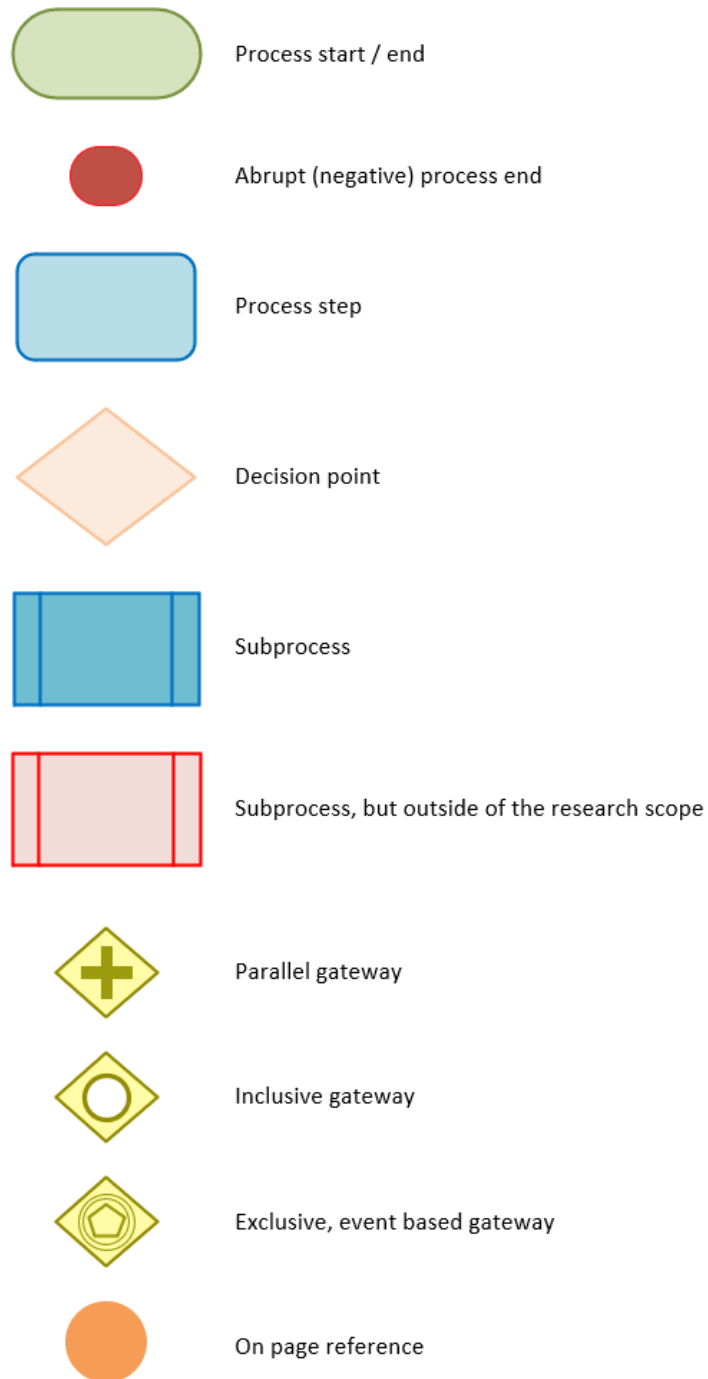


Figure A1: Process legend for the zoomed in process maps

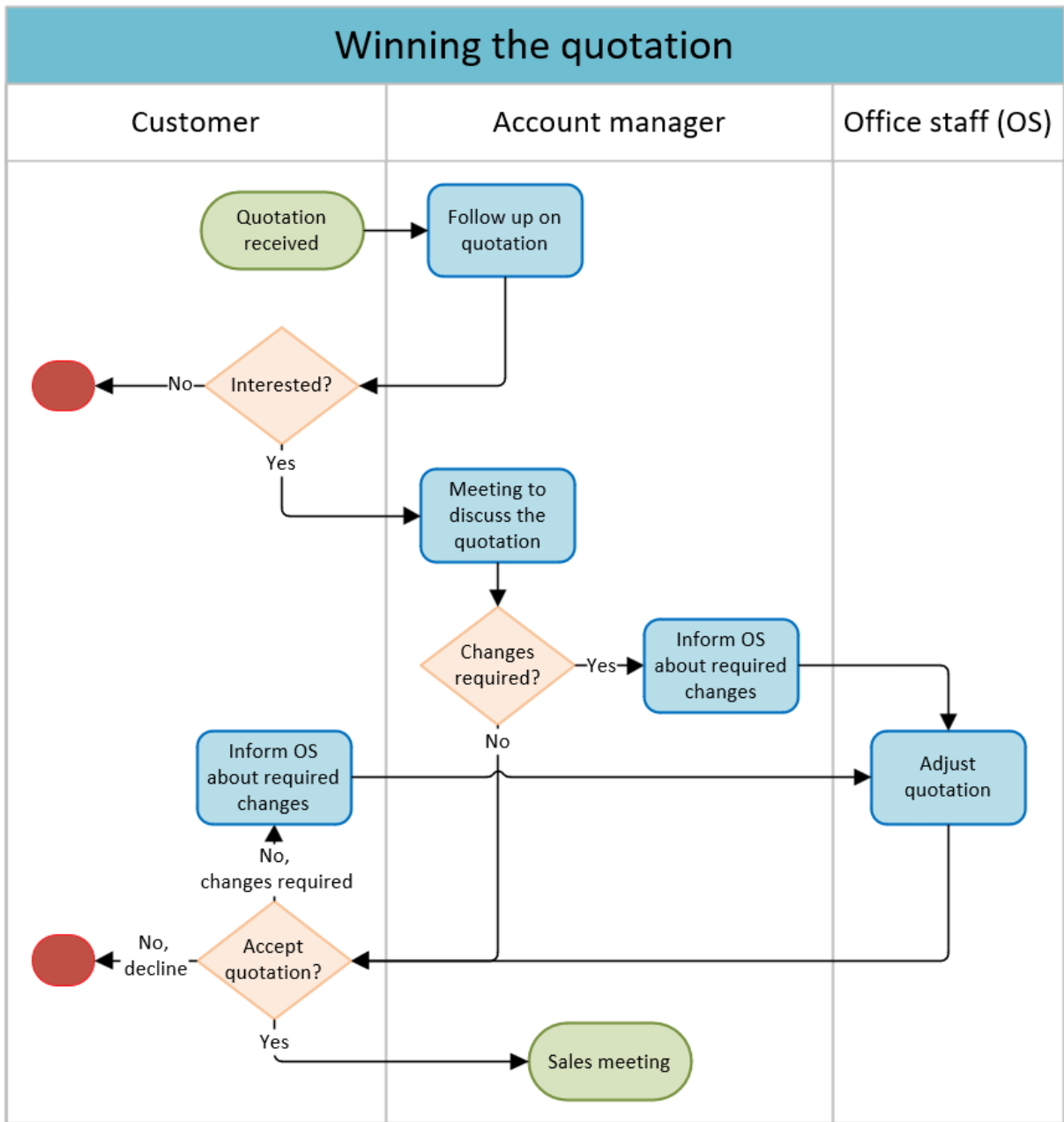


