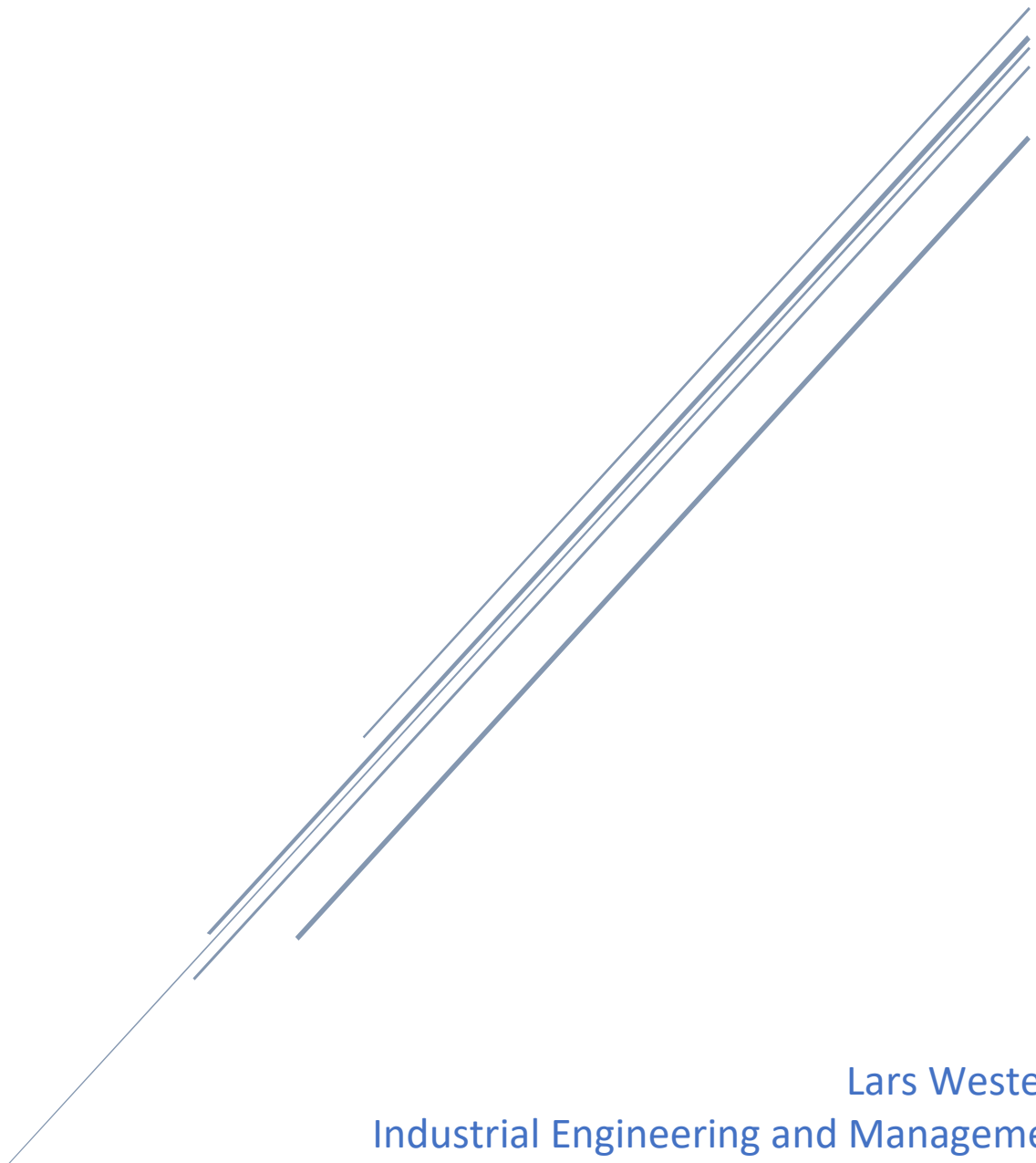# BACHELOR THESIS

Improving performance personnel department Company X

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Increasing performance personnel department Company X

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Preface

This research is the result of my bachelor theses that I have conducted at Company X. This thesis is the final assignment of my study Industrial Engineering and Management at the University of Twente. The focus of this research is to improve the performance of the personnel administration of Company X. This is done by mapping the current processes, and analysing the processes. The processes that cause the most waste are identified, and the waste in these processes will be eliminated.

I would especially thank the team leader of Company X, whose name will remain anonymous for confidentiality reasons. He helped me get this assignment, and was always there for me when I needed him. I would also like to thank the application manager of Company X, who left at company at the start of April. She also helped me a lot in this research before she left the company. I would also like to thank the rest of the employees of the company, as I could always approach them when I had certain questions. They helped me get familiar with the company and the activities that they do by letting me observe them.

From the University of Twente, I would like to thank Sebastian Piest. He was the supervisor for my research, and helped me make progress when I got stuck in my research. I could always approach him if I had questions or when I was not sure what to do. We had regular Skype meetings during the research.

Lastly, I want to thank my mom for helping me in the last phase of this research. She is a director at a company in my village, and the subjects in this research are within her field. We brainstormed some of the ideas together.

Lars Westerik
May 2020

Management summary

Problem context

Company X is an administrative company which does the administration of 3 different school groups. These school groups consist of primary schools and high schools. Whenever some data of an employee changes, the personnel administration of Company X receives these mutations, and has to check and process them. Since the start of 2019 they use a new system for this process. The managers of the schools sends in the mutation, and the personnel administration checks them. When the mutations is correct, the personnel administration processes the mutations. The data of the employee automatically gets altered in the administration software. The problem that they are facing is that they have a low performance and a lot of waste. This causes the employees to have a high working pressure. Their work is never done and the mutations keep stacking up.

Goal of the research

The goal of this research is to increase the performance of Company X. This will be done by mapping the business processes, and by analysing the business processes to identify the wasteful processes. By removing wasteful activities the work stock and thus the working pressure of the personnel administration will decrease.

Approach

First the processes have to be mapped and described so that the employees know exactly how the processes work, and can use these mappings and descriptions as support for their tasks. Then an data analysis is made with the help of process mining. After the data analysis it is identified which processes have the worst performances. This performance is measured in error percentage and throughput times, because these are the most important KPI's. In this data analysis it is also identified which activities are causing the poor performances, and why these poor performances are happening. After that the wasteful processes are identified, solutions are formed so solve these bad performances.

