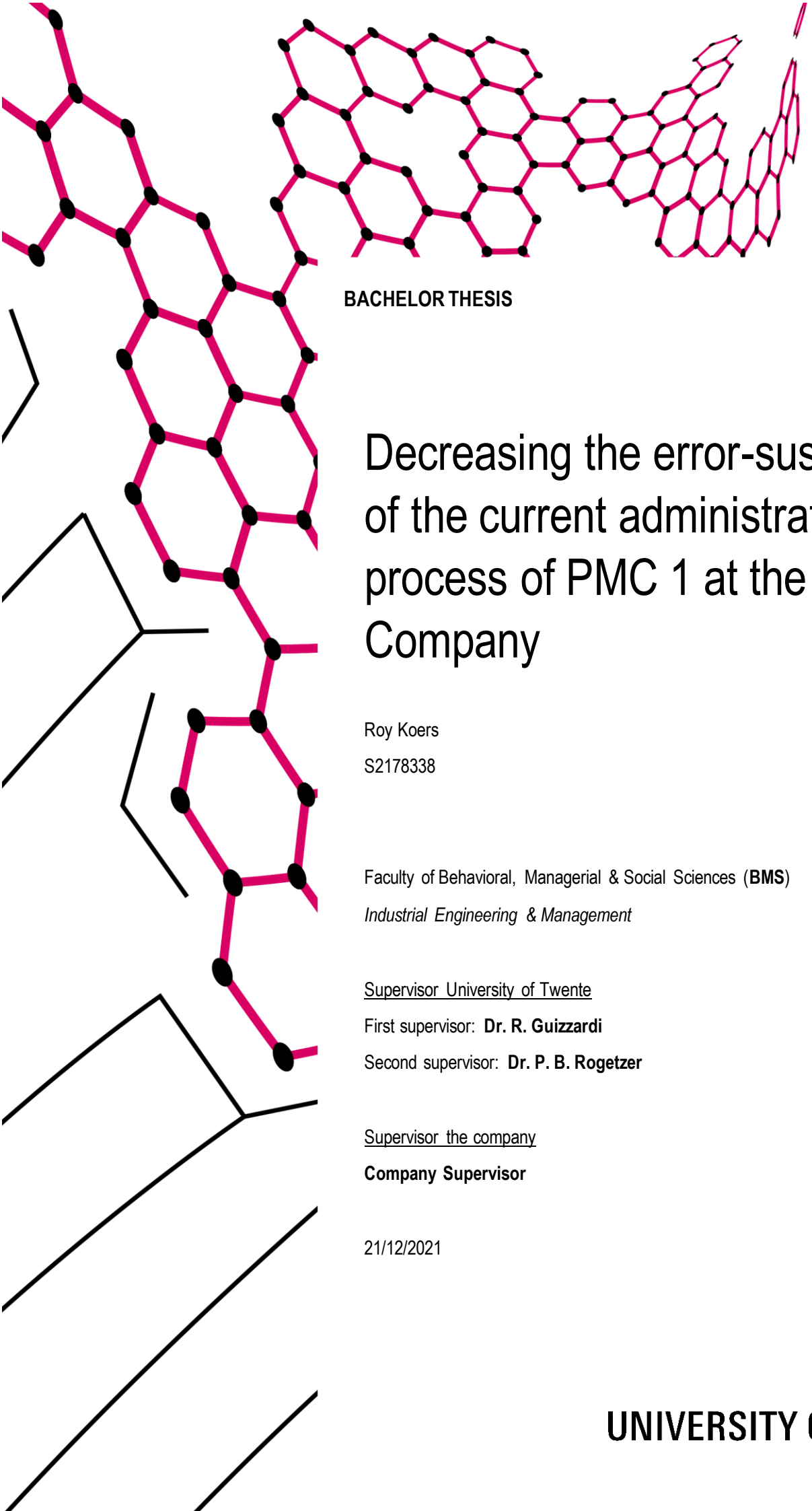

BACHELOR THESIS

Decreasing the error-susceptibility of the current administration process of PMC 1 at the Company

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21/12/2021

UNIVERSITY OF TWENTE.

Bachelor thesis Industrial Engineering and Management

"Decreasing the error-susceptibility of the current administration process of PMC 1 at the company"

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Preface

Dear reader,

You are about to read the bachelor thesis "Decreasing the error-susceptibility of the current administration process of PMC 1 at the company". This research has been executed at the company in Hengelo as final assignment for my bachelor Industrial Engineering and Management at the University of Twente. This thesis aims at minimizing the total time spent in the administration process of PMC 1.

During my research at the company I have gained a lot of practical experience and knowledge. I am very grateful to the company for granting me this opportunity, especially considering the extraordinary circumstances in which this bachelor thesis was conducted; the COVID-19 pandemic. I want to formally thank the company for allowing me to (physically) work at their location during these difficult times.

A special thanks goes out to my supervisor for guiding me during this bachelor thesis. He always helped me by providing feedback and information about the companies' inner workings. During the meetings we had he was always willing to help me in any way necessary. I also wanted to thank the companies' Regional Manager, the regional manager, who often acted as a second supervisor by overseeing my research and providing feedback. Lastly, I want to thank all of the employees at the company for the great atmosphere and specifically everyone that helped me by answering my questionnaires and joining the focus groups. All these great people helped me gain insights, without which I would not have been able to write my thesis.

I would also like to thank my supervisor from the UT: Renata Guizzardi. Without her feedback and patience it would not have been possible for me to conduct this bachelor thesis. Our meetings were always very fruitful and gave me insights that were crucial to this report. I would also like to thank Ipek Seyran Topan for her support during the preparation phase, but also at the last stages of my bachelor thesis. Lastly, I would like to thank my second supervisor Patricia Rogetzer for all of the feedback she provided and helping me in finishing my thesis.

Finally, I would like to thank my family and friends for their support during the research and writing of my bachelor thesis. They always had my back and helped me in many ways in finishing this thesis. Special thanks go out to Maarten van Oosterom and Ruben Klaas who kept my motivated and provided feedback and their opinions on my thesis. Moreover, I would like to thank my fellow board members of the 47th Board of study association Stress for supporting me in very busy times. Due to all of these people I was able to finish and improve my bachelor thesis.

Roy Koers

December 2021

Management Summary

This research has been performed at the company, Hengelo. the company is a company that focuses on horizontal, vertical and heavy transport, with 9 locations spread across the Netherlands and Germany. Since the markets for transport are very competitive, the biggest chances to improve the profit of the company lie in the decrease of internal costs. The company has identified the administration process to be a big source of unnecessary costs. This research will focus on solving the core problem:

"The current administration process of PMC 1 at the company is very susceptible to (human) errors."

the company offers several products and services, which they categorise using Product Market Combinations (PMCs). The most straightforward of these PMCs is PMC 1, which this thesis focuses on. This PMC concerns the rental of crane and materials for a standard tariff, also called bare crane rentals. The administration process of this should be as simple as hours rented times the tariff, making an invoice of this and sending it out. This administration process is actually quite difficult at times, which means that there is quite a difference between norm and reality, making this an excellent action problem to solve.

To make a context analysis and indicate the current state of the administration process, several interviews with employees from all of the different departments as well as the management team. From these interviews a Business Process Model (BPM) was created accompanied by an initial list of improvement points gathered based on criticism of employees about the administration system. Both of these were then thoroughly discussed with the management team of the company for feedback and input. Using the first improvement points and having a few (informal) meetings with several employees, a start for a norm could be formulated.

To further analyse waste within the administration process and discover other possible improvement points, a Makigami was created. The Makigami was built using input from a questionnaire, asking employees about their work routine, problems they might encounter and their interactions with the data systems at the company. This questionnaire was answered by employees from both Hengelo and Groningen, to prevent a one-sided view of how the administration process should work. Using the output of this questionnaire the Makigami was filled in appropriately. The filled-in Makigami was then discussed in several feedback sessions with focus groups from both Hengelo and Groningen. After the feedback sessions, incorrect or incomplete subjects were improved, and several new points were addressed and thus added to the Makigami.

From the improvement points and the problems that were addressed in the feedback sessions and the Makigami, an extensive list of points was formulated. All the improvement points on this lists were categorised and analysed per category. From these clustered points, a bigger, overarching problem could be formulated, comprising the following main issues:

- Unclear structure of data systems.
- Insufficient communication of ordering data.
- Centralized administration process.
- Little to no inspections.
- Lack of communication.
- Input of data could be more user-friendly.
- The multitude of save- and retrieval points.
- The save points and retrieval points do not match.

- The lack of knowledge on save or retrieval points.

Based on these problems, several recommendations were made to improve the administration process:

- Restructuring or clarifying the data systems, so all employees know where to find and where to store data, making the search for information less labour-intensive.
- Standardise the transference of data, so employees get less room for making mistakes, making the data transference less susceptible for human errors.
- Creating a new Product Market Combination, so the actual bare crane rentals can go under PMC 1 and be standardised fully, making it less labour-intensive and less susceptible for human errors.
- Standardisation of the sales, so the invoicing department can always use the standard tariffs, making the invoice-making less labour-intensive and less susceptible for human errors.
- Always use order confirmations, so mistakes within the administration of a job get spotted earlier on in the process, making it less susceptible to human errors.
- Filling the price tables and cost types, so employees do not have to fill it in manually, decreasing the labour-intensity and susceptibility for human errors.
- Increase transparency, so employees know what is expected of them and can thus act like this. This would help in creating a unified way of working, in turn decreasing the susceptibility of human errors.
- Solve the software annoyances. There are certain functionalities within the data systems that make the employees of the company impatient. Solving these issues would help them work faster, as they would not run into these (unnecessary) discontinuities every time.

the company was advised to take these recommendations into account and work on an implementation strategy as well as increasing the use of KPIs to evaluate the effect of the recommendations once taken into action.

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Chapter 2: 'Context analysis'

In this chapter, a more thorough background of the company and the administration process is given. The company background also functions as a current state formulation.

Chapter 3: 'Literature review'

A literature review is conducted on the best method of waste mapping for the administration process by analysing and comparing several methodologies. In this chapter the core concepts of this thesis are also discussed more in-depth.

Chapter 4: 'Mapping the process'

In this chapter the waste is mapped using a Makigami. The questionnaire used for this Makigami as well as the structure of the feedback sessions is elaborated in this chapter as well.

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This chapter starts off by discussing all of the recommendations that can be given based upon the problems/improvement point in the previous chapter. Then these are linked to the process map of chapter 2 to analyse where these recommendations affect the process.

Chapter 7: 'Conclusions and recommendations'

This chapter shortly lists the recommendations and the contribution they have in solving the core problem. Then the implementation and evaluation of these recommendations is discussed, followed by the limitations of this research and any possibilities for further research.

Glossary

For the remainder of this report, the company will be addressed as 'the company', University of Twente will be addressed as 'the university' and Roy Koers will be addressed as 'the researcher', unless indicated otherwise. Any abbreviations used throughout this report are elaborated in the table below:

Abbreviation	*Full name*
BMS	Behavioral, Managerial & Social Sciences
B.V.	Besloten Vennootschap (Private Limited Company)
CRM	Customer Relationship Management
ECRS	Eliminate, Combine, Rearrange, Simplify
ERP	Enterprise Resource Planning

IEM	Industrial Engineering & Management
KPI	Key Performance Indicator
MNE	Multinational Enterprise
MPSM	Managerial Problem Solving Method
PDCA	Plan-Do-Check-Act
PMC	Product Market Combination
QVSM	Quality Value Stream Mapping
SME	Small and Medium Enterprise
SRM	Supplier Relationship Management
UT	University of Twente
VSM	Value Stream Mapping

1. Introduction

1.1 Context description

The company at which the thesis assignment is conducted is the company. This company is located in Hengelo and focuses on vertical and horizontal transport of goods. This facility is part of an organization of companies under the name The company. They offer a wide-ranging service, starting with their most basic service: renting out a crane with a crane driver for a set period of time. They also offer full custom projects with their own project leader and all cranes, transport etc. fixed by the company. All of these different services have been categorized in the Product Market Combinations or PMC for short. This thesis assignment will focus PMC 1.

PMC 1 is the most basic service they offer, the so-called 'bare' crane rentals. In theory, the PMC 1 should be very easy to administrate: a client comes with a job offer, also known as a job request, they come with a price list (cost/hour), the crane and crane driver are planned, the job gets carried out, the driver notes the actual hours worked down, the invoicing departments multiplies cost by time and issues an invoice, this gets sent to the client and they pay. Administratively speaking, this is a rather simple and straight-forward process without much administrative complexity. However, a lot of minor discontinuities occur throughout this administrative process, resulting in a multitude of problems such as incorrect invoices or incorrect job details. This thesis focuses on finding out what discontinuities occur, where these discontinuities occur and most importantly: how to fix them. Solving these discontinuities is such a primary objective in the improvement plan of the company since this administration process should be rather straightforward in theory, but in reality causes time losses across the board.

1.2 Problem description

In this chapter the identification of the action problem is discussed, see Section 1.2.1. Furthermore, the resulting problem cluster and the motivation of the core problem are elaborated in Section 1.2.2.

1.2.1 Identification of the action problem

From the observation that every research paper should provide a solution (Gervasi et al., 2004), we can conclude that each research should also consist of at least one problem. To make an analysis of the problem(s) at hand, one should start with defining the action problem. An action problem consists of a difference between the way we perceive the world, the reality, and the way we think it should be, the norm. This problem is normally solved by changing the state of the world. In the process of solving an action problem sometimes knowledge is produced. This knowledge might even be sufficient to make the problem go away (Gervasi et al., 2004).

After the first meeting with the supervisors from the company, it became abundantly clear that the current market was very competitive and there was little room for alterations towards the market (further discussed in Section 2.1.1). Consequently, to increase their profits, the company would need to improve on their internal processes. A prime example of this is the administration of the 'bare' crane rentals. This is a very simple process, as this basically consists of a predetermined rate for a crane and the hours (or units) that it is being used, this is why it is also called the 'unit-rate process'. Most of these rates are determined by the market and this is why the internal process has the biggest potential for profit increase. Currently, the administration process of PMC 1 takes a lot of time, meaning it incurs a lot of costs. This conclusion leads to the following definition of the action problem:

"A lot of time is being lost in the administration process of PMC 1 at the company".