Figure A2: "Winning the quotation" process

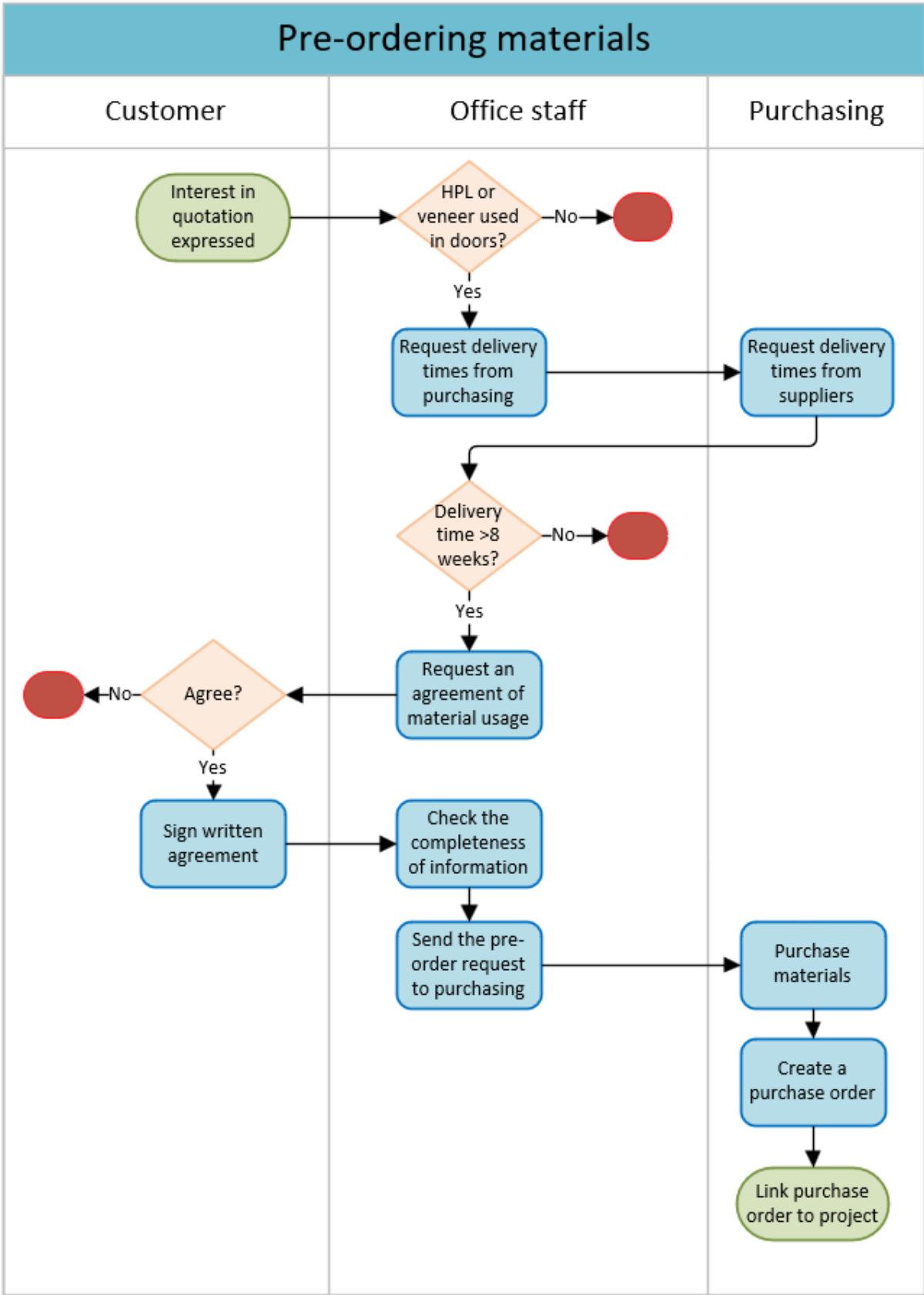