Findings

There are 2 main causes for the bad performance of the personnel administration. The first one is the high error percentage in a lot of processes. Whenever there is an error, the mutation has to be send back to the submitter. The submitter provides additional information and sends the mutations back to the personnel administration. This is 2 extra steps in the process. Also, most of the time it takes a while before the submitter has send back the mutation with additional information.

The second cause for the bad performance are the high throughput times of the activities of the personnel administration. The activities themselves should not take that long to complete, but the high throughput times have other causes. First of all they have a high work stock. Therefore they give priority to mutations that have a due date that is closer to the current date. They leave mutations that are not urgent for later. Secondly they often wait for additional information. This is not always from the submitter, but they often also have to ask more information from a senior employee. When this employee is not available, they leave the mutations for another time. The last cause is that the administrative employees are always busy and do not have time to pick up certain mutations at the time. Altogether, they open and read certain mutations multiple times to look for the urgency, and switch between activities a lot. This is waste in the process because you spend time on activities that do not add value. Also, because they are always busy, they are not willing to make time to improve their processes.

Solutions and recommendations

The first solution that is implemented are the process mappings and process descriptions. These

offer support for the task that the administrative employees do, and will also support the submitters with their tasks. This will help them get more familiar with certain processes and activities and eventually decrease throughput time.

The second solution that is implemented are software improvement with the help of Poka Yoke. Errors in the software are prevented by building in certain mandatory field, or by removing certain distracting information. This will reduce the throughput time, and reduce the error percentage.

Due to circumstances, the rest of the solutions will be recommendations. The first recommendation to reduce the error percentages is to have a centralized submissions per school group, which consists of a few people. At the moment submitters only occasionally work with the software and do not always know what to do. By having a few experts per school group that are familiar with the software error percentages will be reduced. The personnel administration also should have good communication with these submitters about the mutations.

The recommendation towards the personnel administration is that they should all together strive for improvements. This is currently not in their nature, and they think they do not have time for this due to the high working pressure. However, when errors are reduced, work stock will decrease. They should strive to further reduce work stock by eliminating waste, and create a flow within their activities. They should eliminate work stock over time, and when the work stock is eliminated they should have no prioritization anymore. They should finish the mutations at the start of each day.

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Definitions

AFAS InSite	This is the software in which mutations are submitted and processed. Submitters have to fill in certain information in this software, and the personnel administration receives these mutations in their personal inbox within this software.
AFAS Profit	This is the software in which all the information is stored. This information includes all the information of every employee, every school group, government instances, workflows, salaries etc. When a mutation is processed in AFAS InSite, it automatically is altered in AFAS Profit.
Workflow	The workflows determine the sequence of the information flow. It determines who gets which information within a process. The application manager can alter these workflows when needed. A workflow starts when a submitter sends in a mutation. The workflow then determines who gets this information, and what the person can do with the information. The workflow ends when the process is finished.
FTE	FTE stands for Full Time Equivalent. This indicates the workload of an employee. When an employee has a FTE of 1,0, it means that the employee works a full work week. When an employee has a FTE of 0,5, it means the employee works half the hours of a normal work week.
Disco	Disco is the software in which the process mining is done in the data analysis phase. In this software you can insert event logs, and the software gives you clear data about the processes.
Foleta	Foleta is a software in which data is stored about the rosters and FTE of the employees. When the personnel administration receives a mutation that has an influence on the amount of hours that someone works, it will always be checked in Foleta if the provided information is correct. In this software you can also make replacements for the high schools.
Salure	Salure is a software in which replacements are done for the primary schools. When someone is sick, the manager of the school submits this in Salure, and a replacement will be chosen. This software is linked to AFAS Profit, so that the salaries will be altered based on the replacements.

1   INTRODUCTION

This chapter is an introduction to this research and to the organisation. It elaborates on why this research is conducted, and on what problems the organisation is facing. Section 1.1 introduces the company. Section 1.2 explains the reason for research. In section 1.3 a problem cluster is formed, the starting problems are identified, and the core problems are chosen. Section 1.4 elaborates on the norm and reality, and section 1.5 is a description of the research design. Section 1.6 describes all the deliverables that will result from this research.

1.1: About the company

The organization where the research is done will be called Company X throughout this report because they want to stay anonymous. Company X is a collaboration between three reformed school groups, formed in 2009. Their goal is to strengthen the reformed education identity. There are 3 school groups involved, which will be called Group 1, Group 2 and Group 3 throughout this report. Company X provides the administration of the three school groups. Company X is one collaboration, but it has two departments. They have employees that do the personnel administration, and employees who do the financial administration. An organizational chart can be found in Appendix A, figure 6. This research is only about the personnel department of the organization.

1.2: Reason for research

The reason for research is that the personnel department is currently underperforming in terms of performance. There is one known problem, and a few assumptions about why this poor performance is happening. The next section will elaborate on these causes. The poor performance causes the work pressure to increase, the work stock keeps increasing, and the employees are never done with their tasks. Because of this the motivation of the employees will decrease which will have a negative effect on the performance of the company. To solve these problems, it is important to solve the core problems that arise from the problem analysis. The action problem that has to be solved is: 'The performance of the personnel department of Company X is too low.' The precise cause and solution to this problem will be investigated in this research.

1.3: Problem cluster and choice core problem

It is important to choose one or a few core problems that you are going to solve. To get to a core problem, you go back in the problem cluster to the problems that do not have a cause (Heerkens & van Winden, 2012). Based on the meetings with the supervisors and employees, a problem cluster is made which can be found in Appendix A, figure 8. Based on the problem cluster, there are 5 starting problems. These problems are:

1. Nobody keeps track of the KPI's
2. Processes are not well described and are unclear for the employees
3. Mutations are added over time which are not included in the software
4. Mutations that are delivered by the school groups are of poor quality
5. The way of working of the personnel administration is not optimal

So, the main problem Company X is facing is that their personnel administration department is underperforming in terms of performance. The action problem that derives from this is: 'The performance of the personnel department of Company X is too low' This problem is caused by a few other problems, which in turn are also caused by other problems. All the problems and their coherence can be found in the problem cluster. The action problem is in the bottom, and is caused by 5 starting problems.