1.2.2 Problem cluster and motivation of the core problem

After identifying the action problem, it is imperative to find the root of this action problem. This can be done in multiple ways, but the clearest and most visually-pleasing method is by utilizing a problem cluster: *"A model of a problem situation, sometimes called a problem context, in which all action problems are depicted and causally related with arrows going from cause to effect. A particular action problem can be a cause, an effect, or both."* (Löwik et al., 2017). In this situation, the previously mentioned action problem is the effect of some other problems. These are numerous small problems, which for complexity reasons, are not all documented within the problem cluster (Figure 1). Moreover, these problems are the subject of the underlying thesis research and are thus not all defined yet. All these 'smaller problems' can all be summarized by the overarching problem: The current administration process is very susceptible to (human) errors.

We can now identify the core problem. Firstly, we apply one of the rules mentioned in the book: *"Follow the chain of problems back to these problems which have no direct cause themselves. […] It has no cause in itself, and is therefore possibly a core problem."* (Heerkens et al., 2017, p 44). Doing this leaves us with three possible core problems:

1. The current administration process is very susceptible to (human) errors.
2. Jobs are sometimes executed on the terrain of other clients.
3. Prices are sometimes arranged outside of the umbrella contract.

Using the third rule of thumb from Heerkens et al. helps us further in defining our core problem: *"If you cannot influence something, then it cannot be a core problem"* (Heerkens et al., 2017, p 44). Applying this rule to the companies' situation means that we can strike out the second problem, as the company cannot influence this. Now that we are left with only two options for the core problem, we can apply the last rule: *"If more than one problem in the cluster remains, you should choose to fix the most important problem. The most important problem is whichever one whose solution would have the greatest impact effect at the lowest cost."* (Heerkens et al., 2017, p 44). When comparing the potential solutions to these problems, the first problem seems to have a bigger impact at a lower cost, since this problem consists of several small, but often recurring problems, whereas the other problem will entail larger, organisational-wide change(s). Because in this scenario, the company has to change its sales strategy, as offering special prices of packaging is out of the picture. This makes this problem quite complex to solve compared to the first problem, where incremental changed could have a large impact in the long run. This means that we have identified the core problem for this thesis assignment:

"The current administration process of PMC 1 at the company is very susceptible to (human) errors."

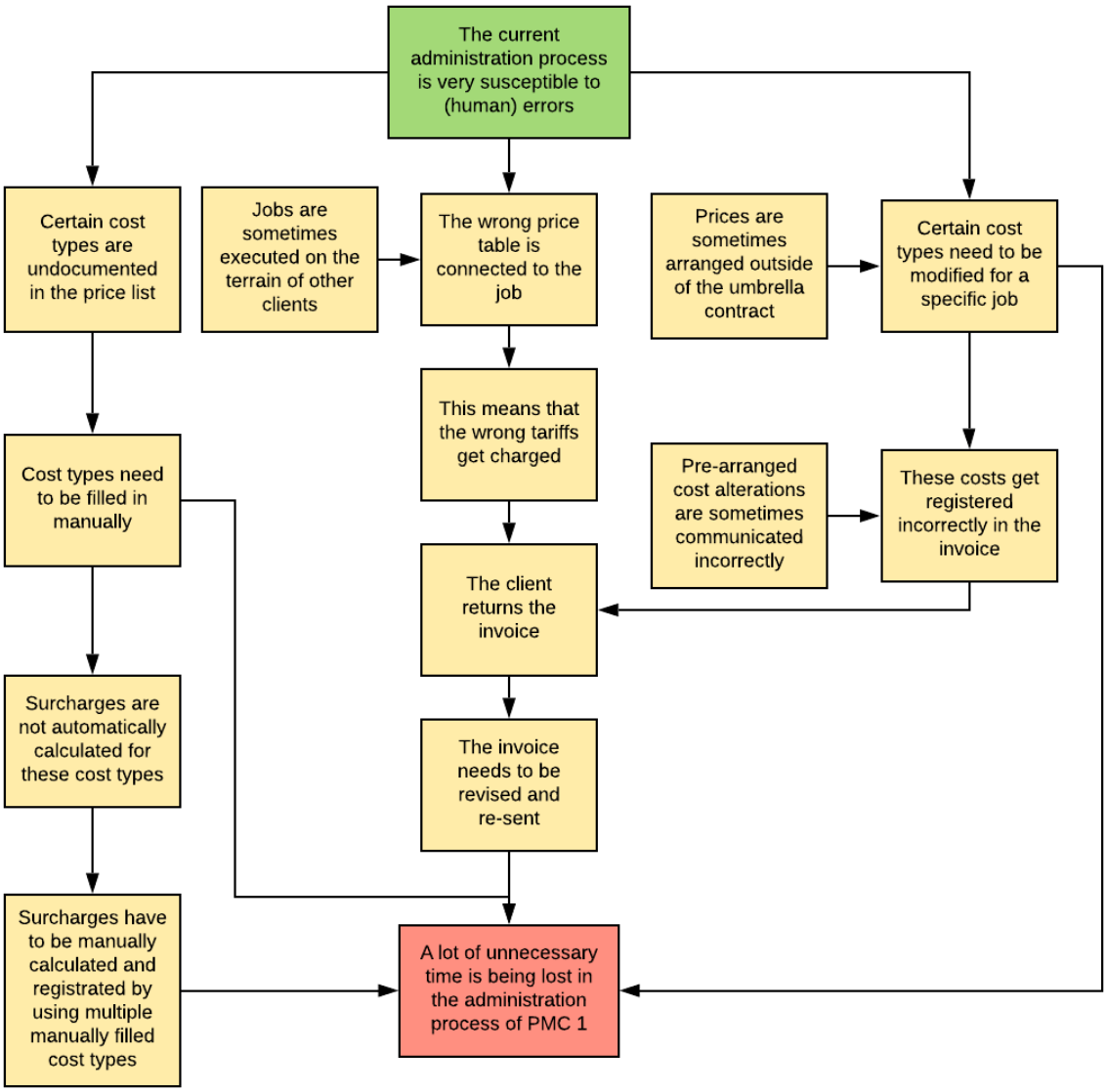

FIGURE 1: THE PROBLEM CLUSTER

1.3 Research design

In this chapter the methodology behind the solution generation are discussed, also known as the research design. The questions which will lead this process are discussed in Section 1.3.1. In Section 1.3.2 the restrictions of this research design will be indicated.

Research questions

- *What does the current logistics flow look like for the administration process of PMC 1?*

The first step in the research process is to create a clear overview of the administration process. For this purpose, a flow chart would seem as the most effective. This flow chart will have a pool with several lanes which symbolize the different departments that interact with the administration process. This way the transfer of data between departments gets a lot clearer, which is valuable because that is where a lot of complications currently arise.

- *What relevant theories and methods are there for identifying waste in this process?*

After formulating a clear overview of the administration process, it is important to map the time lost within this process. Starting the research, the researcher did not possess the skills nor the knowledge to map this, making this a clear knowledge question, requiring extensive literature research. One or several relevant theories arose and were compared during this literature research (Section 3.2). The most effective theory was used to map the waste within the process (Chapter 4).

- *What specific complications can arise at data transfer and where do other complications arise?*

After formulating the process flow and investigating which useful tools there are to identify waste in a process, it becomes time to combine the outcome of both of these. This will start with a round of interviews to question employees on the things they think go wrong in their department and what other departments could do to help them. These interviews will be elaborated in Section 4.2. With the information gained during these interviews and using the tools from the previous research question the waste can be identified. The answer to this question is an exhaustive list of the problems, with the cause(s) and departments that are directly related to the respected complication(s). The complications will be related to the departments, data systems and problem category (Chapter 5).

- *Can these complications be prevented and if so, how?*

Taking a closer look at the waste which has been identified at the previous step, we can investigate whether this waste can be reduced or completely resolved. Some waste might be caused by the nature of the process and will thus be impossible to reduce. However, a lot of waste would probably be reducible. For this waste it will be a matter of analysing the trade-offs that need to be made in order to reduce this waste and what impact it will then have.

- *How could the solution be implemented and checked?*

In this question the strategy on how to implement the solutions from the last question will be formulated. This will basically serve as a manual for the board of the company on how to implement the solutions. Moreover, the solutions need to be checked and evaluated, to make sure they have the intended impact. For this key performance indicators (KPIs) or other indicators need to be developed and incorporated.

- *Based on all gathered data, which recommendations can be done and what conclusions can be made?*

Based on all the above-mentioned research, in this step, all the recommendations that can be given to the board of The company B.V. will be identified. This includes an analysis of the complications that are most important to resolve, solutions to these complications, an implementation plan and KPIs to evaluate the effectiveness of these solutions. In this step also several conclusions need to be drawn from the research. These conclusions will not only help summarize this research thesis, but also serve as a starting point for future research.

1.4 Plan of approach

To ensure that my thesis assignment will have a well thought-out structure, the theories and principles of the Managerial Problem Solving Method (MPSM) as described in Heerkens et al., 2017 and Heerkens, 2019 will be used. Although some of the seven steps of the MPSM will be relatively unapplicable to my thesis research, I will discuss all the steps and what I plan to do in those steps:

1. *Problem identification.* To begin my research, it is essential that I get a good understanding of the company and the administration process. To facilitate this, I had planned a couple of meetings with employees from different departments. This, combined with all the information I got from my supervisor at the company, paints a pretty clear picture of what the problem is. The biggest hinderance in this step of the MPSM is that the core problem consists of a lot of smaller problems, so this makes it hard to make a complete problem identification.
2. *Solution planning.* In the aforementioned meetings, a lot of complications already came to light. Although not every complication can be solved by one single solution, there are some overarching solutions/concepts that could help solve several complications at once. These solutions include, but are not limited to:
    - *Standardisation of the system.* By standardising certain parts of the administration process (e.g. having more cost types defined on the price lists) there is considerably less room for (human) errors.
    - *Standardisation of the sales.* Currently, at the sales and telecom department, which together form the figurative 'front-side' of the company, a lot of special prices/tariffs are being arranged with the clients. This means that the standardisation that is already in place, becomes (at least somewhat) redundant. Special price lists have to be made for a specific client and sometimes even for a specific job. One simple solution would thus be to stop doing this altogether or at least cut down on the number of distinct tariffs that are being arranged.

    These and many more solution are discussed and further elaborated in Section 6.1. In order to make a good choice on what solution(s) to use, there are a couple of knowledge problems that arise. These knowledge problems are along the lines of "What complications are there?" and "Where do these complications occur?", these are discussed in Chapter 2.

3. *Problem analysis.* This step is all about doing literature research and collecting the necessary knowledge in solving the core problem. For this purpose, the research questions/knowledge problems have been defined. This phase focuses on answering these questions so these can assist in making a sound solution choice. To answer these questions we will be conducting interviews with employees, to get a better feel for what and where complications occur. Moreover, I will be conducting literature searches to gather the required theoretical knowledge.
4. *Solution generation.* After heavily researching the problem, it is now time to start thinking about possible solutions. Even though I already have some possible solutions, as previously mentioned, there will probably more solutions that come to mind after the extensive research from the prior phase(s). This phase will also be the time to do some more research into possible theories or models to use for solving the core problem.
5. *Solution choice.* Once the solutions have been generated, it becomes time to make a decision on what solutions will work (best) and which solutions we would like to use in order to solve the core problem. Within this step, there is very little research involved, so interviews/literature searches will not be necessary in this phase of the research.
6. *Solution implementation.* To ensure that the solution(s) chosen in the previous phase will be used correctly, it is crucial to think about the solution implementation. In this phase we will consider all the actors that come into touch with the solution and the environment that the solution will have to work in. Taking all these factors into consideration, an implementation will be chosen in order to make the solution work as effectively as possible. This solution will

then be communicated to the company as, in bachelor theses, it is unusual for the researcher to involve themselves with the implementation track.

7. *Solution evaluation.* Similarly to the previous step, the researcher will try to guide the company in evaluating the solution(s), however, this phase will be outside the scope of the thesis assignment. Conclusionary, the researcher thinks of several ways to evaluate their own solution(s) and/or recommendations; such as KPIs. However, they will not be evaluating their own work directly and thus not be actively participating in this phase.

Deliverables

To make sure that the research heads in the right direction, several deliverables will need to be formulated. This is a solution where the susceptibility of the administration process of PMC 1 to (human) errors is minimized. This solution has a couple of restrictions. Firstly, the solution needs to have an implementation strategy. The board of the company will need to have an idea of how to implement the solution(s) into the company. This is an important thing to keep in mind whilst formulating a solution as it will need to fit the company's environment. Secondly, the solution needs to be able to be evaluated. The company wants to check whether the proposed solution works and if so, how well it functions. This can be achieved by defining KPIs or setting up a dashboard. For this purpose, an evaluation plan will be set up (Section 7.2), but will have to be carried out by the company. Lastly, the collaboration between the several departments is very important in this process. So the solution should not hinder this collaboration, but preferably improve the collaboration between departments.

2. Context analysis

This chapter discusses all the context that is necessary to fully understand and appreciate this thesis assignment. In Section 2.1 the situation of the company in relation to the thesis are discussed. This includes concepts such as the company environment, the structure of the data systems etc..

2.1 Current situation at the company

To comprehend the situation at the company, but also several choices made in this bachelor thesis, it is vital to clarify the current situation at the company. This includes the environment at the company, the organisational structure, the data systems and the process description.

2.1.1 Company environment

To make sound choices, especially considering the implementation of the solutions, it is crucial to understand the environment at the company. Exemplary, not all solutions would work at all companies, so the researcher should also consider this in solution generation and solution implementation.