Figure A3: "Pre-ordering materials" process

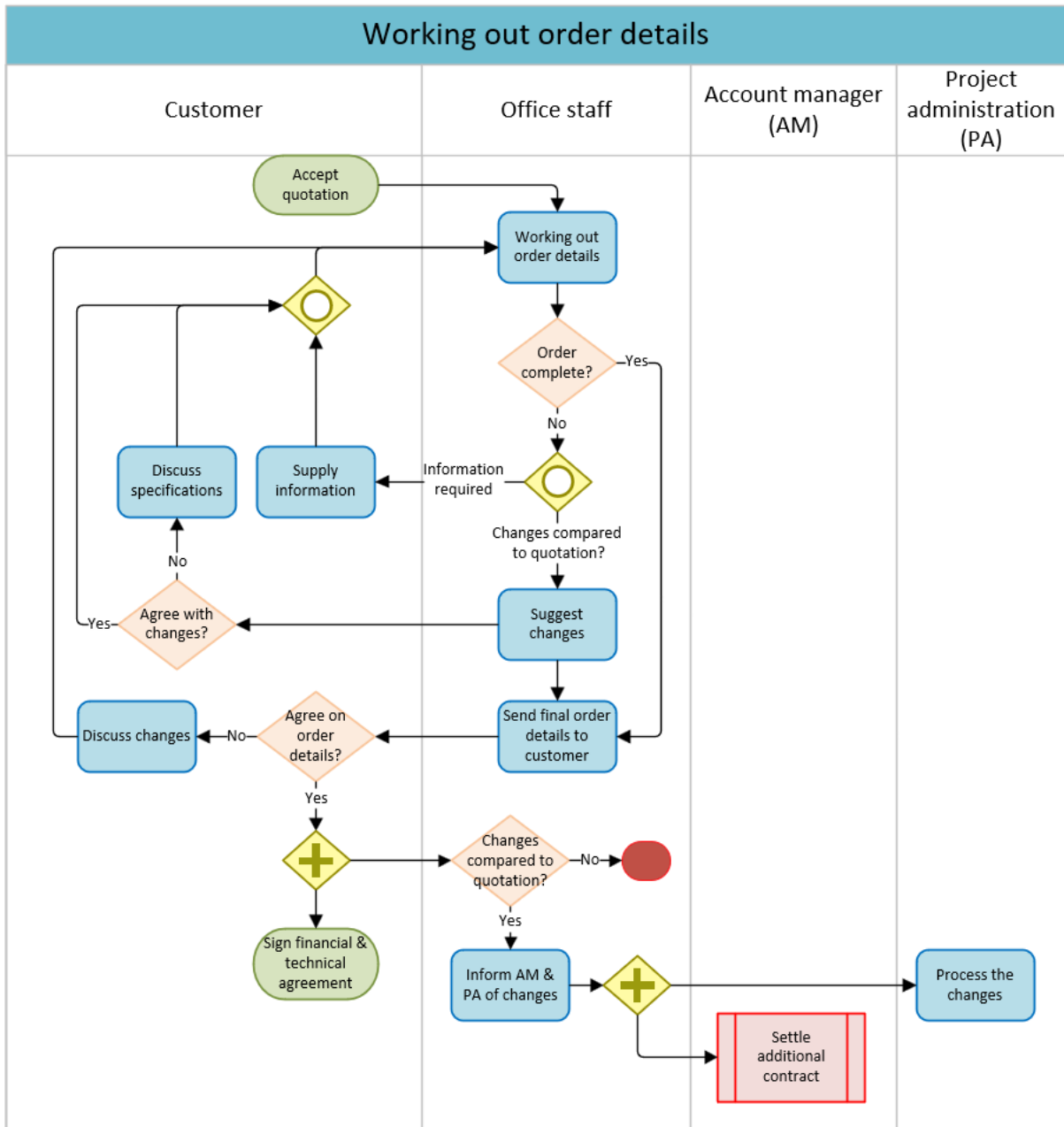


Figure A4: "Working out order details" process