Nobody keeps track of the KPI's
The first starting problem is that nobody keeps track of their KPI's. Because nobody keeps track of the KPI's, the values of the KPI's are not known. This causes the company to have no clear reality, which causes that the organization is not entirely sure where the poor performance is coming from. This is the first causes of the poor performance of the department. To have a good understanding of the problem it is important to have clear KPI's. When you have clear KPI's you know which processes and which activities have the worst performances. You can also set goals, and you can measure how far you currently deviate from this goal. This problem could be solved when someone takes the time to do this. This is currently not the case because they did not think it would be that important, and everyone has a high working pressure so no one has the time to do this.

Because it is necessary to know where the poor performance is coming from before you can improve the processes, this is a core problem. By analysing the data you identify bottlenecks and the critical paths, and you know on which aspects you need to improve. Also, it is necessary to have a clear reality to see how much you deviate from the norm.

Processes are not well described and are unclear for the employees
The second starting problem causing the low performance is that the processes are not well described and are unclear for the employees. Therefore employees do not always know why they do something, and they do not always know what to do. This causes the administrative employee to take longer with their checking and correcting tasks, which causes the throughput times to increase. Because the throughput times are too long, the work of the administrative employees stacks up, which is a cause of the poor performance of Company X. Currently there are some process descriptions, but the processes are poorly described and are hard to find for the employees. Besides, a lot of these process descriptions are not up to date. If the processes are well described, and are easy to find, employees will work more effectively. The throughput times will decrease and the performance of the department will increase.

Because this problem is of great significance, and is solvable, this is a core problem. It is also something that the organization values a lot. They want to have proper process mappings and descriptions.

Mutations are added over time which are not included in the software
The third starting problem causing the low performance is that there are mutations added over time which are not included in the software. At the introduction of the new digital system they tried to include every mutation that is possible. But during the year, they found out that there are more different mutations that they planned for. Therefore, the software cannot process all the mutations that they receive. The mutations that cannot be inserted in the software are send via the mail, and have to be done manually. The employees have to pay attention to these mails while they get a lot of other mails in their inbox too, and the manual tasks take more time. This is not optimal and causes the checking and correcting process to take longer. Because of this, the throughput times increase, and the work of the administrative employees stacks up. This is also a cause of the poor performance of the personnel department.

The starting problem that mutations are added which are not included in the software cannot be solved, because these mutations are necessary for the administration of the school groups. The next problem, the software cannot process all the mutations that they receive, can be solved. By solving this problem the throughput times will decrease, which in turn will also decrease the error sensitivity. However, this problem is not a core problem. The problem can be solved by some modifications in the software.

Mutations that are delivered by the school groups are of poor quality
The fourth starting problem is that mutations that are delivered by the school groups are sometimes of poor quality. Whenever the personnel administration receive an incomplete, or poor mutation, the personnel administration has to send the mutation back to the submitter to ask for more information. This causes the process to have 2 more steps. It also often takes a while before the submitter corrected the mutation. These are errors, and this causes the throughput times to increase. The assumption is that the mutations are of poor quality because either the submitter does not understand the process completely, or they think too easily about the mutations. They think that Company X will understand and fix the problem. However, they sometimes just deliver incomplete mutations which cannot be completed if the administrative employees do not have all the information. The exact impact of these poor mutations will be investigated in the data analysis part.

This problem has an impact on the performance of Company X, but it is not clear how big of an impact it has. That is why this is not a core problem. First, it is necessary to analyse the data to know which processes and activities are the bottlenecks in the company. If it becomes clear in the data analysis that this indeed is a big part of the problem, this problem can still be solved.

The way of working of the personnel administration is not optimal
The final starting problem is that the way of working of the administrative employees is not optimal. They do not have a good structure, and waste is created in their activities. This causes that the checking and correcting takes too long, which in turn causes longer throughput times. For example, when they receive mutations in their inbox, they look for the mutations that are most urgent, and they start processing these mutations. They leave mutations that are not urgent. However, a few weeks later those mutations will become urgent and are still not finished. Then these mutations get the priority and they will leave other mutations. This will go on and on. Other problems that arise in the way of working will be identified in the data analysis chapter. At this stage of the research it is not clear which processes and which activities are going wrong. In the data analysis part it will become more clear which processes, and which activities are the bottlenecks in the organization.

At the start of the research it is not clear how big of an impact this problem has on the performance of the company. A wrong way of working will cause waste and bigger throughput times, but maybe this is not the main bottleneck that the organization is facing. Also, it is not clear which activities are causing the most waste. A more efficient way of working will increase the performance of the company, but it is not clear if it would be best to solve this problem. After the data analysis the exact bottlenecks and critical paths will become clear, and if this problem proves to be a big part of the poor performance, this problem can still be solved.

Core problems
So the two core problems that will be solved are:

1. Processes are not well described and are unclear for the employees
2. Nobody keeps track of the KPI's

So after that the second core problem is solved, it will be clear where the poor performance is exactly coming from. Based on these results, improvements will be made on the bottlenecks of the company.

1.4: Measurement of norm and reality
The KPI's in the processes of the administrative employees are the throughput times, and the error percentages. The assumption is that the error percentages are a big cause for the throughput times. As mentioned in the problem description, there are no values available for the KPI's, so there is no

clear reality. To get measurable results it is important that you can express your KPI's in a clear reality and norm. The reality will be calculated in the chapter about the data analysis. However, a norm can be described based on the meetings with the team leader. The processes can be divided in salary mutations and non-salary mutations. Since the salaries have to be paid at the end of the month, salary mutations should have a lower throughput time than non-salary mutations. For the throughput time the following norm is defined:

The throughput times of salary mutations should not be longer than 1 week, and the throughput times of non-salary mutations should not be longer than 1 month.

For the error percentage there is no distinction between salary and non-salary mutations, because it should be optimal that the error percentage is 0%. However, since it still could happen that sometimes a mistake is made, the following norm is defined:

The error percentage of the mutations should be close to 0%.

Chapter 6 will elaborate more about the reality regarding the throughput time and the error percentage of the processes.

1.5: Research design and research questions

Based on the problem identification the following research question is defined:

'What are the main causes of the poor performance of company X, and how can this performance be increased?'

To answer this research questions, some other research and knowledge questions have to be answered first. In every phase of the research design there are one or two research question and some knowledge questions that have to be answered to answer the corresponding research question.