At a smaller company like the company it is important to involve the employees and watch the morale of the employees. A case study by Gunasekaran et al., 2009 reviews this matter and gives several important tips. They firstly propose to use gradual implementation as this will lead to a reduction in production loss and improve the morale of employees during the change process. They also hint on the importance of employee empowerment and self-directed work teams, as this helps in implementing productivity improvement programs in SMEs. These points prove that for SMEs, it is important to make the employees feel involved with the changes being made in order for them to work as intended. Furthermore, there is a prevalent, informal atmosphere at the company. It should be noted that this might make the implementation of the solutions a little more difficult. Therefore the usefulness of the changes should be thoroughly communicated and it should be kept easy to understand, without too many complicated terms. Considering the tips from Gunasekaran et al., 2009 and the other points made in this chapter, the implementation should come along easier and more effectively than without considering the change management.

The company operates mostly within the crane-rental market, which takes a one-size-fits-all approach. This means a product that would fit in all instances. Since the company cannot vary with its product and only somewhat with its service, meaning that the company practices the market prices. The one-size-fits-all market also has another consequence for the company: an abundance of competitors. Since the product and service are quite standard, the threshold for possible competitors to join the market is low. Many smaller companies or freelancers can easily join the market and will not have as much fixed costs as a bigger company like The company. This means that they can offer this product at a lower price than The company could afford. This is another reason why the internal costs need to decrease.

2.1.2 Organisational structure

The company is part of a larger chain of the company. They have 9 locations spread across the Netherlands and Germany. Most important are the two locations in Hengelo and Groningen. The research will be carried out at Hengelo, but the location of Groningen has also been contacted for feedback and input on the subject matter. Their processes are quite similar to the ones in Hengelo, but their operating procedures differ quite a lot, which makes it interesting to consider their point of view as well.

The location in Hengelo has it's a structure that is comparable to the one in Groningen. They both have several departments that each have their own tasks and focus points. For the sake of

comprehension, only the departments that are involved in the administration process of PMC 1 are discussed in this section. These departments are:

- *Telecom/sales.* They have primary contact with potential customers and can discuss price arrangements.
- *Work preparation.* They receive job offers from telecom or directly from customers. They discuss the job details with the customer and make sure the right crane(s) and equipment are noted in the job order. They then confirm the order and pass it on to planning and the customer.
- *Planning.* Once an order is confirmed, the planning will plan the job. This includes, the cranes, crane drivers, materials, road blocks, permits etc..
- *Invoicing/billing.* When the crane driver signs the crane ticket, this department gets a sign to construct an invoice. They fill in the gaps where necessary and send the invoice to the customer.
- *Finance.* They check all the financials, also the creditworthiness of potential customers.

These departments highly depend on information of other department, which makes the administration process of PMC 1 quite complex. Moreover, employees' tasks may differ within the departments, depending on whether they specialize in a PMC. For example, some planners only plan jobs that are according to the unit-rate process. This makes the communication stream more manageable in some cases, as employees of a certain PMC know to contact employees that work on the same PMC as them. With this type of departmentalization the company tries to make sure that the responsibilities of each employee are clear and everybody knows what is expected of them.

2.1.3 Data systems

Since the administration of PMC 1 makes abundant use of data systems, it is crucial to explain which data systems are in place and what their functionalities are. This chapter focuses on providing this information.

2.1.3.1 Corsa

Corsa is a document management system that the company employs. It serves as a big archive of job offers, orders, invoices etc.. They are all put under an order-number or project-number, so all the information pertaining to a single job is bunched together. Documents get put into Corsa either automatically (as mentioned in Section 2.1.3.1) or via email. Employees can send an email to the map in Corsa where it belongs and put the order- or project-number as the first text, then the attached files automatically get added to Corsa.

2.1.3.2 Metacom

Metacom is the ERP system that the company uses. In Metacom the planners plan the jobs. While planning the jobs, they fill in the employer, location, materials, crane drivers etcetera. In PMC 1, there should be a framework contract linked to the employer which states the tariffs. Whenever the job is planned, the crane driver does the job and signs it off on a tablet, which feeds it back to Metacom. Then the hours worked are also on Metacom and the billing department can fill in the gaps in the invoice and send it to the customer. Metacom also automatically sends the invoice to Corsa.

2.1.3.3 Relatie360

Relatie360 is the CRM-system that the company employs. In this CRM-system the information of all the contacts is documented, as soon as there is an offer on the table. Since the company hires materials or cranes from other companies when they do not have it available and vice-versa, the CRM-system also functions as a SRM-system, since suppliers are also documented in Relatie360. In

Relatie360 all the framework contracts and price arrangements are also linked to the customers. Whenever a prospect 'promotes' to a customer, this goes to Metacom and the offer becomes an order.

2.1.3.4 Cleverdesk

Cleverdesk is the data system the material office uses for planning and obtaining materials. Whenever a job is planned in Metacom which requires materials, a message is sent to Cleverdesk to inform them which materials are necessary and they will be procured and prepared for the job.

2.1.3.5 V-schijf

The V-schijf is an enormous storage for documents of all kinds. It is being used for quite some while now, so it has enormous amounts of documents, making it hard to know what is in there and if it is, where it even is. The company is now working on a better overview and layout for the V-schijf as they acknowledge this problem as well. The V-schijf is primarily used for documents that exist before they have an order- or project-number or for which there is not category on Corsa. However, even after these numbers exist, documents are often put into the V-schijf as well as in Corsa. A job order is first made and put into the V-schijf and then saved on Relatie360

2.1.3.6 Shared mailboxes

The company uses shared mailboxes to make collaboration easier. Moreover, when someone forgets to put information into data systems and leaves it on their email, colleagues that need that information can find it themselves instead of having to work through someone else.

2.1.4 Process description

To paint a picture of how the administration process works, a process map has been created (Figure 3) with the use of Business Process Mapping (Section 2.2.3). In this map, the tasks within the administration process have been divided into the categories according to the legend (Figure 2). Moreover, the tasks have been divided over the different departments (Section 2.1.2) to make the transference of information clear within the administration process.

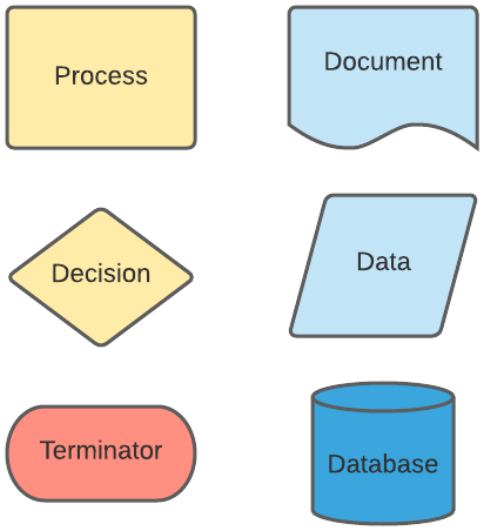

FIGURE 2: THE LEGEND FOR THE PROCESS MAP

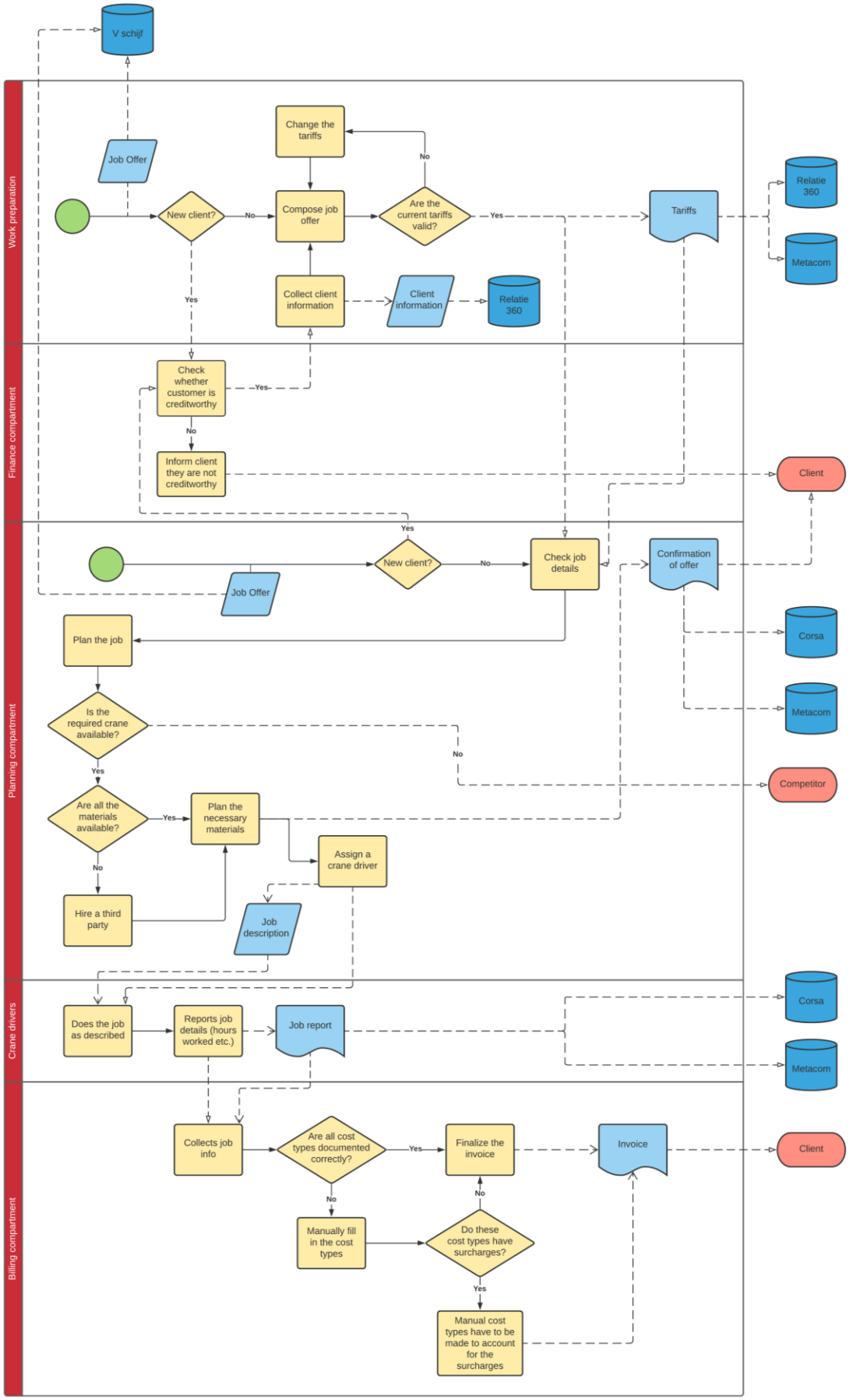

FIGURE 3: PROCESS MAP OF THE ADMINISTRATION PROCESS OF PMC 1

Process map explanation

The administration process always start with a job offer. This means that either a client is approached or a client approaches the company to propose a job to them. This offer comes in at either the planning or work preparation department. Depending on whether the client has previously been involved with the company, they either:

- Get checked on creditworthiness. After which they either get terminated as a possible client or the company collects their information for their database. When the necessary data is collected, the work preparation department composes a formal job offer.
- Or the work preparation department immediately composes a formal job offer.

As soon as the tariffs are suitable, they get saved in the database and the information gets sent to the planning department. There, the information gets checked for correctness and completeness. After confirming that the information is correct and complete, they plan the job. If at the time of the job there is no crane available, they often pass the job over to another company as a professional courtesy. When materials are not available, they hire/rent them externally, so they can still carry out the job. The last part of planning is to assign a crane drive to the job, after which the job description enters the system and gets communicated to the schedule of the crane driver. After finishing the job, the crane driver makes a report on the job, which goes into the database and to the invoicing department. They gather the job info and check whether the system has automatically filled in all the information and whether the information is correct. As soon as all of the information is correct, they send out the invoice to the client who, hopefully pays the fees, ending the administration process of PMC 1.

3. Literature review

In this Chapter the relevant literature for this graduation research is explored. In Section 3.1 the core concepts of this research are elaborated. In Section 3.2 relevant methods of identifying waste are explained.

3.1 Core concepts

Besides the context at the company there are some theoretical concepts that are vital to this thesis assignment. These core concepts are discussed and elaborated in this chapter.

3.1.1 Lean Management

As also discussed in Section 3.1, Lean poses an influential and very important methodology regarding the reduction of waste. Consequently, Lean Management will pose one of the core concepts of this thesis. Womack and Jones (2003) define Lean as "...a way to do more and more with less and less—less human effort, less equipment, less time, and less space—while coming closer and closer to providing customers exactly what they want" and then translate this into five key principles:

1. Value: Specify the value desired by the customer. "Form a team for each product to stick with that product during its entire production cycle", "Enter into a dialogue with the customer" (e.g. Voice of the customer)
2. The Value Stream: Identify the value stream for each product providing that value and challenge all of the wasted steps (generally nine out of ten) currently necessary to provide it
3. Flow: Make the product flow continuously through the remaining value-added steps
4. Pull: Introduce pull between all steps where continuous flow is possible. The 'pull principle' basically mean that an organisation should only produce products whenever the customer has a need for these products. So whenever the is a continuous flow, you should only produce when there is demand for the product or service.
5. Perfection: Manage toward perfection so that the number of steps and the amount of time and information needed to serve the customer continually falls

Lean is founded on the concept of continuous and incremental improvements on product and process while eliminating redundant activities. "The value of adding activities are simply only those things the customer is willing to pay for, everything else is waste, and should be eliminated, simplified, reduced, or integrated" (Rizzardo & Brooks, 2003).

3.1.2 PDCA cycles

The PDCA cycle (Figure 4) is a project planning tool. It has four stages, Plan-Do-Check-Act. These phases form the cycle and just like a circle has no end, the PDCA cycle should be repeated again and again, ensuring continuous improvement. These steps are:

1 **Plan:** Recognize an opportunity and plan a change.
2 **Do:** Test the change. Carry out a small-scale study.
3 **Check:** Review the test, analyse the results, and identify what you've learned.
4 **Act:** Take action based on what you learned in the study step. If the change did not work, go through the cycle again with a different plan. If you were successful, incorporate what you learned from the test into wider changes. Use what you learned to plan new improvements, beginning the cycle again.