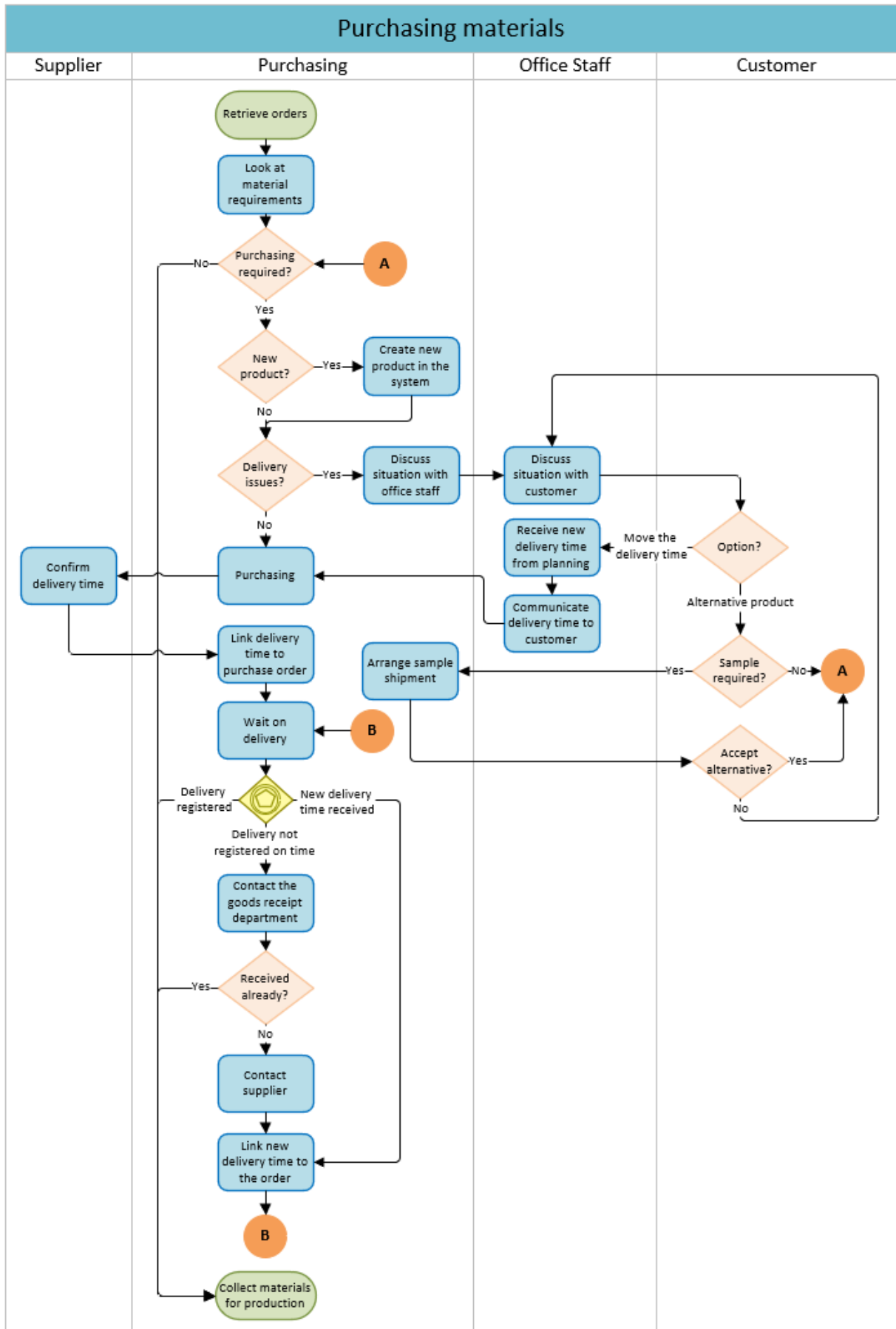


Figure A5: "Purchasing materials" process

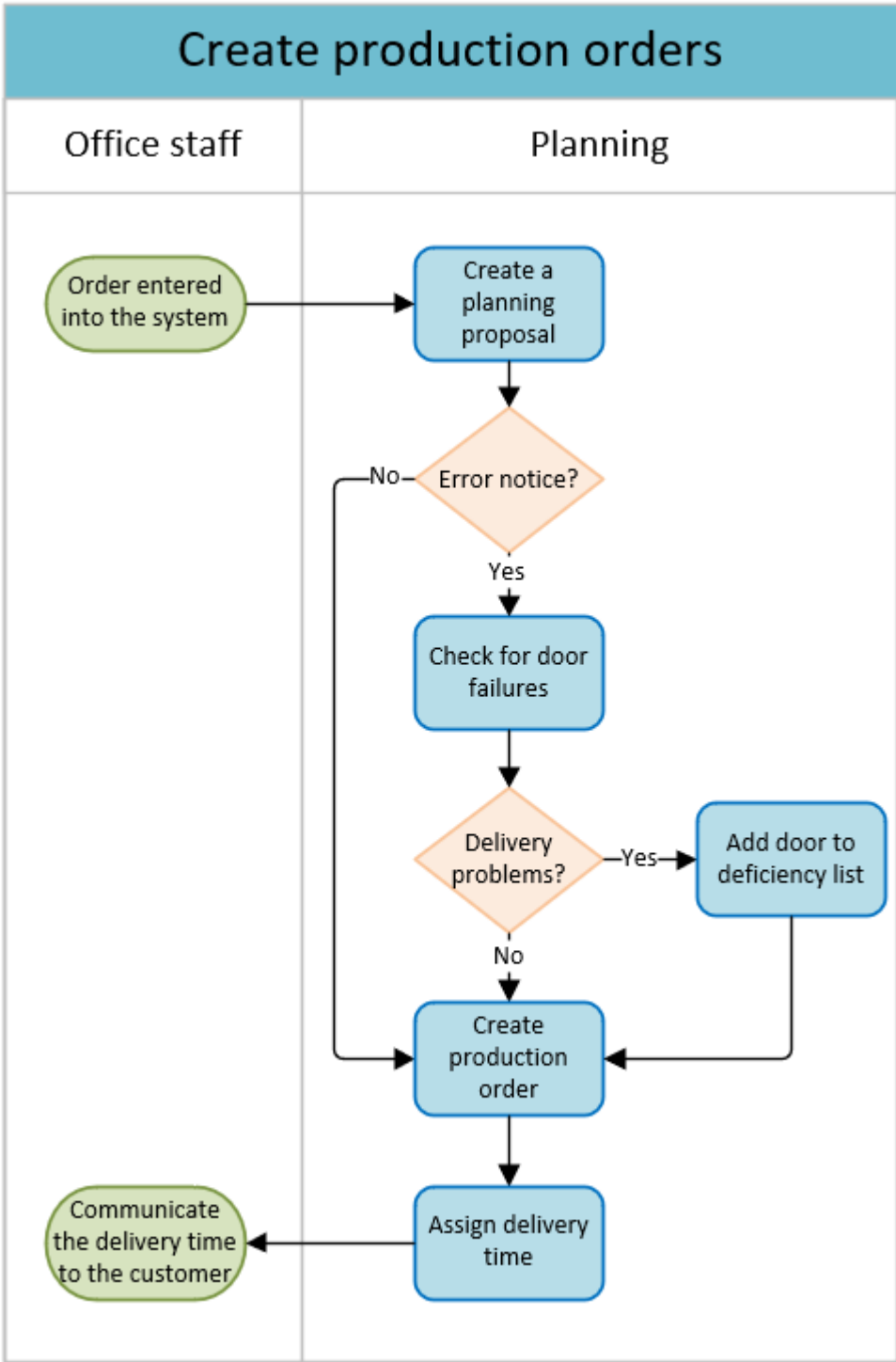