The research design has 6 phases. These phase and their research and knowledge questions are given in Appendix A, table 2**.** The 6 phases are:

1. Theoretical framework
2. Current situation
3. Mapping and describing the business processes
4. Data analysis
5. Forming solutions
6. Evaluation

Theoretical framework (Chapter 2 and 3)
The first phase will be choosing theoretical frameworks to support the research. This will be done based on preliminary research and some literature research. There are two research questions and no knowledge questions in this phase. The research questions that have to be answered are:

'Which theoretical frameworks are best suited for this research?'
'Which tools can be used to improve the wasteful business processes?'

After the fourth phase the KPI's per process are known, and it is clear which processes are causing the most waste. These processes have to be improved. With the help of theoretical frameworks the problems will be analysed and solutions will be formed. The two research questions will
be answered and the theoretical frameworks and tools can be used to support this research. More

information about the theoretical framework and the literature research will be given in chapter 2 and chapter 3.

Current situation (Chapter 4)
The second phase in the research design is the describing the current situation. In this phase the following research question will be answered:

'What is the current situation?'

To answer this research questions a few knowledge questions have to be answered first to get a better understanding about the organization.

- 'Who are the stakeholders?'
- 'How do the administrative employees perform their daily tasks?'
- 'Which problems do the administrative employees have on a daily basis?'

In this phase a better understanding about the organization is formed by having meetings with the team leader and application manager. To get a better understanding of the daily tasks of the administrative employees, an ethnographic research will be done. After these observations there will already be an idea about the processes. More elaboration on this phase will be given in chapter 4 of this report.

Mapping the business processes (Chapter 5)
The third phase will be mapping and describing the business processes. But before the processes can be mapped and described the following research question has to be answered:

'What is the best way to map and describe the processes, so that the employees can use this as support for their tasks?'

To answer this research question, the following knowledge questions have to be answered:

- 'What process descriptions are currently available, and are these of any use?'
- 'Which processes have to be described?'
- 'Which format is most suited for the employees to work with?'
- 'What level of detail should be included in the process description?'

The fifth chapter will be about mapping and describing the business processes. With the help of the observations of the second phase, the processes have become clearer, but this will not be enough to map the business processes. In this phase there will be a deeper analysis of the processes. A mapping and description will be made of all the processes. After this phase the first core problem will be solved. More elaboration on this phase will be given in chapter 5.

Data analysis (Chapter 6)
The fourth phase will be the data analysis. There are two research questions in this phase. The first research question answered in this phase is:

'What are the current values of the KPI's of the processes?'

This research question has the following knowledge question:

- 'How can the KPI's be measured?'

Based on the calculated values of the KPI's the second research question in this phase will be answered:

'Based on the analysis, which processes have poor performances and why?'

To answer this second research questions, the following knowledge questions have to be answered:

- 'Which processes have the biggest throughput times and why?'
- 'Which processes have the biggest error percentages and why?'
- 'Which employee groups are causing the most throughput time and why?'

Chapter 6 will be about the data analysis. This phase will solve the second core problem. The current values of the KPI's are not known, and these are necessary for a good analysis of the problem. In the first stage of this phase, the KPI's are calculated and the first research questions is answered. Based on this answer, the second research questions can be answered with the help of the knowledge questions. After the two research questions are answered, the values of the KPI's are known, and the processes and activities which create the most waste will be identified. It will also be known what causes this waste in the processes. After that the second core problem is solved, improvements can be made on critical and wasteful processes. More elaboration about the data analysis will be given in chapter 6.

Forming solutions (Chapter 7)
The fifth phase is forming solutions. This will be based on the processes and activities with the worst performances. This will be in cooperation with the team leader and the senior employees, they have the most knowledge about the organization and know what will work or not. The research question that has to be answered in this phase is:

'What are the best solutions for the problems the organization is facing?'

In the fourth phase, the areas that are causing the low performance are identified. In the fifth phase, solutions for the poor performance will be formed with the help of theoretical frameworks and the corresponding tools. More elaboration about forming solutions for the wasteful processes and activities will be given in chapter 7.

Evaluation (Chapter 8)
The sixth and final phase is evaluation. This contains all the results of the research. The research question answered in this phase is:

'What are the main findings of this research?'

The knowledge questions that has to be answered are:

- 'What obstacles were encountered?'
- 'What recommendations can I give to the company to achieve the goals?'

Because there will not be an implementation phase due to time constraints, it is not possible to determine if the norms will be achieved, and if the performance will increase after implementation. The results and main findings will be given here, and the advices towards the company are summarized here. More information about the evaluation will be given in chapter 8.

1.6: Intended deliverables
There will be a few deliverables. The first one is a mapping of all the processes, with a corresponding description. The process mappings will be with the use of flowcharts. These mappings and descriptions will support the employees with their tasks. It is not a work instruction, but a process description. More information about this deliverable will be given in chapter 4.

The second deliverable are the realities of the KPI's. This will be done with the help of process mining. The excel file with all the information will be available for the company. More information about this deliverable will be given in chapter 6.

The third deliverable are improvements on the processes that poor performances. With the help of Poka Yoke, some error proofing will be implemented. Furthermore, there will be recommendations for improvements with the help of Lean. More information about the theoretical frameworks will be given in chapter 2, and more information about the improvements will be given in chapter 7.

The fourth deliverable is this bachelor thesis. This is an in-depth analysis of the problem and the research. The organizations can use this after my research to look back on certain findings, advice and conclusions.

2   LITERATURE RESEARCH

This chapter answers two research questions. The first one is: 'Which theoretical frameworks are best suited for this research?'. This question is answered with the help of preliminary research, and some literature research. These theoretical frameworks are described in section 2.1. When this research question is answered, the second research question can be answered: 'Which tools can be used to improve the wasteful business processes?'. To answer the second research question a literature research is held to explore which tools are available. This literature research is given in section 2.2, and some useful tools are described here.

2.1: Theoretical frameworks

2.1.1: Process management

Process management can be a good theoretical framework to help solve the first core problem. First, the concept 'process' is described. According to Davenport (1994), 'process' is a set of organized activities and expected models of products or services for customers, such as the flow of materials used in the transformation of inputs into outputs. According to Biazzi et al. (2011), a process can be defined as a group of activities that transforms resources or inputs into results or outputs.