Ren et al., (2015) describe the usefulness of the PDCA cycle within quality management as a having a very important role in quality management of the project, schedule management and cost management. Through iterative process, the PDCA cycle can gradually enhance project quality,

reduce project costs, and it can help implement reasonable arrangements for schedule effectively. By PDCA circulation, management gradually approaches the optimum value.

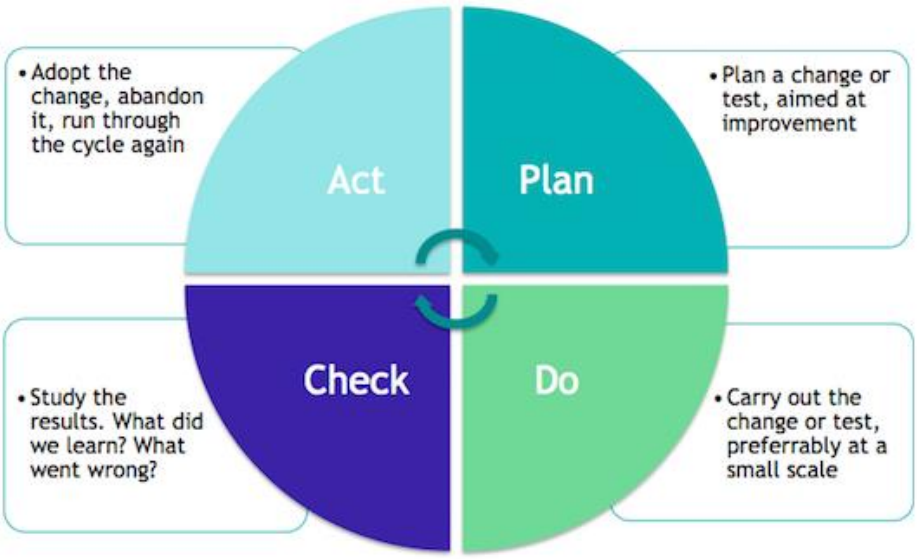

FIGURE 4: THE PDCA CYCLE (VAN OTTERLOO, 2015)

3.1.3 Business Process Management

In the book by Weske (2020), that is also used in teaching Business Process Management to students at the University of Twente, the author gives a very clear and elaborate definition of Business Process Management. They start by defining a business process as consisting of a set of activities that are performed in coordination in an organizational and technical environment. The activities together help achieve the business' goal. Business processes can interact with business processes from other organisations, such as suppliers or clients, but can never be enacted by another organisation.

After a first, thorough consideration of business processes, the view is broadened. Business process management should not only covers the representation of business processes, but also additional activities.

This brings forth the definition of Business Process Management. This includes concepts, methods, and techniques to support the design, administration, configuration, enactment, and analysis of business processes.

The basis of business process management is the explicit representation of business processes with their activities and the execution constraints between them. Once business processes are defined, they can be subject to analysis, improvement, and enactment.

3.1.4 Value Stream Mapping

Value Stream Mapping or VSM for short, is a tool used for mapping a process and identifying waste. J. Womack & Jones (2011) describe VSM as follows: "Value-stream mapping is the process of directly observing the flows of information and materials as they now occur, summarizing them visually, and then envisioning a future state with much better performance. …This is done by disaggregating operations to the level of specific products, where they can be more easily acted on by managers.". So VSM makes the process visually surveyable and then makes the changes manageable by zooming in into specific products. This is achieved in two main phases : value stream analysis, in which the current value stream is visualized, and value stream design, in which sources of waste within the

production process are uncovered and reduced. The method targets at a lean, dynamic and customer controlled value stream, with short lead time and reduced inventories. It is widely used in industrial practice. However, within classical Value Stream Mapping quality defects are only addressed in a very rudimentary manner (Haefner et al., 2014).

Moreover, VSM has many variants which can have different uses. One of these variants is extended value stream mapping. Extended value stream is a map of all of the actions, both value-creating and wasteful, required to bring a product from raw materials into the arms of the customer. Another variant is the quality value stream mapping. QVSM is a procedure model, which complements the classical Value Stream Mapping with specific quality-related elements to visualize, analyse and improve quality issues within a process chain. This method presents the quality defects, quality inspections and quality control loops, in addition to the production processes and flow of materials. Using this in combination with KPIs, the status of quality control across the entire process can be evaluated (Haefner et al., 2014).

3.2 Methods for Identifying Waste

To answer the following research question, a thorough literature review needs to be conducted:

What relevant theories and methods are there for identifying waste in this process?

In the previous steps several of these theories and methods are already identified. The first one of these methods is the Value Stream Mapping tool. This has been used or mentioned in most of the sources and is an incremental tool in waste identification for Lean Management (Haefner et al., 2014 & Womack & Jones, 2011). This will be the first method of choice for this thesis assignment. There were also a lot of general lean management tools that have been used, generally identifying waste by using lean terms such as 'muda' 'mura' and 'muri'. This can easily be using in cooperation with the Value Stream Mapping and will be useful as a building block to build the Value Stream Map upon. The Balanced Scorecard can be used to identify which wastes are the most important and where the improvements should take place (Stewart et al., 2001). Another similar method is the 'low hanging fruits' principle, which aims to improve on the easiest and most impactful wastes first. Both of these theories can be helpful after the waste has been identified, but are not particularly useful in identifying the waste itself. ECRS is a combination of the following core principles: E = Eliminate unnecessary work C = Combine operations R = Rearrange sequence of operations S = Simplify the necessary operations (Barsan et al., 2019). Which is a theory which seems quite similar to Lean Management but focuses on some different fields, so this could be of additional help, but this research will primarily use Lean Management. Moreover, this is a very general theory and will thus be hard to use for directly identifying waste. The last method mentioned in the sources is to use simulation. As mentioned in Limere (2008), simulation is useful in process which are complex and have a lot of uncertainties. This is not very applicable to the administration process of the company. Conclusionary, Value Stream Mapping seems to be the ideal tool to identify waste in our process and could very well be combined with general Lean Management principles and the Balanced Scorecard and low hanging fruits theories.

3.2.1 Makigami

Directly linked with the lean Japanese theory of waste removal and the transactional process mapping approach of the swim-lane, the literature presents another structured and interesting tool – Makigami. Makigami tends to be analysed and studied by practitioners and consultants, rather than academics (Chiarini & Gabberi, 2020). This tool proves quite useful in the communication between process maps and the stakeholders, hence the wide use by consultants and practitioners. The first evidence of this particular mapping tool for transactional processes can be found in the healthcare

system. Kuo et al. (2011) claimed that, although Makigami is very powerful for identifying waste in processes, it is not a traditional lean–TQM tool. So, opposed to the aforementioned theories, Makigami does not fit with the traditional Lean tool principles. The authors claimed that Makigami can be viewed as a type of integration of lean VSM (to eliminate waste and introduce continuous improvement) with BPR metrics-based flow (to measure and reengineer processes).

According to Aij et al. (2014), Makigami is developed during a dedicated kaizen event, similar in its steps to VSM mapping, where a team deeply analyzes activity after activity in the process flow, and eventually subdivides them further and highlights process metrics. Aij et al. (2014) demonstrated this particular use of the tool to map operating theatre processes, while Kuo et al. (2011) employed it in the same way to improve the post-anesthesia care unit workflow. Chiarini (2013) wrote a chapter that analysed the implementation of Makigami for the manufacturing sector. According to the author, the tool can be used as a magnifying glass for parts of manufacturing transactional processes, as well as for pure service processes. The author highlighted the possibility of using typical lean indicators – such as process time, lead time, and number of value-added activities – alongside more personalised indicators – such as the quality of the transaction and headcount–equivalent. According to Kuo et al. (2011) and Chiarini (2013), Makigami can be implemented following defined steps which are:

- identifying the process and its boundaries
- breaking up the process into activities
- identifying the stakeholders or who is in charge of the activities
- measuring activity performance such as process time, lead time, headcount equivalent, etc.

Ultimately, the results from this literature review indicate how the lean and TQM movements have always coped with the need for process mapping (Chiarini & Gabberi, 2020).

3.2.2 Makigami versus Value Stream Mapping

Now that two very useful mapping tools have been identified, it is necessary to compare them and evaluate whichever tool is more valuable to this thesis assignment. In a case study by Chiarini & Gabberi (2020) they compared these two mapping tools in a transactional office environment. They concluded that: “The biggest limitation of the VSM in transactional office environments is that it does not indicate who is in charge of an activity and the headcount–equivalent measurement. … Further, according to the interviewees, the Makigami – through using arrows, loops, and swim-lanes dedicated to each stakeholder – better displays the flow and sequence of all activities within a process.”. So for these transactional environments, Makigami provides a clearer overview of the entire process, especially of the stakeholders’ position in the process.

However, the interviewees in the case study of stated that the Makigami tends to ignore data and information such as setup times or failures when there are machines/technologies in the transactional flow. Moreover, the backlog or WIP is not as visualisable as in the VSM, where one can immediately see the yellow triangle. These measures are thus better mapped in a VSM, as the Makigami does not provide a good representation of these values. The values are not very relevant in this case however, as these are mainly used in production processes instead of processes like the administration process.

Considering all this, VSM seems to have more worth in a production-like process, where measures such as setup times and failure rates are important. The Makigami provides a clearer overview of the processes and people in play in the processes. This means that for transactional processes, especially for complex processes, the Makigami if better fit for mapping the process and waste within the process. This conclusion lies in line with the conclusion made in the case study: “In terms of obtained

improvement in the future state of the maps, the interviewees believed that the VSM used in a transactional office environment was poor in displaying organisational action plans. The VSM functions well in highlighting waste in terms of WIPs, long times, poor quality, and non-synchronisation; however, it is difficult to understand, for example, whether these factors can be linked with overloaded people who could be helped by people from other departments.". Even considering the versions of VSM that are discussed in Section 2.2.4, Conclusionary, Makigami is a better fit for this thesis assignment than the Value Stream Mapping tool.

4. Mapping the process

In this chapter the set-up and results from the interviews conducted with the employees are discussed. The first, exploratory interviews that were aimed at getting to know the company and the process are discussed in Section 4.1. The second round of interviews were conducted via forms, to spread the questions widely and gain as much information as possible in a short time span. This questionnaire and the results flowing forth from the answers are elaborated in Section 4.2. The results from the questionnaire were then formatted and discussed in two feedback sessions, one session with selected personnel from the company at Hengelo and one feedback session with employees from the franchise in Groningen. The results from the feedbacks sessions are discussed in Section 4.3.

4.1 Exploratory interviews

After the first few weeks at the company, the problem cluster had been built and the action problem was identified (see sections 1.2.2 and 1.2.1 respectivley). With this, the rough objective for this research was set. This meant that it was now time to start gaining the first information on the administration process and the precise bottlenecks that occur within the process. To do this, it would have been preferable to speak to everyone that is involved in this administration process. However, practically this is not possible within the time frame that is present with this thesis assignment. Henceforth, it was preferable to speak with one employee from each of the departments that are directly involved with administration process: telecom, work preparation, planning, invoicing, crane drivers and project leaders. Together with the representatives from the company, a list was created with employees that would be willing to help with the research and were most likely paint a clear picture of their tasks.

The interviews with these employees were generally structured in the same way. First, the employee would give an explanation of their tasks: how to do them, with which other department they interact, what could go wrong etcetera. During and after the explanation, there would be room for questions to get some information on subjects that the employee did not mention or to go deeper into subjects that were of interest to this research. Most of these questions were written before the interview, to ensure that nothing was forgotten during the interview (see Appendix 1). Some of the questions were formed during the interview, e.g. when the interviewee touched upon a matter not previously considered by the researcher. These questions and answers were all documented in separate word files per department. Examples of these questions (for planning) would be:

- Does everybody check the planned jobs or specific, appointed employees?
- Do you only check your own planned jobs or everyone's planned jobs?
- How easy is it to find the order-format?

The answers to these questions would give an indication of possible improvement points or bottlenecks within the administrations process. The results of these primary interviews are the process map shown in figure 3 and a basis upon which the secondary line of questioning was based.

4.2 Questionnaire

Now that the basic information was gained and a starting ground for the research was established, it was important to gain as much information about the possible improvement points and bottlenecks as possible. Once again it would have been preferable to speak to every individual that has a direct link to the administration process of PMC 1. Similarly, this would not have been possible due to time limitations. However, in this case the chosen alternative was different. Since the quantity of information was more important than the quality in this case, the researcher opted for a

questionnaire instead of specified interviews. To identify as many bottlenecks and opportunities for improvement as possible, it is vital to gain information about this subjects from as much sources as possible. Moreover, an online questionnaire is much safer in these times.

This questionnaire's purpose was to identify possible improvement points per department, but also gain a better insight into the transference of data. The questionnaire would make a difference in department and then be able to ask targeted questions that would have far better outcome than general questions. However, some questions would still be asked to every department, so there was a split in general questions and department-specific questions. The questionnaire was submitted to employees in Dutch. But for documentation purpose, a translation of the questions can be found in Appendix 3. This features the structure and content of the entire questionnaire.

4.2.1 General Questions

These are the goals of the general questions in the questionnaire:

- Making clear which data systems are most used by which departments. This also indicates where the department thinks the employees leave the information for them.
- Pointing explicit what information should be handed over at the transfer. This also acts as an indication what information should be documented by other departments.
- Understand where departments leave their information, but also where other departments should look if they need information. Together with other questions this should give an indication of any miscommunication or data loss within the administration process and also provide us with the exact position of the data loss.
- Helping us understand what data is presumed to be important enough to document and communicate with the other departments. Together with the other questions, this provides an indication of missing data, but because it was never asked or documented. With this clear definitions could be formulated on what data is important (and should thus be saved) and what data is not.
- Providing the information of an approximate timeframe of processing a job. This could help set up performance indicators later on or provide us with extra information on how the job is processed.
- Collecting possible improvement points. Since not everybody might be able to give their input or feedback the way they wanted within the frame of the questionnaire, the questions should provide an opportunity to do so.