Figure A6: "Create production orders" process

Appendix B: New process maps

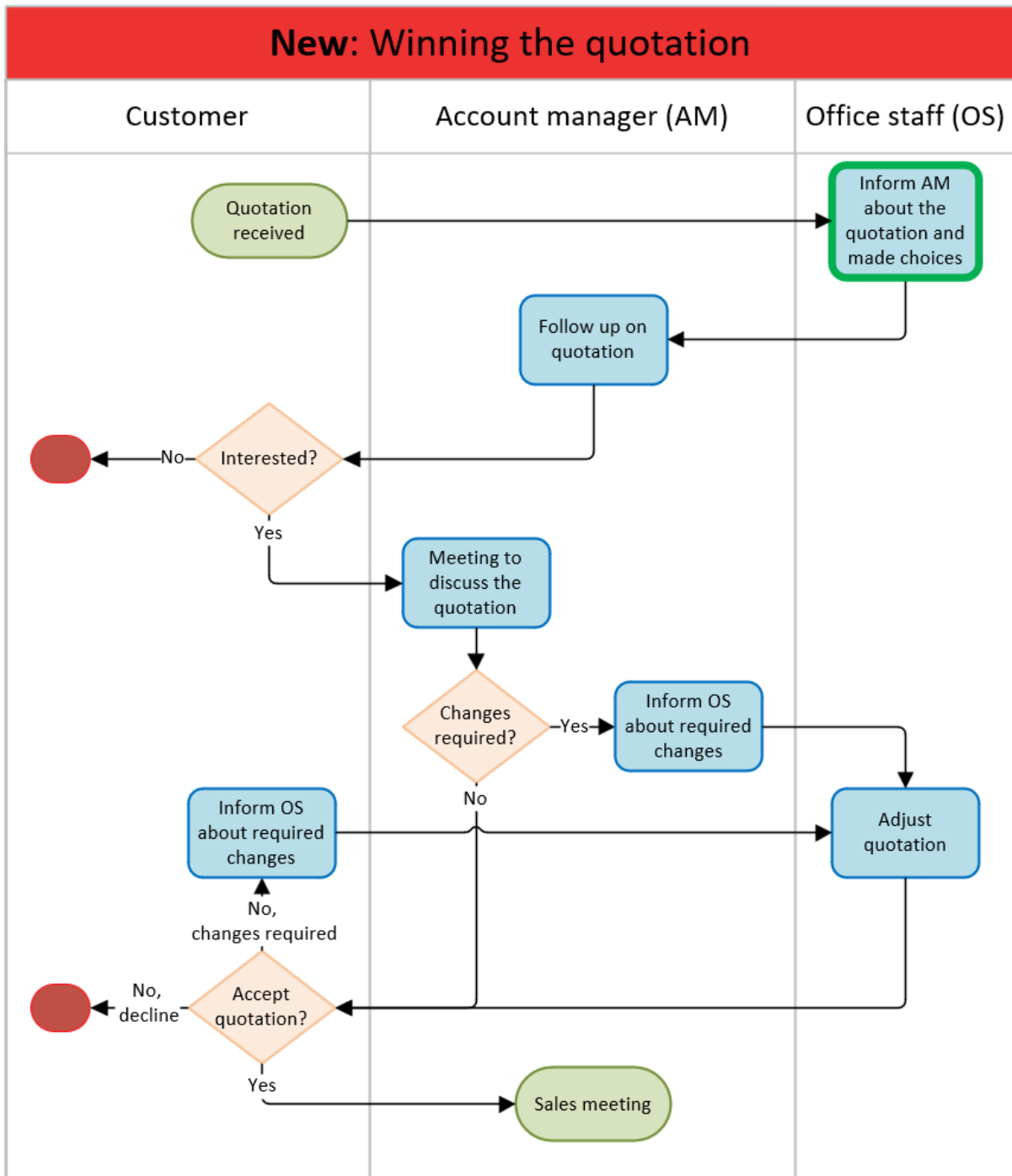