With process management you align processes with the strategic goal of the organization (Nieuwenhuis, 2003-2010). It also helps the employees understand the processes. They will get a better understanding about what happens before the process step reaches them, and what happens with information they provide. For a proper process management it is necessary to know and describe all process activities. You should describe process inputs, outputs and relations between processes (Gašparín, 2015).

Process management has 7 steps (Nieuwenhuis, 2003-2010):

1. Goal – Determine the goal of a process.
2. Customer and result – Determine the customers and results of the process.
3. Process progress – Determine which activities have to be executed to get the desired results.
4. Means – Determine what means you need to get the desired results.
5. People – Determine what people you need and what their role is.
6. Supplier and result – Determine what input you need for the process to work.
7. Control – How do you control the process?

2.1.2: Flowcharts

The flowchart is a very commonly used tool for process mappings. It graphically describes the processes within the organisation, showing the sequence of activities through symbols, lines and words (Harrington, 1991). Flowcharts can serve as a manual, or a tool for facilitating detailed analysis and optimization of workflows. Every employee group is divided in columns. With the help of certain shapes activities, choices, data, starting points and end points are displayed. Flowcharts often depict the process as how it should be. Therefore, errors and variations in the process are not given.

2.1.3: Process mining

A good technique to analyse the processes and the KPI's is process mining. Process mining is a technique that support the analysis of business processes with the help of a certain software. Data mining uses input data to make models or patterns as output. This output can be used to detect anomalies or unusual behaviour (Yee & Sagadevan & Malim & Hassain, 2018). The starting point for process mining is an event log. An event log is the execution of a business process as sequences of events. Each event in a log is an activity within a certain process, and is related to a particular case. A

case is a single run of the process, which consist of all the activities that are carried out in that particular case. Event logs may contain additional information about the activities, such as timestamps, the employee group who carries out the activity, or other data elements associated with the events. The data elements can be event attributes or case attributes. Event attributes is data that is produced by the activities, and case attributes is data that is associated with the whole process (Leno & Dumas & Maggi & La Rosa & Polyvyanyy, 2020). It must be noted that the event logs data may be too detailed, or may have some noise. You have to make sure that your event logs contain only the necessary information, and that noise is omitted. Noise in event logs means incorrectly recorded sequences of events or traces in the process execution that does not represent the typical process. The process miner should clean and filter the data, while ensuring consistency (Li et al., 2018).

Process mining mainly includes the following: model discovery, conformance checking, and process improvement. Model discovery is the analysis of the event log, the extraction of the relevant information, and the construction of the process model. The process model can be analysed, and bottlenecks in the processes can be identified (Li et al., 2018).

2.1.4: Gemba Walk

The term 'gemba' is Japanese and means 'the real place'. Gemba is the place where the real work happens, and is therefore the most important place for a team (Business Ltd., 2020). In business gemba refers to the place where value is created. In a Gemba Walk you observe the place where the work actually is done. By observing the actual working place you identify how the employees carry out their activities, and you can identify certain bottlenecks that you cannot identify with other analysis methods. You have to be careful that you do not influence the work of the employees by being present. You can do the Gemba Walk in a two different ways. You can either make a plan, and observe according to that plan. You can also just be present at the working place and observe, and write down important findings.

2.1.5: Kotter's 8 step change model

Kotter's model is a systematic model to implement changes within an organization. It consists of 8 steps (Mind Tools, 2007):

1. Create urgency: When you want a change to happen, it is important that the whole company really wants it. You have to develop a sense of urgency around the need for change. You need to involve every stakeholder and make them realize that change is necessary for the performance of the whole organization.
2. Form a coalition: You need certain people with expertise or leadership to implement the changes. In this phase you form a team that is going to lead the change. The coalition usually exists of the team leader, and senior employees that have certain expertise on the area that you want to change.
3. Create a vision for change: You need a clear vision that people can easily grasp and remember. This will help people understand why you do something, and they will be more willing to achieve it.
4. Communicate the vision: Once you created a clear vision, you should communicate this within the organization. What you do with your vision after you have created it will determine your success. You should communicate it powerfully and frequently, and embed it in everything you do, so that people will remember it.
5. Remove obstacles: Obstacles could be different things within an organization. Processes could produce too much waste, or employees might resist to the change. You should continually look for barriers, and eliminate them as soon as possible.

6. Create short-term wins: The greatest motivational tool is success. You should set short term goals, and celebrate them when achieved. This will motivate employees, and make them want to continue the change, and make them want to keep improving.
7. Build on the change: It is important that you continue the change after short term victories. The short term victories are only the beginning. After every win you should set new goals, and try to achieve these as soon as possible.
8. Anchor the changes in corporate culture: To make a change stick it should become part of the core of your organization. You should not stop when the end goal is achieved. With the help of continuous improvement, you should keep improving so you will not fall back to old patterns.

2.1.6: Lean

The theory guiding the Lean technique is based on five principles (Doanh, 2017):

1. Define (customer) value: Value is what the customer is willing to pay for. When defining value you discover the needs of the customer.
2. Map value stream: Identify which activities there are, and define which activities add value and which not. You take the customer value as reference point. There are non-value added but necessary and non-value added and unnecessary activities. Non-value added and unnecessary activities should be eliminated, and non-value added but necessary activities should be limited.
3. Create flow: After removing waste you can create a flow in the processes. A flow means that activities are evenly distributed over time and structured.
4. Establish pull: Inventories are considered waste. The goal of a pull system is to limit inventory and work in process by letting the demand determine the supply.
5. Pursuit perfection: After the previous 4 steps, it is important to maintain the results. Lean thinking should be a part of the organizational culture. Every employee should strive towards perfection while delivering products or services. The goal for the organization is to keep improving.

Figure 1: The 5 Lean principles (Doanh, 2017)

These 5 principles are used in combination with Lean tools and methods to maximize the value-adding activities in an organization. Value is added by using less resources while maintaining high quality products or services. You want to work as efficiently and economically as possible

(Rathilall & Singh, 2018). Choosing one method or tool over another depends on a number of factors. It depends on the organizational culture, the willingness to change, the general vision of the company management and the process of creating internal value (Grose & Hrubliak & Anisie & Ratsa, 2019).