4.2.2 Department-specific questions

The answers to the department-specific questions are mainly interesting for departments that rely heavily on data from internal customers or fellow employees. Therefore, these questions were only included for the planning and invoicing departments, as they are the last two departments in the administration process and thus experience the most nuisance when the information is missing or incorrect. The main goals of these questions are the following:

- Giving an indication of the importance of continuity and standardization. Even though there is a template for an order, some employees still communicate orders in a number of different ways. This sometimes leads to missing, misplaced or incorrect data and would thus hurt the efficiency of the administration process. With this question it should be possible to determine a quality standard and uphold it.
- Giving a general indication of what information is most often lost in translation or not collected at all. This could then be communicated with personnel to make sure everybody is on the same page about data collection.

- Giving an indication on what data is communicated incorrectly or in the wrong way, making it invalid.
- Identifing possible bottlenecks or points of improvement. These points of improvement would be focused on improving the quality and consistency of the information and the transference of this information.

4.2.3 Results

This questionnaire was sent to 23 employees of the company (Regio Oost). Of these 23 people, 18 people responded to the questionnaire. At least two people per department answered the questionnaire apart from the telecom department, which currently only employs two people. This means that with a response rate of around 80%, this questionnaire should be quite representative of the actual process and the responses should collectively lead to representative conclusions. The collective result was modeled in a Makigami, presented in figure 5. This Makigami was then used as input for the feedback sessions with focus groups that are discussed in the next section. It should be noted that the makigami, together with much of the results that had to be communicated back to the company and its employees, is in Dutch, for the sake of communication with the company. A translation of the Makigami can be found in the appendix.

FIGURE 5: THE FIRST MAKIGAMI OF THE INFORMATION FLOW OF THE ADMINISTRATION PROCESS OF PMC 1

4.3 Feedback Sessions

To discuss the results from the questionnaire, a focus group from Hengelo and one focus group from Groningen were assigned. The goal of the feedback sessions with these focus groups is to present the results from the questionnaire to regional managers, project managers and important employees within the several departments. This way the results were checked again for anomalies or outstanding results. Moreover, this feedback sessions was an opportunity for the department 'representatives' and their supervisors to communicate with each other, which was not possible in any of the previous interactions. This way the standards that the employees have for themselves and

each other could be clearly communicated. This also was a great opportunity for discussion and/or consultation about several key points or other points of divergence.

After the first feedback session, the Makigami was updated with the new insights gained, see figure 6. Several points of improvement were added, some points of improvement were relocated and some points were laid off or deemed unsatisfactory. A translation of this Makigami can be found in Appendix 4.

FIGURE 6: THE MAKIGAMI OF THE INFORMATION FLOW OF THE ADMINISTRATION PROCESS OF PMC 1 AFTER FEEDBACK SESSION ONE

5. Result Analysis

This chapter focuses on the analysis of the results from the research, as mentioned in Chapter 4. In Section 5.1 the points of improvement gained from the researched are clustered together to identify the covering problem. Then Section 5.2 focuses on department-specific problems and Section 5.3 on data system-specific problems.

5.1 Clustering of the problems

After the feedback sessions mentioned in Section 4.3, a lot of improvement points were identified. To ensure that all solutions are considered, it is important to relate these points back to the underlying problems that they are meant to solve, this chapter will do exactly this by giving each point of improvement their own color code, which relates to a covering problem.

5.1.1 Points of improvement

TABLE 1: IMPROVEMENTS POINTS OF THE ADMINISTRATION PROCESS

Point of Improvement	Category	Datasystem(s)	Department(s)
Outsourcing/decentralizing administration	Centralisation of administration	-	ALL
More use of Relatie360	Data system structure	Relatie360	ALL
Pour telecom information into a database	Data system structure	-	Telecom
Hear the customer out better	Communication of ordering data	-	Work preparation, telecom, planning
Link price table to order	Communication of ordering data	Corsa	Work preparation, telecom, planning
Unity in ordering	Communication of ordering data	-	Work preparation, telecom, planning
Link to the V-schijf in the order	Communication of ordering data	V-Schijf, Corsa	Work preparation, telecom, planning
More and better communication before planning a job	Better general communication	-	ALL
More use of Corsa	Data system structure	Corsa	ALL
Communicate price-arrangements earlier	Communication of ordering data	Corsa, Metacom	Work preparation, telecom, planning
Make invoices transparent to everyone	Better general communication	Metacom, Corsa, V-schijf	ALL
Less places for data saving	Data system structure	-	-
Keep responsibility in the right place	Centralisation of administration	-	ALL
Arrange the V-schijf differently	Data system structure	V-schijf	-
More clarity regarding data sources	Data system structure	ALL	-
Unit-rate+ category in Metacom	Ease of data input	Metacom	Work preparation, telecom, planning
Inspection on the input of yearly tariffs	Inspections	Relatie360	-
Send a confirmation of order to	Inspections	Corsa, Relatie360	Work preparation,

the customer with the price			telecom, planning
Make sending a confirmation of order easier	Ease of data input	Corsa, Relatie360	Work preparation, telecom, planning
Make the concern agreements more clear	Communication of ordering data	Relatie360	Work preparation, telecom, planning
Put purchasing-numbers into Corsa	Communication of ordering data	Corsa	Work preparation, telecom, planning
Make a better connection between Relatie360 and Metacom	Data system structure	Relatie360, Metacom	-
Make a harder relation between the job offer and the order (automatically setting the job offer into an order)	Communication of ordering data	Relatie360, Metacom	-

Unclear structure of data systems

Currently, the company employs quite some different data systems. Most of them were created as add-on's to Metacom. This led to an overwhelming amount of places to leave data and recover data from. This leads to the loss of information within the administration system. When information about a job is lost within the process, jobs cannot be carried out to full satisfaction of the customer, or the subsequent invoice does not entail the right details. In either way, this leads to unnecessary costs or time lost.

Insufficient communication of ordering data

Orders can come from outside clients or from within The company. These orders get transmitted to the planning department, where the planners plan the job. Moreover, the data from the order is used to make the invoices. Basically, the ordering information plays an important role within the administration process of the company. Henceforth, it is valuable to standardise, simplify or generally improve this task.

Centralized administration process

In the current administration process, there is a lot of overlap between departments, which creates some uncertainties in the task division. Since not every employees knows exactly what is expected of him or her, since the tasks are so centralized, tasks get done twice or not at all.

Little to no inspections

Currently, there is not a lot of control on certain tasks that are quite vital to the administration process. By enjoying (better) inspections, the quality of the work should go up and make the administration process go along more efficiently.

Lack of communication

Some details of the jobs are not communicated clearly or not on time. If the communication, both active and passive, would be better, the administration process should have less mistakes. The active communication means that all data should be passed on to the coherent department. The passive communication entails the communication of certain standards. An example of this is the communication of necessary data for making invoices to preceding department. This problem could

also be solved by increasing the transparency at the company, which is also suggested by an employee for the invoices.

Input of data could be more user-friendly

In the current data systems, some instances, e.g. data input, can be simplified to make it easier for the user to interact with the system. Since the interactions with the data systems are in some instances difficult or unclear, data can be mis-input or lost entirely. This leads to problems further into the process.

5.2 Information carriers

As mentioned in Section 4.2, the questionnaire could provide an insight in the usage of data systems. The different department were asked where they save and wherefrom they retrieve their data. These so-called information carriers were all documented in the Makigami (Figure 6). The information carriers are structured in table 2.

TABLE 2: THE INFORMATION CARRIERS IN THE ADMINISTRATION PROCESS

DATA TRANSFER	DATA SAVE POINT	DATA RETRIEVAL POINT
FIRST CUSTOMER CONTACT -> CUSTOMER ADVISE	RELATIE360, V-SCHIJF, CORSA, EMAIL	RELATIE360, V-SCHIJF, CORSA, MAIL, ASKING AROUND
CUSTOMER ADVICE -> MAKING AN ORDER	V-SCHIJF (FOLDERS: 210, 350, 107), RELATIE360	V-SCHIJF, METACOM, RELATIE360, MAIL, CORSA
MAKING AN ORDER -> PLANNING	MAIL, CORSA, V-SCHIJF, RELATIE360, PERSONAL FOLDERS	V-SCHIJF, MAIL, INTERNET, TABLE-OVERVIEW, COLLEAGUES, PHONING, PROFIT, INTRANET AND "WHEREVER I CAN FIND IT"
PLANNING -> INVOICING	V-SCHIJF, METACOM, CORSA, MAIL, PAPER AND "JUST REMEMBERING IT"	V-SCHIJF, MAIL, MOUTH-TO-MOUTH, METACOM, PAPERCLIP (IN METACOM)

Looking at the table, it becomes abundantly clear that there is no real structure in the data transference. This conclusion can be assumed by three main aspects:

1. *The multitude of save- and retrieval points.* For every data transfer, there are at least four different data systems or methods to save and retrieve data. Ideally, each data transfer would go via one channel, so everything would be clear and easily accessible. With the current set-up of data systems this is obviously not the case.
2. *The save points and retrieval points do not match.* Obviously, you cannot or should not be able to access information in a place it was not saved. However, in the survey and feedback sessions it seems a lot of data is saved in places it is not looked for or data is looked for in placed it is not saved. This means that the departments' expectations of each other's working methods differ, leading to no clear structure.
3. *The lack of knowledge on save- or retrieval points.* Having some correlation with the second aspect, this aspect relates to the unclarity of data transference. This becomes profusely clear by comments such as: 'Wherever I can find it' and 'just remembering it'. This points out the fact that even, at least of, the employees are now uncertain of the procedures of data transference.

From all this, one can conclude that there is no clear structure. To ensure that all data is properly transferred to right place and gathered from the right place, there will need to be a structural reorganisation of the data systems or a clearer structure within the current environment of data systems. This will be further discussed in Chapter 6.

5.3 Information transference

The third and last factor that was researched with the interviews and sessions from Chapter 4 is the information that is being transferred. By asking the departments what information they transfer onto other departments and which information their receive from other departments, it should become clear whether any unnecessary information is being transferred or that information is missing because it is not saved for other departments to find.

Some of the responses on this question were far too specific to provide any real value, such as specific information pieces like dates, locations etc. Whereas other responses were so vague that concluding anything from them would be impossible. Moreover, the responses were not only varying in specificity, but in content as well. Some employees indicated to need job offers and client information, whereas their colleagues would imply no such thing. In conclusion, the responses to these question had little to no correlation and thus any conclusions drawn from these would hold no academic value.

6. Recommendation Analysis

This chapter serves as a platform to draw conclusions from the data gathering and data analysis is discussed. These are projected into recommendations towards the company (Section 6.1). These recommendations are then linked to the BPM of Chapter 2 to analyse where they improve the process (Section 6.2).

6.1 Recommendations

Throughout this research study, several problems have been identified. However, not all of the problems are solvable, because they are caused by human error or incurred by factors that the company has no influence on. Consequently, this section discusses only the problems which can be solved. The recommendations will address the problems that are (most) valuable to solve and will shortly touch upon methods to solve the problems.

6.1.1 Restructuring or clarifying the data systems

One main problem that kept arising was the structure of the data systems. Currently, the employees have no clear overview of where they should save, retrieve or view information. Obviously, they are not clueless, as the administration process still goes along quite well, but a better general structure would help data from getting lost in the process. There are several ways to tackle this problem, which both provide a unique method and result.

The first one of these solutions would be to completely reorganise the data systems. This reorganisation has already started at the company. At this time, the company is working on the reorganisation of the V-schijf, which currently is in quite a disarray. By restructuring this data system, they hope to make the system more clear and useable for the departments and provide more transparency by connecting all order-related files in one drive. This way everybody should know where they are supposed to work within the V-schijf, and employees can retrieve data from other offers more easily. Doing this on a larger scale would provide a similar benefit, albeit with a lot more work. Reorganising the data systems would inquire an analysis of the current data systems and what their functionalities are and which value their provide to all departments and tasks. By doing this, it should become clear if there are any abundant data systems and whether data systems should have more or less functionalities, get upgraded or expanded with new applications. Especially when it becomes possible to remove one or several data systems from the administration process or substitute one data system for an upgrade or extension of another data system, the reorganisation of the data systems becomes beneficial for the company. Otherwise it should also be possible to research the connection between the data systems and the structure in which they function. By making different connections or make more direct connections, the structure of the data systems would become more well-defined. An example of this would be the more direct connection between Metacom and Relatie360, as mentioned in one of the feedback sessions.

Another method to increase the knowledge of employees on the data system structure, is to provide a visual overview of all of the data systems and for which tasks/information they should be indulged. This document could function as a roadmap for the digital landscape of the company, by clearly indicating which data systems are connected and how they are connected. Moreover, they could show what information could be retrieved where and what information should be saved where. Once implemented this could work as both a roadmap and a learning tool for new employees, where they can get to know the digital structure of the company.

Both solution reach a different goal, but both serve the purpose of making the structure of data systems more clear. Where the reorganisation does this by simplifying the structure of the data

systems, the roadmap would create a better overview of the current structure. It is up to the company to choose which solution provides more value to them and whether they actually find any of these recommendations beneficial.

6.1.2 Standardise the transference of data

Another problem that was encountered within the administration process is that data is being lost or not being collected at all. Without this information, the job order description is incomplete, which may lead to incorrect invoices or inadequate job execution. This problem is partly caused by the variance of information and job details. One example of this is, is a case where the company was supposed to do a job for company A, but on the terrain of company B. This is mainly because company A and company B are in the same consortium. However, the location is either not disclosed by the customer or not communicated clearly.