Figure B1: The new "Winning the quotation" process

New: Pre-ordering materials

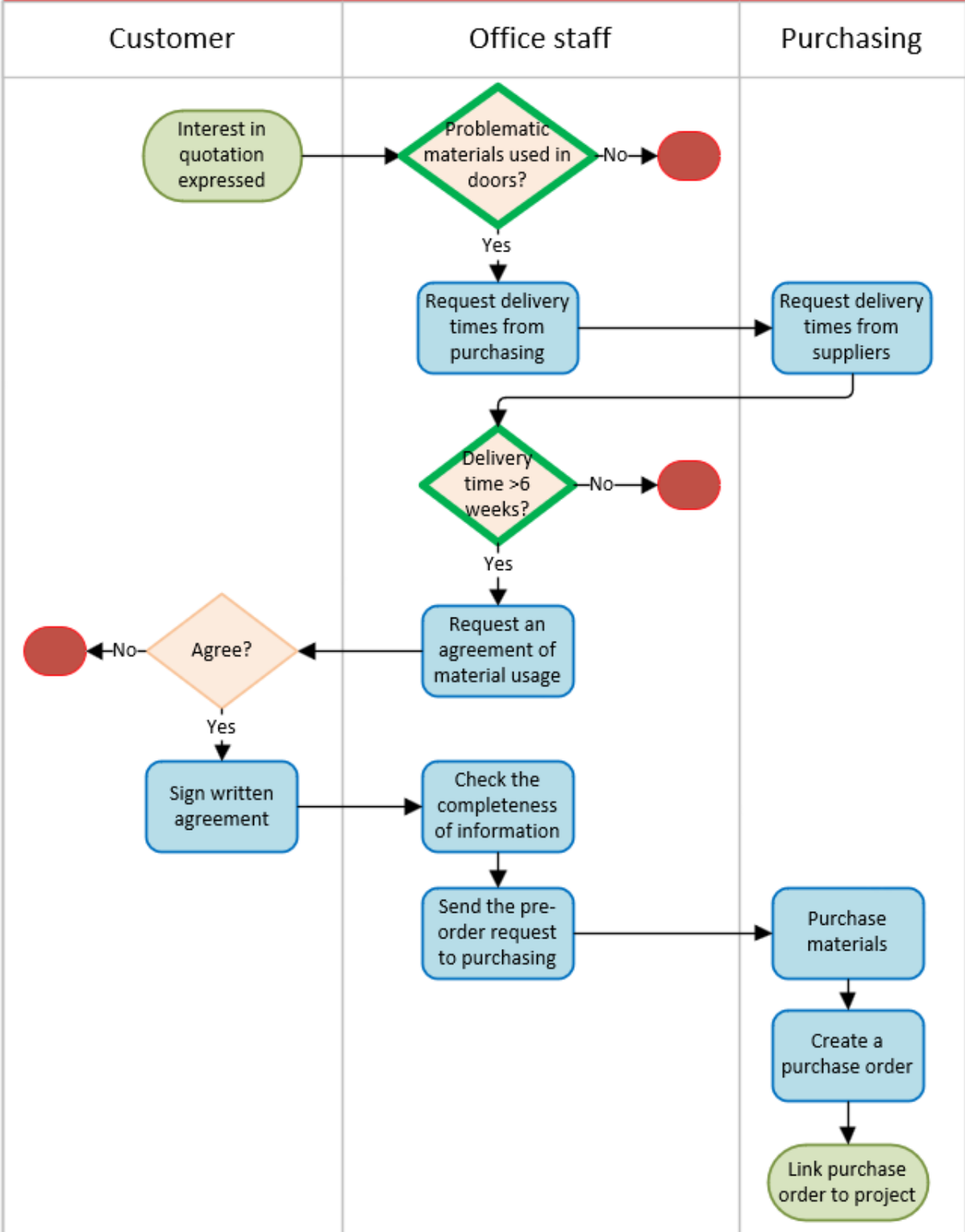