2.1.7: Six Sigma

With Six Sigma you strive to remove variation from processes and manufacture defect free products. It is a quantitative approach to continuous improvement and cost reduction by reducing variation in the output of a process. The acceptable range depends on the product and organization, and is specified by two lower values, the Lower Specification Limit (LSL) and the Upper Specification Limit (USL) (Grosu & Hrubliak & Anisie & Ratsa, 2019). If a process is Six Sigma, it means having 12 standard deviations of process output between the upper & lower specification limits. This is the same as 3.4 defects per one million opportunities in a process.

The DMAIC cycle is often used with Six Sigma. DMAIC stand for Define, Measure, Analyse, Improve and Control. This is a systematic, five step problem-solving methodology. It is used to find the causes of variation and waste in processes (Rathilall & Singh, 2018). In the Define phase, the project is defined. In the Measure phase you try to understand and measure the current processes. The goal of the Analyse phase is to analyse the data that was collected in the measure phase. In this phase the causes of the problems are identified. In the Improve phase solutions are formed to attack the causes of the problems that were identified in the analyse phase. The goal of the Control phase is check if the improvements had a positive impact, and to make sure the improvements will be maintained and controlled (Grosu & Hrubliak & Anisie & Ratsa, 2019).

THE SIX SIGMA DMAIC IMPROVEMENT PROCESS

D: Define the project goals and customer (internal and external) deliverables.

M: Measure the process to determine current performance and quantify the problem.

DEFINE
MEASURE
CONTROL
THE DMAIC CYCLE
ANALYZE
IMPROVE

C: Control future process performance so improved process doesn't degrade.

A: Analyze and determine the root cause(s) of the defects.

I: Improve the process by eliminating defects.

Figure 2: The DMAIC cycle (Terry, n.d.)

2.2: Lean tools

In the previous sections the first research question is answered. Theoretical frameworks are defined that will be useful throughout this research. However, to increase the performance of the wasteful processes and activities, the Lean methodology will be used. This methodology is not a straightforward tool, Lean is a philosophy with corresponding tools. Each tool is useful for certain situations. To discover which tools will be useful in the problems of Company X a literature research is done. Tools that could be useful are noted here.

2.2.1: Value Stream Mapping (VSM)

VSM is a Lean tool which is used to identify waste and non-value added activities (NVA). The goal is to eliminate the waste and NVA's. In VSM you first make a current Value Stream Map, to map current

processes and their variables. Then you make a Future Stream Map, which is the ideal situation. By comparing the two maps, you can identify the areas that need improvement (Amin & Wan Mahmood & Kamat & Kamalrudin, 2019). In the Value Stream Maps, you include every step taken in the process. You also include the corresponding KPI's per step.

Rother & Shook (2003) presented the mapping process as 'wherever there is a product for a customer, there is a value stream'. According to the same authors, a value stream represents the sum of all the activities within each process which are necessary to produce a particular service or product. This also includes the flow of information and materials within the supply chain. The literature suggests that there are often the same 4 or 5 steps that are carried out when implementing the VSM tool. These are the following stages (Alkher et al., 2013):

1. Initiating changes
2. VSM current state map
3. VSM future state map
4. Simulation (optional)
5. Implementation

2.2.2: Poka Yoke

The Poka Yoke method can be employed in design. Poka Yoke is an approach that helps equipment or software avoid (yokeru) mistakes (poka) (Saurin et al., 2012). The idea of poka-yoke is to design your process or software in a way that mistakes are either impossible or are easily detected and corrected in an early stage. There are two categories to Poka Yoke: prevention and discovery. Prevention is about engineering the process or software, so it is impossible to make mistakes. An example is a mandatory field that cannot be skipped. With discovery you make the user detect the error so the user can correct the mistake early on. An example is an error message when certain data is inserted which could not be true. Software testing is also a form of error detection, but it often happens that software testing occurs too late in the process (Robinson, 2011).

There are a few recommendations for creating good error preventions and discoveries in software (Robinson, 2011):

- Think simple: A few simple poka-yokes is better than one complicated script.
- Think specific: Identify mistakes that occur frequently and design a poka-yoke for that mistake.
- Think attributes: Look for parts of the software that can be taken independently and make poka-yokes per part.
- Think early: It is best to eliminate mistakes as early as possible so that you do not build up pollution.
- Think responsive: When a mistake is detected, correct as soon as possible.
- Think re-use: When you have good poka-yokes, they often can be modified and reused in other situations.

2.2.3: Continuous improvement

Continuous improvement is an ongoing effort to improve processes. It is improvement in steps, rather than one big improvement at once. The aim is also to keep improving, rather than stop the improvement process when the problem is solved. It is a never-ending strive for perfection in everything you do.

Kaizen is a certain approach of continuous improvement. With Kaizen you do consistent measurements to maintain and raise performance standards in all processes (Khayrullina &

Kislitsyna & Chuvaev, 2015). This philosophy strives to eliminate waste based on solutions with a low implementation cost (Bordin & Dall'Agnol & Lantelme & Costella, 2018).

In continuous improvement you often work with the Plan Do Check Act (PDCA) cycle. The PDCA cycle begins in the Plan stage. In this stage you analyse the process, and identify possible points of failure, and possible points of improvement. You determine points of action that will improve the process. In the next stage, Do, the actions that are determined in the act stage are carried out. In the Check stage you do measurements to have performance indicators. These measurements can be compared with predicted numbers in the planning stage to check if the improvement process is going as planned. In the Act stage you intervene in the process in order to propose improvement actions in the cycle. In this stage you can also recommend the creation of a new PDCA cycle (Bordin & Dall'Agnol & Lantelme & Costella, 2018).
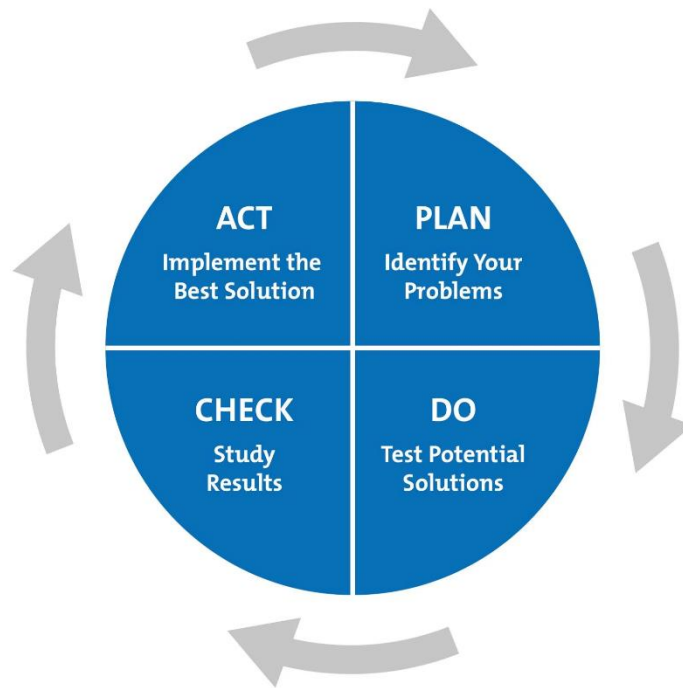