To make sure that that the employees know which information should be communicated with other departments, the company should look into standardising the transference of data. As mentioned in Section 5.2 and 5.3, the information that needs to be shared is not always clear. Setting up a standard format for both internal and external job orders would help create clarity and transparency within the administration process. Currently, the company already has an ordering form, which can be filled in when all job details are known. This is then send to the planning department to plan the job. However, not everyone uses this form, which means that it is currently pretty ineffective. Researching why this form is currently not always employed and what should be changed would be a great way to create some standard practices within the data transference. Whenever a process becomes more standardised, the output becomes less variant and employees have a better understanding of their functionality. Both factors will help make the ordering data and other information more complete, by ensuring that the employee knows ‘what boxes to tick’, since the data transference will always be the same.

Increasing the standardisation within the administration process would also allow for more check-ups and continuous improvement (Kaizen). Since it is only possible to evaluate improvements objectively when existing procedures are standardized and documented. As standards improve, the new standard for Kaizen becomes the basis for further improvements: improving standardized work is a never-ending process (Tulip, 2021). This would help with the evaluation and implementation of KPIs within the administration process.

6.1.3 Creating a new Product Market Combination

In theory the PMC 1 administration should be really simple. But in practice, many complications arise because of specific price arrangements outside of price tables, multiple locations for one customer, extra materials and other remarks that do not fit the ‘normal’ bill for PMC 1. These things are mostly communicated through a paperclip in Metacom or mailed in documents via Corsa. Considering all this, in practice there might be a separate (Figure between the unit rate rentals of PMC 1 and the custom projects of PMC 2: unit-rate+. Currently, there are quite some job offers that fall in between PMC 1 and PMC 2 and get swept up by personnel of PMC 1. This means that information gets put in paperclips and other unstandardised methods. If the company where to create a ‘new’ PMC-category that would have more room for specialisation, there would be less miscommunications. The employees would know that the job is not just a ‘bare’ crane rental and be on the lookout for customer-specific information or price agreements. This way the actual PMC 1 could go along more smoothly, as this is actually really standardised and can go almost automatically and unit-rate+ would take as much work as PMC 1 does now, but with better overview and better results.

6.1.4 Standardisation of the sales

One of the recurring discontinuities that occur within the administration process is the incomplete or incorrect prices. Although this PMC is supposed to be all about unit-rate prices and simple prices, often custom price arrangements are made with clients. These custom tariffs can even change from job to job, making the standardisation of the invoicing rather difficult if not impossible. By standardising the prices, all of the price categories can be entered in the system and the automatically filled in in the invoice. This would greatly decrease the susceptibility of the process to human errors and also make it far less labour-intensive. However, there one major drawback of this decision. Standardising the sales would mean that the company would be unable to bargain with potential clients and, as a result of this, lose out on a potential job. Clients would much rather go to a company that is willing to bargain and adapt their prices to their projects. So with decreasing the costs of the administration process by standardising their sales, the company might lose out on a segment of their (potential) clientele.

6.1.5 General remarks

Not all points of improvement fall under one great theme. These points of improvement are still quite important to consider. In this chapter, the most valuable and easily implementable of these improvement points are discussed.

Order confirmations

Currently, the company issues order confirmations to all of their customers, to ensure that the job details are communicated well. Royal The company in Groningen does not do this and has a considerably higher credit note. Credit notes are the percentages of invoices that are sent back because they were incomplete or incorrect. The first recommendation would obviously be that Groningen would also issue these job confirmations as this ensures that both sides, the company and client, share the same view upon the job at hand. Moreover, the company (Hengelo) does not enclose all of the job details, as they do not share the price of the job. Sharing this as well could help create more transparency and function as an inspection on the price tables. As they were established by both parties, this should not lead to oversharing of information, but only as a reminder of the agreed prices. At least for PMC 1, this would be a good option for extra inspection and quality control.

Filling the price tables and cost types

In the current environment, the company issues price tables that are almost exclusive to each customer. In these price tables everything the company can offer is noted under a cost type. However, on Metacom not every cost type is filled in or not mentioned in the price table. This means that Metacom is not able to automatically fill in the prices for the invoices. This either causes the employees to manually fill in the cost types and prices, which takes up quite some time, or it is overlooked meaning that the invoice will be incorrect. If a cost type is not connected, it will automatically fill in a price, meaning that, in most cases, the company loses out on money. Filling in the price tables and connecting the right cost types would lead to a structural better, complete invoice and on average increase the turnover. Another factor which plays into this is the administration of surcharges. If a cost type has to be filled in manually, there is no way within Metacom to fill in a surcharge. This causes the invoice to be incorrect or more manual work to be done. By filling in all of the cost types this can be prevented.

Transparency

This is quite a big thing to change, but by increasing transparency, employees know what is expected of them by other departments. One example of this would be a document which is owned by The company, containing information on clients which have special wishes in regards to the invoices (e.g.

special formatting or extra information). If this document is shared with all departments, everyone should know what they need to with these special customers in order to realise their wishes. There are certainly many more cases in which transparency would help reach over the gap between the expectations of the different employees, creating a clearer workspace.

Software annoyances

There are several small annoyances within the data systems that The company uses. If these were all collected in a list and communicated with the provider, perhaps solutions could be formed and these annoyances could be prevented. An example of these annoyances is that crane drivers and cranes are automatically connected, which is easy when you need to plan a job. When a crane driver uses another crane they stay connected to the previous crane, which means it has to be fixed manually. If complications like these were gathered and communicated, at least some of them could probably get solved.

6.2 Process Analysis

To present a clear overview of where they impact the process, it is important to put the recommendations and the BPM side by side. This also helps in the implementation process, as it becomes more clearer where the effects will transpire.

Restructuring or clarifying the data systems

This recommendation mainly aims at minimizing the loss and alternation of information. By creating a clear structure within the data systems, the information will stay present and valuable. Consequently, this recommendation will hold the most significance early on in the process. Examples of these are the job offer details that are obtained at the planning and work preparation, the tariffs and cost tables formulated before transference to the planning department, the clients' information and preferences gathered at acquisition and the confirmed job offer, which contains all of the information on the job (see figure 7). If these preliminary pieces of information get transferred accordingly, this can prevent many discontinuities later on in the process.

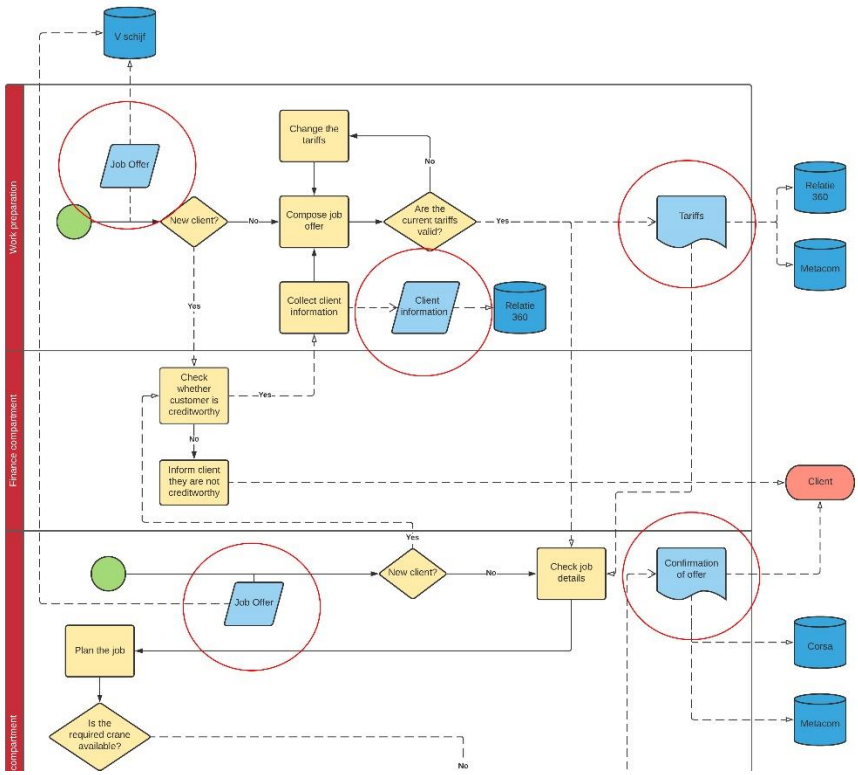

FIGURE 7: IMPROVEMENT POINTS FOR RESTRUCTURING OR CLARIFYING THE DATA SYSTEMS

Standardise the transference of data

This recommendation will amount to similar advantages as the previous recommendation. Mainly, preventing the loss and transformation of information within the process, upholding the quality of information. This will however impact different parts of the process, as this will have a greater effect in transference between departments and not as much with the data systems. Areas of the process where this will have effect are the transference of the job description from the office to the employees on site, the report of the job and at the planning department, when the job details are checked (see figure 8). The first two seem obvious, but the latter one will undergo an improvement as all of the small pieces of information that are vital for the planning department should now be present and correct, meaning the job can be planned accordingly and assuming the improvement in the job description and job report, this should add up to an easier job creating an invoice.

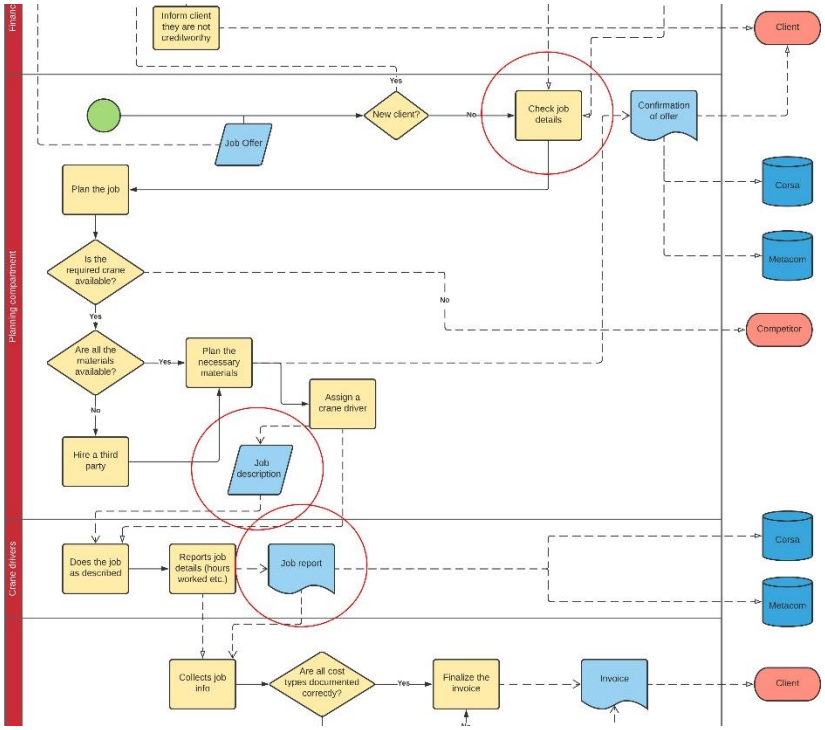

FIGURE 8: IMPROVEMENT POINTS FOR STANDARDISING THE TRANSFERENCE OF DATA

Creating a new Product Market Combination

The main purpose of creating a new PMC is to make the administration of the actual 'bare' crane rentals easier and make it clear where alterations to this standard PMC are. This will make it unnecessary for several scenarios to be considered, making the process more standardised. These scenarios are (see figure 9): checking whether the tariffs are correct, as in the actual 'bare' crane rentals there would be a set price, and checking whether the cost types are documented correctly, as these would always be the same cost prices and would then be correct for all cases. Besides these considerations, this recommendation would also make the tariffs less variable and thus easier to handle and the data systems wherein these tariffs are documented less packed and thus easier to oversee.

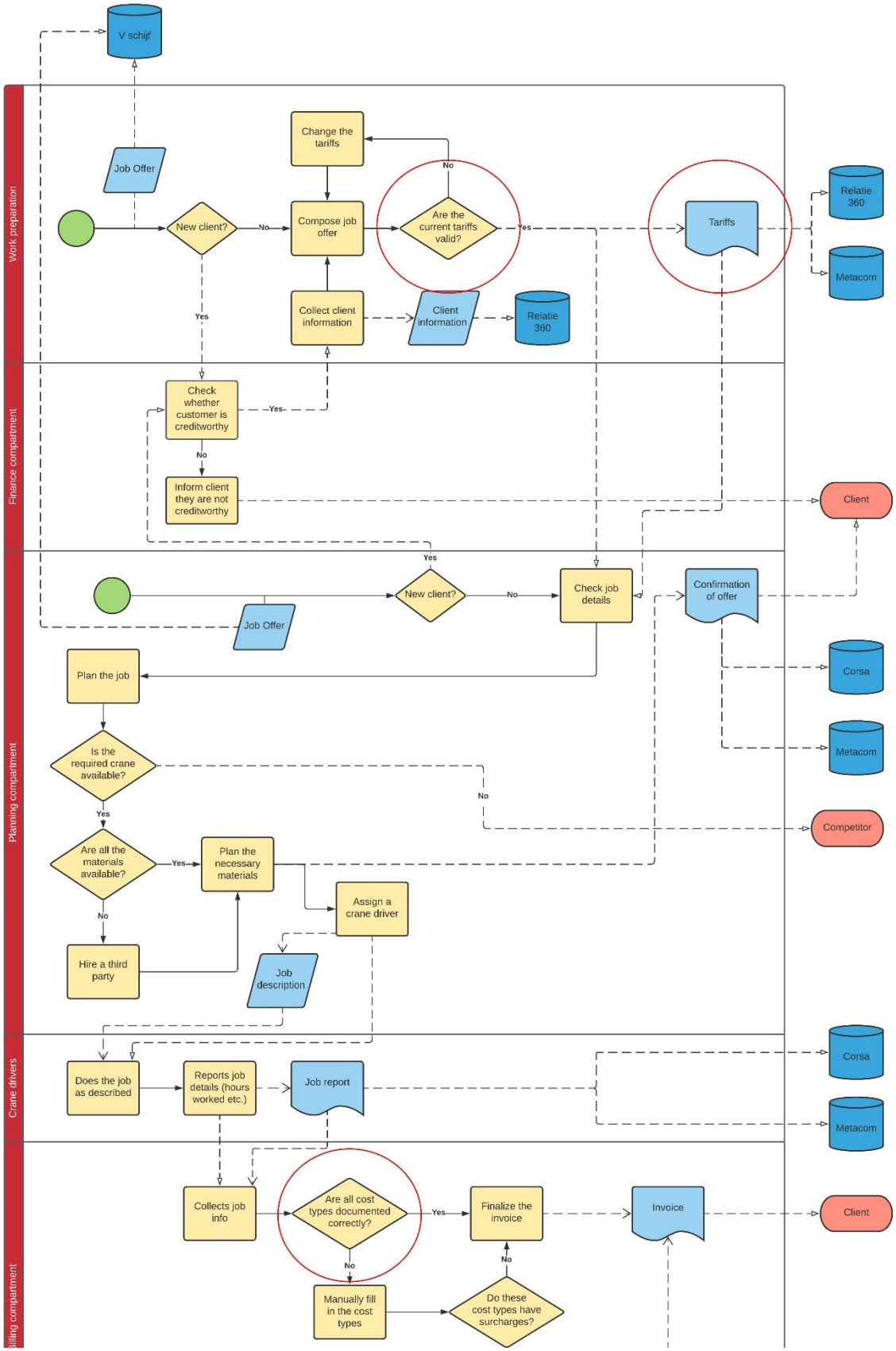

FIGURE 9: IMPROVEMENT POINTS FOR CREATING A NEW PRODUCT MARKET COMBINATION

Standardisation of the sales

Making the decision to standardise all or most of the sales would have a fairly comparable outcome to the previous recommendation. This would mean that all or most of the jobs would go according to the rules of a unit-rate process, making an impact in the same areas as the creation of a new PMC (see figure 9). The main difference is the severity in which this is carried out, as in the previous recommendation the cases are separated and in this case all of the cases are standardised to fit the format of PMC 1.