Figure B2: The new “Pre-ordering materials” process

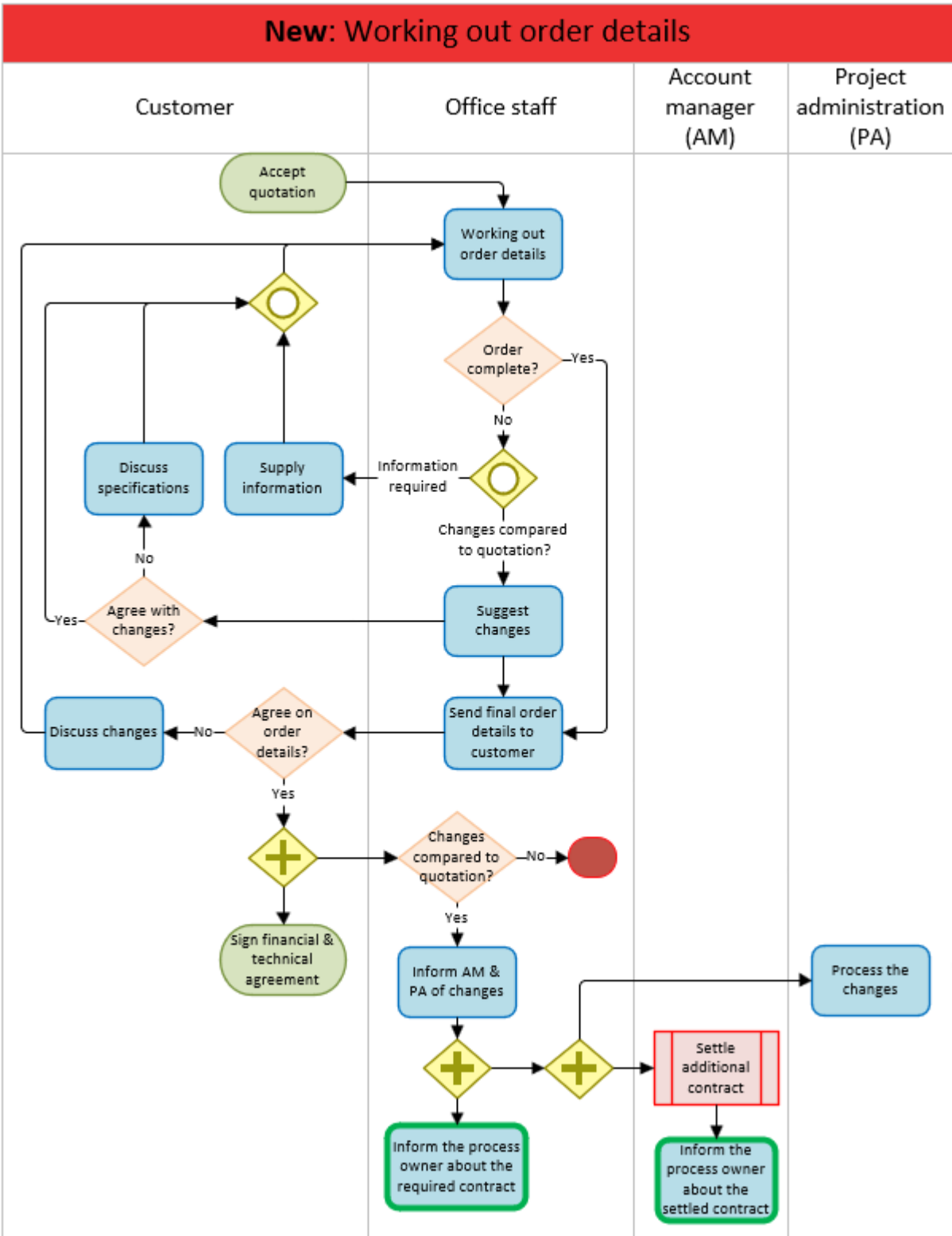


Figure B3: The new "Working