Figure 3: PDCA cycle (Mind Tools, 2016)

The theoretical frameworks described in the first section of chapter 2 are used in different parts of this research. In section 3.1 it is explained how the DMAIC cycle is used. Section 3.2 will elaborate on when and how process management is used. Section 3.3 will shortly tell about the flowcharts. Section 3.4 is about the process mining tool, while section 3.5 will explains how the Gemba Walk is used. Section 3.6 tells how the 5 steps of change by Kotter is used. In section 3.7 the Lean tools are discussed.

3.1: DMAIC cycle

Six Sigma makes use of the DMAIC cycle. Six Sigma will not be further used in this research, but the DMAIC cycle will. DMAIC stands for Define, Measure, Analyse, Improve, Control. This cycle is the basis of this research. The 'Define' will be used in the problem analysis, and in the phase of mapping and describing the processes (chapter 4 and 5). The current organization is defined here, and the processes are made clear. The 'Measure' and 'Analyse' will be used in the data analysis (chapter 6). In this part the KPI's are calculated per process, and areas that need improvement are identified. 'Improve' and 'Control' will be used in the possible solution phase (chapter 7). In this phase solutions are formed with the help of Lean tools, based on the analysis phase. There will also be recommendations on how to control the progress.

3.2: Process management

Process management will be used in the define phase of the DMAIC cycle. It will be used to solve part of the first core problem. In chapter 5 the processes will be mapped and described. The processes will be mapped with the help of flowcharts. The process descriptions will be about these flowcharts. For the process descriptions the theory of process management is used. By using process management, you make all the steps in the process, and their coherence, clear. As mentioned before, process management has 7 steps: goal, customer and result, process progress, means, people, supplier and result, and control. These steps are all included in the process descriptions, for every step in the flowchart.

1. Goal: The goal of the entire process, and for every process step is determined.
2. Customer and result: Because there is no traditional customer, the customer will be the next person in the process. The result is the output of the process step.
3. Process progress: States what the employee has to do in the current process step.
4. Means: The input of the process step.
5. People: The people that are needed in the process.
6. Supplier and result: The supplier is the person that sends the workflow to the current step.
7. Control: How to control the process, and checking if the process is going right.

3.3: Flowcharts

Flowcharts will be used in the define phase of the DMAIC cycle. For every process that is mentioned in this research a flowchart will made. These flowcharts are mainly used for the employees so that they can use them as support for their activities. With the help of the flowcharts with the corresponding process descriptions, the employees will know how the processes work, and what they have to do. More information about the flowcharts is given in chapter 5.

3.4: Process mining

Process mining will be used in the data analysis part of this research, which is the measure and analyse phase of the DMAIC cycle. With the help of process mining you can have a nice overview of all the processes and their KPI's. As mentioned before, the KPI's are the throughput time and the

error percentage. The error percentage will be calculated based on how many times the mutations has to be send back to ask a question to the submitter or another party that comes before the personnel administration in the workflow.

There are a few different methodologies that can support a process mining project. Van Eck, Lu, Leemans and van der Aalst (2015) did a research on the methodology called PM^2. This methodology will be used in this research. The remaining of this section is based on their research.

PM^2

PM^2 is a useful for projects that aim to improve process performances, or compliance to rules and regulations. With this methodology you set goals, and translate these goals in research questions. After a few stages, the answers for these research questions should be found. Based on the answers and the findings, improvements can be defined.

PM^2 has 6 stages, and each stage has their own activities. Not all activities have to be carried out, it depends on your goals and you project. The 6 stages are:

1. Planning
2. Extraction
3. Data processing
4. Mining & analysis
5. Evaluation
6. Process improvement & Support
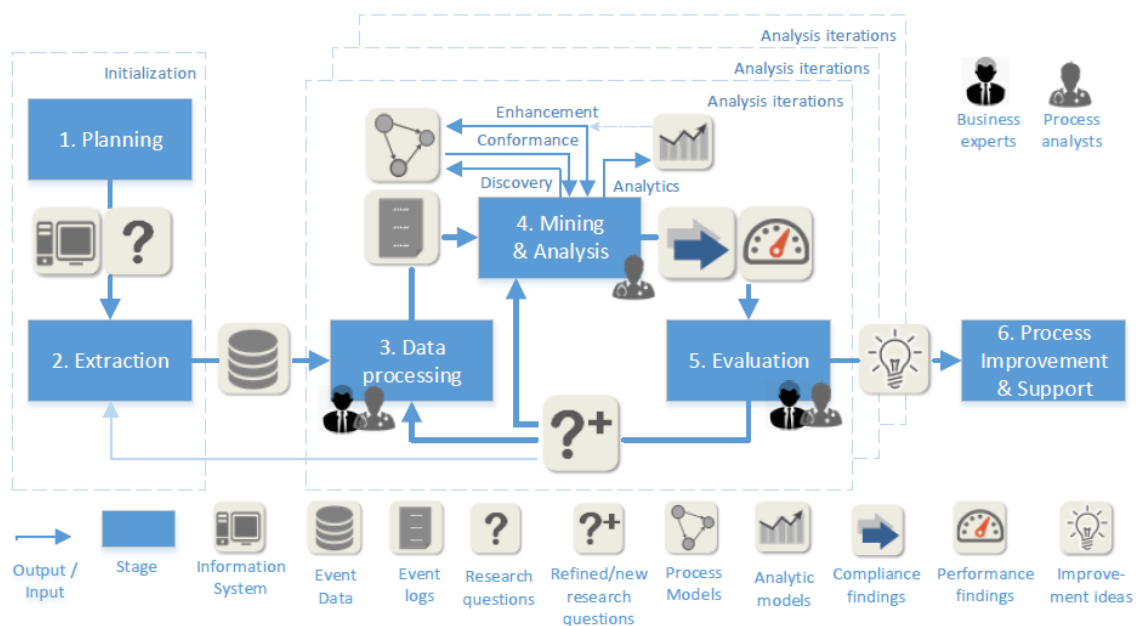
Figure 4: Process mining stages (van Eck & Lu & Leemans & van der Aalst, 2015)