Order confirmations

Sending more frequent and more elaborate order confirmations helps the company gain an insight in possible miscommunications between them and the clients. This will obviously have an effect on the confirmations themselves, but mainly on the process steps that inquire the crane drivers to carry out the job (see figure 10). Since this will prevent miscommunications and prevents any discontinuities at the site, such as incorrect locations or missing materials.

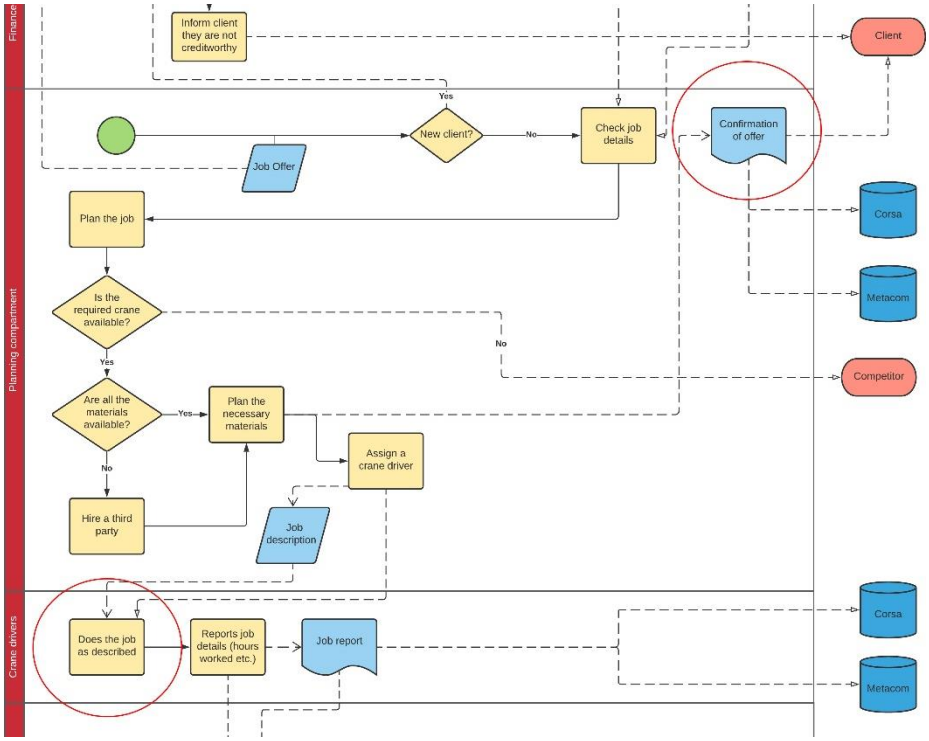

FIGURE 10: IMPROVEMENT POINTS FOR IMPROVING THE ORDER CONFIRMATIONS

Filling the price tables and cost types

Ensuring that more of the price tables and cost types are filled in (correctly), will make the necessity for the process step 'manually fill in the cost types' less (see figure 11). As more of these will already be filled in, the invoicing department will have to spend less time on this process step and this step will ideally disappear completely from the process.

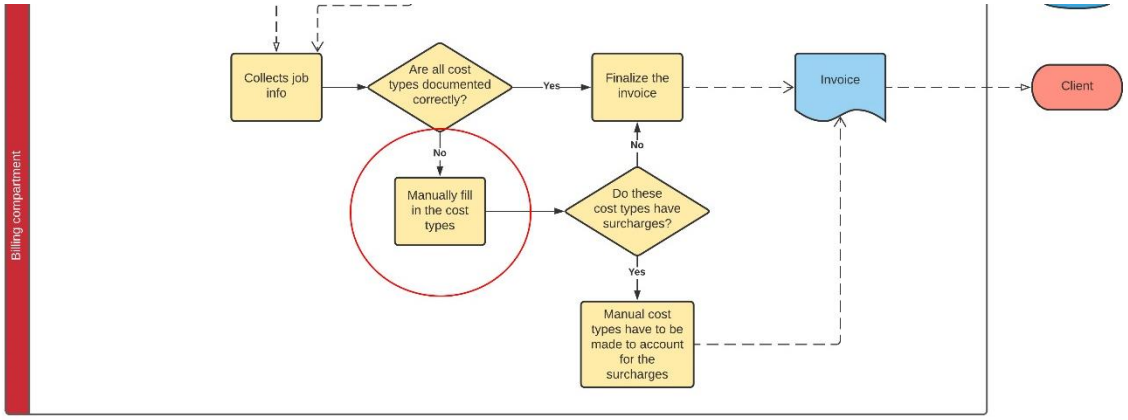

FIGURE 11: IMPROVEMENT POINTS FOR FILLING THE PRICE TABLES AND COST TYPES

Transparency

Making the process and the expectations of the other deparments more transparent, will help increase insight in the output that needs to be produced (in terms of data or information) by each deparment. This will improve the process across the board, but mostly at one specific process step: checking the job details (see figure 12). This recommendation will not only make it easier for previous departments to provide the correct information to the planning department, but also help the planning deparmtent in checking the details, as it should be more clear to them what they need to check for, as they should know what is expected from them in terms of output.

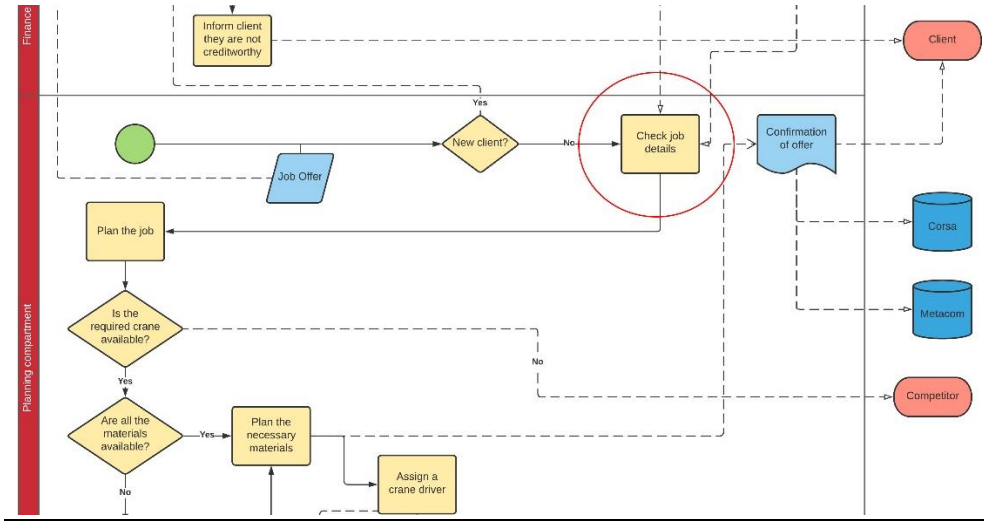

FIGURE 12: IMPROVEMENT POINTS FOR INCREASING TRANSPARENCY

Software annoyances

These include a lot of minor inconveniencies, which will improve the quality of work and ease-of-use of some data systems within the entire process. There are however some specific points that will help in explicit areas of the process. These are the assignment of crane drivers to a job (see section 6.1.5), the task of manually filling in the cost types and the fact that if the cost types are filled in manually, the surcharges are not calculated automatically and also have to be filled in manually (see figure 13).

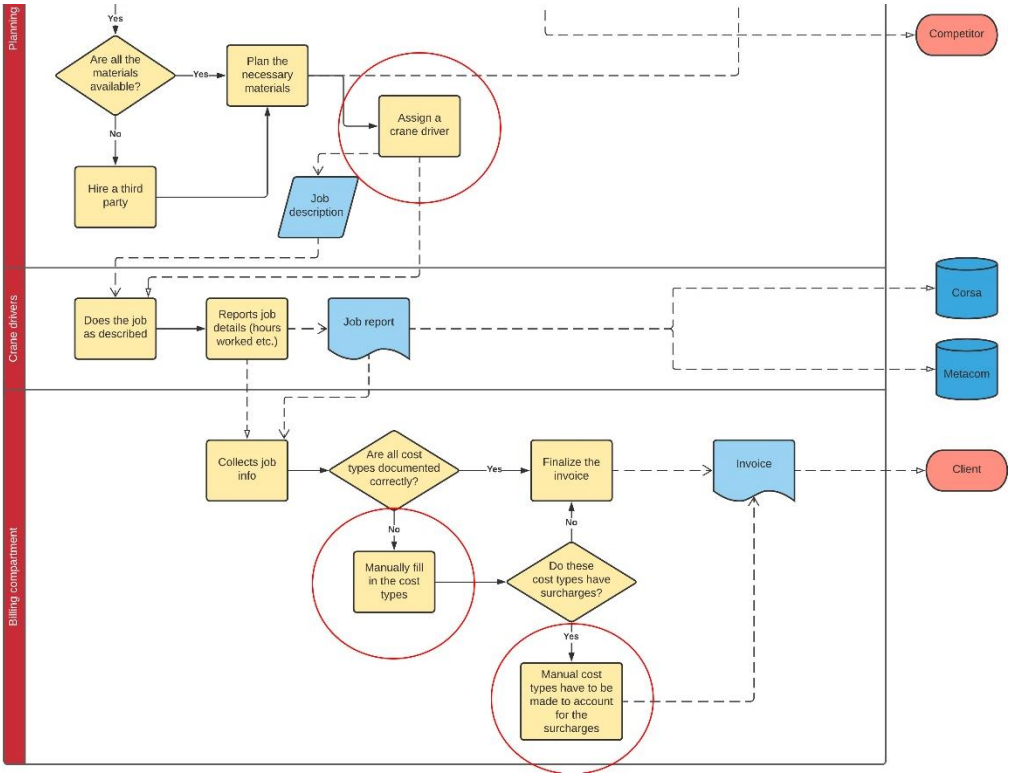

FIGURE 13: IMPROVEMENT POINTS FOR SOLVING SOFTWARE ANNOYANCES

7. Conclusions and recommendations

In this chapter, the conclusions drawn from the data gathering and data analysis are discussed and projected into recommendations towards the company (Section 7.1). The implementation and evaluation of these recommendations are also discussed in Section 7.2. Any limiting factors on this research are elaborated in Section 7.3. The conclusion about the entire bachelor thesis process and research set-up is discussed in Section 7.4. Lastly, the possibilities for future research are expounded in Section 7.5.

7.1 Contribution of recommendations

TABLE 3: ANALYSIS OF THE CONTRIBUTION PER RECOMMENDATION

Recommendation	**Targeted problem**	**Benefit(s)**
Restructuring or clarifying the data systems	Unclear structure of data systems	Decrease in loss and transformation of data (improving the overall quality of data)
Standardising the transference of data	Insufficient communication of ordering data & centralized administration process	Decrease in loss and transformation of data (improving the overall quality of data)
Creating a new PMC	Insufficient communication of ordering data	Making PMC 1 an unit-rate process whilst maintaining the opportunity to bargain with clients
Standardising the sales	Insufficient communication of ordering data	Making PMC 1 simpler by using a standardised price table
Improving the order confirmations	Insufficient communication of ordering data & little to no inspections	Increase the correctness of job details, thus improving the quality of work
Filling the price tables and cost types	Insufficient communication of ordering data	Making the process more standardised with less unnecessary tasks for the invoicing department
Increasing transparency	Lack of communication	Increase the accuracy of data output by communicating expectations across departments
Solving software annoyances	Input of data could be more user-friendly	Making the interaction(s) with data systems more user-friendly and less time-consuming

7.2 Implementation and evaluation

To ensure that the abovementioned recommendations are well-received and efficient, it is important to think of an implementation strategy. With this, it is important to consider all of the aspects mentioned about the company's environment (Section 2.1.1).

First of all, all of the employees should be actively engaged within the implementation process. By making them feel heard and engaging them, the implementations have a much higher chance of becomes widely accepted. This might seem obvious, but as some routines are currently not used by all employees (such as the order forms), it is important to do this whilst implementing any of the recommendations. It is also important not to rush these things so the employees can get used to the implementations gradually. This is especially important at the company, since some of the employees

are quite conventional. This slower implementation process also provides an opportunity to use continuous improvement methodologies such as the PDCA-cycle and feedback loops.