out order details" process

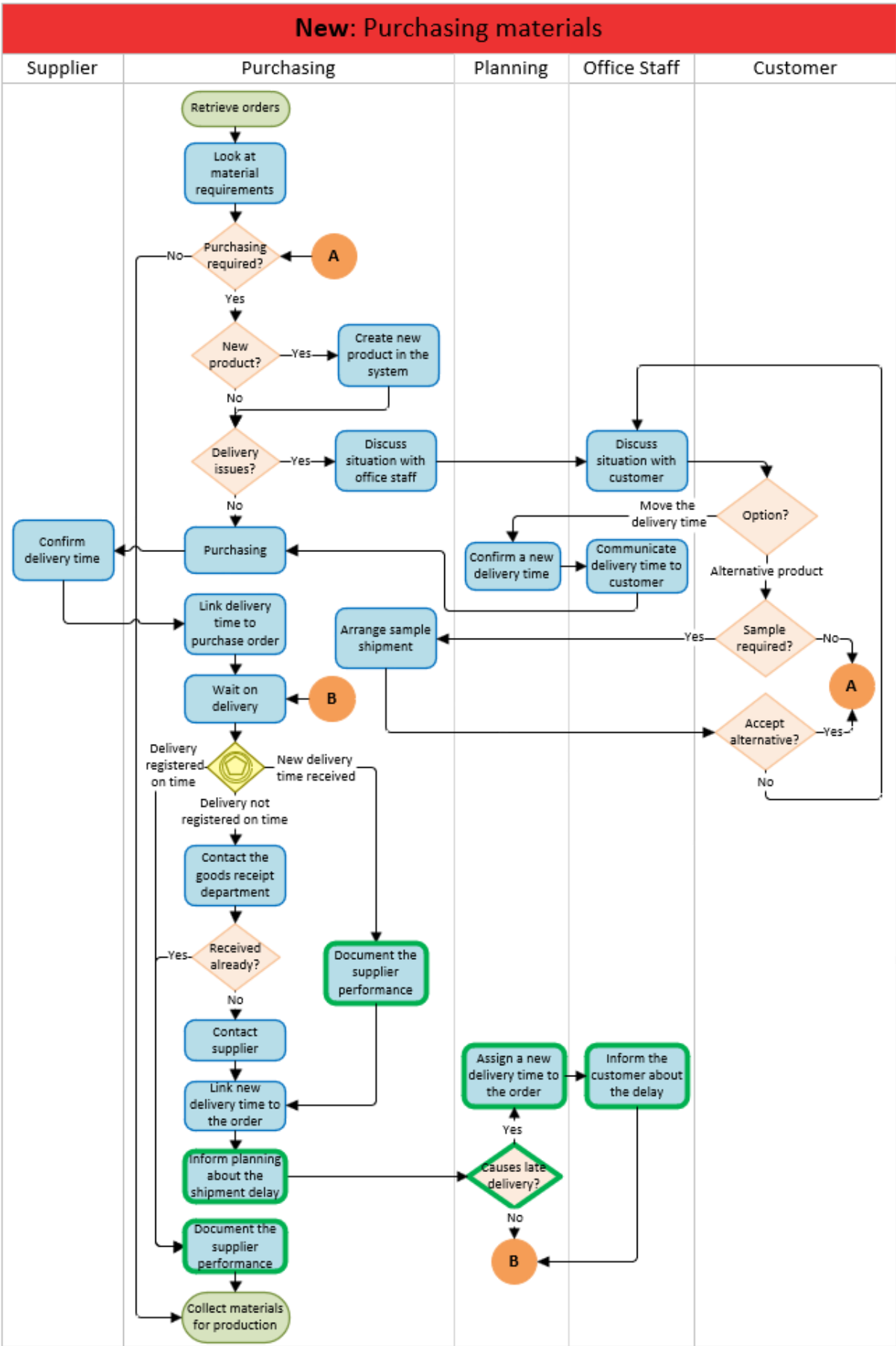


Figure B4: The new "Purchasing materials" process