Another thing to consider whilst implementing the recommendations is the contact with the data system providers. A multitude of problems stem from or have to do with data systems. On many occasions, these providers are willing or able to provide something that helps with the implementation or helps with the process of implementing. Asking their opinion and expertise would prove quite useful as they may have already encountered the struggles that the company has.

The evaluation of the recommendations will probably be a difficult subject, as this is a qualitative process. However, the company does keep track of its credit note, which functions as a success rate of the administrative process. Using this as a primary KPI would help the company evaluate the performance of several recommendations. Furthermore, Metacom mentions on their website that they provide dashboards that provide performance tracking. This might not have been valuable to invest in normally, but if the company considers to change up their patterns and wants to check the performance, it might be valuable to inform at Metacom whether they can provide performance trackers for the administration process.

7.3 Limitations of the research

When doing any research it is important to notice that the research will never be perfect. It is crucial to reflect on the research and identify the points where the research might be lacking or causes for possible quality decrease. In this chapter these factors are discussed as well as how they impacted the research.

The first and most obvious limitation is the COVID-19 situation that has the world in its grip. Since the virus is roaming the earth, all countries have put up regulations to prevent its spread. In the Netherlands this means that work from home is encouraged and within the office it is obligated to keep 1,5 meters of distance. This meant that the research was harder to do, as not everyone was working at the office at all times. This lengthened communication lines, making it harder to do the interviews and questionnaires, but also to ask quick questions on certain subjects or ask for feedback. Moreover, it is difficult to safely conduct mass interviews. As is discussed in Chapter 5, this is one of the main reasons why there were no mass interviews, but questionnaires instead. These questionnaires still provides some useful input, but without the possibility to provide context, some responses were inadequate and thus close to useless. In general all information gathering has become quite a struggle in a qualitative process like the administration process of PMC 1, because there is little to no quantitative data, which is on servers.

Secondly, this research has been conducted at one of the offices of the company. Whilst speaking to employees from both the office in Hengelo as well as the office in Groningen it immediately became clear that not only do they not share the same vision, but neither do they share the same working methods. In Groningen they do not send order confirmation for example, which may or may not lead to a higher credit note. Seeing as how these two offices are already quite different, it is not odd to assume that many of the assumptions on which the analysis and conclusion of the research are built, do not hold for other offices of the company. This means that this research might hold value for other offices, but is mainly useful for the office in Hengelo and does not provide as much value to the entire corporation as hoped. Nevertheless, sharing the recommendations and outcome of this research might still hold value for the company.

Another obvious limitation is time. Although the researcher went on for longer than initially expected, there still was pressure to finish the research in limited time. If there were possibilities to

continue the research for as long as was preferable, there could have been longer and more intensive interviewing rounds and more in-depth data gathering in general. The limited time also restricted the opportunities for working out or researching some of the recommendations.

7.4 Conclusion

In this chapter, the research questions from Section 1.3.1 will be answered and the action and core problem are discussed.

7.4.1 Answering the research questions

To conclude if the thesis was successful and how the research process went, it is important to reflect on the research questions that were made at the beginning of the research.

- *What does the current logistics flow look like for the administration process of PMC 1?*

The first step in the research course was to get an overview of the current situation at the company. This goal was reached by mapping the logistics flow of the administration process of PMC 1. This map is shown in figure 3. This map provided the basis for the rest of the research, as this was the reality/current situation. From this the improvements can be formulated using the next research questions.

- *What relevant theories and methods are there for identifying waste in this process?*

With the Structured Literature review from Section 3.2, it became clear that there were a lot of sufficient candidates. Two of those candidates were taking into consideration for mapping the waste: Makigami and Value Stream Mapping. Of these two, Makigami was more fit for qualitative processes where the makigami would provide a better overview and have a better division between stakeholders within the process. Value Stream Mapping provides a better overview of many factors pertaining to a general production process by being able to provide info on lead times and such. Even considering multiple variants of VSM, Makigami was deemed to be more valuable in mapping the waste in the administration process.

- *What specific complications can arise at data transfer and where do other complications arise?*

To answer this question, there were multiple interview rounds as well as a questionnaire which got sent to every employee that has contact with the administration process of PMC 1. The responses from the questionnaire where then analysed and improvement points where formulated, see table 1. In this table, the improvement points where categorised per problem so it was clear which improvement points solved which problem and whether they would be substitutable or compatible. They were also related to the data systems of the company to see what problem or improvement point could be solved or integrated within certain data systems (table 2).

- *Can these complications be prevented and if so, how?*

After categorising the improvement points, the problems could be analysed on the solvability. Since many problems stem from human error or factors that cannot be controlled by the company, these problems were deemed unsolvable. The problems that were in fact solvable have got several solutions, which are all mentioned in Section 6.1. These recommendations should help the company in solving the complications within the administration process.

- *How could the solution be implemented and checked?*

The implementation of the recommendations has been elaborated in Section 7.2. In the chapter, the factors pertaining to the company's environment, the attitude of the employees and the difficulty of the implementation within the systems has been considered. The advice is to have a long and intensive implementation process to ensure the greatest chance at success.

The evaluation of the recommendation is again a difficult subject as almost all data is qualitative. However, the credit note should prove useful in the evaluation and otherwise there should be opportunities within Metacom for dashboard or other forms of performance indicators if the company wishes to use these.

- *Based on all gathered data, which recommendations can be done and what conclusions can be made?*

There are several recommendations made, but the biggest recommendation would be to do further research into the data system structure and the method of data input. This further research should allow the company to make a better judgement of the situation at hand and provide more specific data on the problem that they would like to solve.

7.4.2 The action- and core problem

The purpose of this bachelor thesis research was to solve the action- and core problems at the company, so it is vital to reflect on these problems and check whether the research has actually served its purpose.

Core problem

The current administration process is very susceptible to (human) errors

The core problem was never completely solvable, as human error will always be around and solving all of the minor discontinuities in the process would be next to impossible. However, big steps have been taking towards solving the biggest complications within the process. This is mainly done by implementing standardisation, so the room for (human) error is smaller and provided the employees with a clear overview and task description, serving the same goal as the standardisation.

Action problem

A lot of unnecessary time is being lost in the administration process of PMC 1

When implementing all of the recommendations, the amount of manual work should go down as well as the amount of invoices that get sent back (the credit note). When the amount of manual work gets reduced, there will be less time unnecessarily spent doing manual work, which solves the action problem. Moreover, when less invoices get returned, the invoicing department can focus more on making invoices instead of repaired old invoices, meaning they spent less time on old invoices and more on new invoices, effectively reducing the time spent on the administration of one job and making the department more efficient.

7.5 Possibilities for future research

Every finished research course provides an opportunity for more research. This is exactly what are discussed in this chapter. The recommendations done in this chapter are far from specific, so obviously, these provide great opportunities for future research:

- *Research on the data system structure.* As mentioned in Section 6.1.1, the structure of the data systems is still quite unclear. This provides an opportunity to look into the functionality of all of the different data systems. This helps the company get a clear overview of what system is used for what purpose and whether every employee is using the system right and

to its full potential. Results from this research could be to discard data systems to make the data system structure clearer or to expand/upgrade several data systems to let the administration process go along more swimmingly. This could also be input for the roadmap mentioned in Section 6.1.1.

- *The transference of data.* One of the goals of the questionnaire that was given to the employees was to analyse what data was expected to get transferred and what data was actually transferred. But because of the lack of correlation between the answers, this held no real weight. This data could be gathered by doing more extensive interviewing and give insight in the difference between the expectations and reality of the data transference.
- *The introduction of KPIs in the administration process of the company.* The nature of the administration leaves little room for evaluation and continuous improvement. There would probably be quite some opportunities to add performance indicators within this process, but there would have to be some research in order to find out whether this is true and where these KPIs could be implemented.
- *The impact of COVID-19 restrictions on an administration process.* As previously mentioned, the restrictions on COVID make it hard to communicate clearly, as it is more difficult to approach people, especially if they are working from home. It is imaginable that this has negatively impacted the administration process of the company and many others alike. Researching the impact of this could be quite insightful on the topic of long-distance communication.

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9. Appendices

Appendix 1: Questions for the preliminary interviews

Planning

- How up-to-date is the database of other crane companies?
- What is Nedlift's own position in this?
- There are people who refuse to use the good quotation format, what do they do?
- How consistent is everyone with Corsa?
- What kind of calls do you all get in your department?
- How well does everyone go about checking the cost types for errors or the cost types that have no price connected?
- Does everyone check or do certain people do that?
- Do you only check what you plan yourself or from everyone?
- How easy is the quotation format to find?
- Do the contacts also forward the quotation formats?
- How do you know that an 'assignment thrown over the fence' will be fine?

Invoicing

- You indicated earlier that if you want to change the price/hour and also the surcharges that it does not work, does it make sense to change the price earlier in the process?
- How has the percentage of incorrect invoices developed over time?

Appendix 2: The questionnaire

Section 1: Introduction

What is your name (optional)?

At which department do you work?

Section 2: Telecom

How long do you spend, on average, on giving clients advice?

How long do you spend, on average, on registering the jobs?

Where do you save your information after concluding your advice?

Which information do you carry over (and to who) after concluding your advice?

Do you see opportunities for improvement in your function/department within the administration process and if so, which?

Do you see opportunities for improvement in general within the administration process and if so, which?

Section 3: Work preparation

How long do you spend, on average, on making an internal order?

Where do you save your information after concluding your advice?

Which information do you carry over (and to who) after concluding your advice?

Do you see opportunities for improvement in your function/department within the administration process and if so, which?

Do you see opportunities for improvement in general within the administration process and if so, which?

Section 4: Planning

What are you main tasks?

How long do you spend, on average, carrying out these tasks?

If you need information, what do you expect from the way it is presented?

Where do you get the information you need to carry out your tasks?

Where do you save your information?

Which data do you carry over after planning a job?

If the information to carry out your task is missing, which information is often missing?

If the information to carry out your task is incorrect, which information is often incorrect?

According to you, what is/are often the cause(s) of incomplete or incorrect information?

Do you see opportunities for improvement in your function/department within the administration process and if so, which?

Do you see opportunities for improvement in general within the administration process and if so, which?

Section 5: Sales

What information do you carry over?

Where do you save your information?

Do you see opportunities for improvement in your function/department within the administration process and if so, which?

Do you see opportunities for improvement in general within the administration process and if so, which?

Section 6: Invoicing

How long do you spend, on average, on making an invoice for a job?

Where do you get your information for making an invoice?

Which information do you need for making an invoice?

If the information to carry out your tasks is missing, which information is often missing?

If the information to carry out your tasks is incorrect, which information is often incorrect?

How often are invoices incorrect?

If an invoice is incorrect, what is often the cause of this?

Do you see opportunities for improvement in your function/department within the administration process and if so, which?

Do you see opportunities for improvement in general within the administration process and if so, which?

Section 7: Closure

Do you have any further questions, comments or additions as a response to this questionnaire?

Appendix 3: Translation of the Makigami (Version 1)

Informationflow of the crane rentals						
Involved parties	Activity per step 1	2	3	4	5	Transfermoments
Sales	First customer contact	Client advice				Job offers, price arrangements, additional documents
Telecom		Client advice	Input of job			Materials, info on the job
Work preparation		Client advice	Placing an order			orders, invoicing info, job info, materials, contact details
Planning				Planning		Confirmations, routes, time and dates, location
Invoicing					Invoicing	workhours, signed crane receipts, deviations, client demands
Information carriers (in)				V-schijf, mail, internet, book of tables, external employees, planning, phoning people, profit, intranet, "Wherever I can find it"	V-schijf, mail, mouth-to-mouth, metacom, paperclip of orders	
Information carriers (out)		V-schijf (210, 350, 107) relatie360	mail, Corsa, V-schijf, Relatie 360, personal map	V-schijf, metacom, corsa, mail, paper, "just remember it"		
Improvement points		Outsource administration, pour telecom info into database, use Relatie360 more, question the client better/more		Unity in ordering, More and better communication before planning a job, save more in Corsa, communicate price arrangements earlier	Stop using automatic invoicing, give a better insight in invoicing for the rest	Less data save points, keep responsibilities in the right places, more clarity in data save places, decentralising the administration
Activity Time		1,5 uur	15-30 min		5 min	
Throughput Time			5-10 min			
Value Adding Time						

Appendix 4: Translation of the Makigami (Version 2)

Informationflow of the crane rentals						
Involved parties	Activity per step 1	2	3	4	5	Transfermoments
Sales	First customer contact	Client advice				arrangements, additional documents
Telecom		Client advice	Input of job			Materials, info on the job
Work preparation		Client advice	Placing an order			info, job info, materials, contact details
Planning				Planning		Confirmations, routes, time and dates, location
Invoicing					Invoicing	workhours, signed crane receipts, deviations, client demands
Information carriers (in)				V-schijf, mail, internet, book of tables, external employees, planning, phoning people, profit, intranet, "Wherever I can find it"	V-schijf, mail, mouth-to-mouth, metacom, paperclip of orders	
nformation carriers (out		V-schijf (210, 350, 107) relatie360	mail, Corsa, V-schijf, Relatie 360, personal map	V-schijf, metacom, corsa, mail, paper, "just remember it"		
Improvement points		Outsource administration, pour telecom info into database, use Relatie360 more, question the client better/more	Link the price tables to the orders	Unity in ordering, More and better communication before planning a job, save more in Corsa, communicate price arrangements earlier, link to the V-schijf in the order	Stop using automatic invoicing, give a better insight in invoicing for the rest	Less data save points, keep responsibilities in the right places, more clarity in data save places, decentralising the administration, reorganize the V-schijf), make a unit-rate+ category,
Activity Time		1,5 uur	15-30 min		5 min	
Throughput Time			5-10 min			
Value Adding Time						