Stage 1: Planning

The goal of the first stage is to set up the project, and to determine research questions. The goal of the process mining project is improving process performance. The input in this stage are the business processes. The outputs are goal-related research questions and the information systems that support the business processes that have to be analysed. There are 3 activities in this stage:

- Selecting business processes -> Here you determine which processes are going to be analysed during the process mining project. If the goal is improvement, you should take the

changeability of the processes into account, because you want to improve (and change) the processes after the analysis.
- Identifying research questions -> Research questions are defined based on the goals of the project. These research questions will be answered during the project.
- Composing project team -> Here you determine who will take part in the project. You need experts with different background. You need people that are familiar with the processes and people that are familiar with the IT aspects.

Stage 2: Extraction

In the extraction phase you aim to extract event data. Input for this stage are the research questions which are defined in the planning stage, and the information systems that support the business processes that have to be analysed. The outputs in this stage are the event data and the process models. There are three activities in this stage:

- Determining scope -> This is the scope of the data extraction. You have to determine within which period you are going to extract your data, and which attributes should be extracted.
- Extracting event data -> Once the scope is defined, you can collect the data from the information system and put them in one file.
- Transferring process knowledge -> In this activity you get familiar with the steps of the processes by having meetings with the process experts. Understanding the processes is essential for an effective data processing stage.

Stage 3: Data processing

The objective here is to create optimal event logs. The logs should be created in a way that they are fit for the mining and analysis stage. The main input here is the event data that is collected in the previous stage. The outputs are modified event logs that are used in the mining and analysis stage. There are four activities in this stage:

- Creating views -> Here you define case notions and event classes. Case notions relate events such that together they form a process instance. The event classes distinguish different activities within a process instance. Which view to create depends on the goal.
- Aggregating events -> Whenever multiple processes can be seen as one process, you can aggregate these processes to reduce complexity. You can also split a process into multiple processes if the process is too complex.
- Enriching logs -> When you want different attributes that could not be retrieved from the information system, you can enrich the logs. You can do this either by adding attributes based on the log itself, or you can add external data.
- Filtering logs -> You can filter logs to reduce complexity, or when you want to focus the analysis on a specific part of the dataset.

Stage 4: Mining & Analysis

In this stage, the process mining techniques are executed on the event logs to answer the research questions, and to gain insight into process performance and compliance. The input for this stage are the event logs and process models. The output in this stage are findings that answer the research questions. There are four activities here:

- Process discovery -> After inserting the event logs, the software that you use will return fact-based process models as output. You can use these models to find out how the processes actually are carried out.

- Conformance checking -> Something you can do is comparing the generated process models with existing process models or process descriptions. You can identify areas that differ from the usual process and find out why this is happening.
- Enhancement -> With this activity you can improve existing models based on the findings in the process model generated by the software.
- Process analytics -> Analysis techniques can be applied to get a better understanding of the retrieved data from the software. For example, you can collect all the data in an excel file and make graphs about the throughput times to identify wasteful processes.

Stage 5: Evaluation
The objective here is to relate the findings in the analysis phase to improvement ideas. These improvement ideas should achieve the goals that were set at the start of the project. The inputs are the process models, and the performance and compliance findings from the analysis stage. The outputs are improvement ideas, or, if necessary, new research questions. There are 2 activities in this stage:

- Diagnose -> In this activity you interpret the results of the previous stage. You should distinguish the interesting and unusual results from the expected ones, and possibly identify or refine research questions.
- Verify & Validate -> It is investigated if the findings are correct or not. Verification compares the findings with the original data. Validation compares the findings to the claims of the process stakeholders.

Stage 6: Process improvement & Support
In this stage you use the knowledge you gained in the previous stages to modify the wasteful processes. The inputs are the improvement ideas from the previous stage. The outputs are modification in the wasteful processes. There are 2 activities involved:

- Implementing improvements -> After defining improvements, you want to implement these improvements. This is often done in a different project. The results from process mining form the fact-based input. You can use other methodologies for the implementation of the improvements.
- Supporting operations -> Process mining can provide support by identifying cases that are causing a lot of waste. Process mining can help predict the future of these processes, and can suggest actions that have to be taken to improve these processes.

3.5: Gemba Walk
The Gemba walk will be used throughout the research to identify how the employees work. For a few weeks, the working place will be observed and observations will be made about the employees, and the activities that they do. It will not be a structured Gemba Walk in which a detailed plan is made and followed. It will be a Gemba walk to just observe things that you cannot observe with other analysis methods. With this kind of Gemba Walk you can identify wasteful activities in the actual working place. However, it should be noted that the employees might act a little bit differently while being observed. It should be made sure that the employees act normally. This can be done by observing them from a distance while being busy with other activities. By doing this every day for a few weeks, you observe how the employees work on a daily basis while not interfering with them.

3.6: Kotter's 8 step change model
Kotter's 8 step change model will be used in the improvement phase. The goal of this model is to systematically implement the changes that are necessary to improve the processes and activities that

will be identified. It is also a useful model to involve and motivate the employees to change. A description of all 8 steps is given in chapter 7.

3.7: Lean

In the improvement phase, the principles of lean will be used. The goal is to let the department perform well on the Lean principles: customer value, value stream, create flow, create pull, pursue perfection.

Lean also makes use of tools that support the methodology. To make a choice about which tools to use, the following questions will be answered to determine if the tool fits the research, and fits Company X:

- Does the tool fit with Company X as an administrative organization?
- How long does it take to implement the tool?
- Is it expensive to implement the tool?
- How difficult is it to implement the tool?
- What will be the expected impact of the tool?
- Is the data available that the tool needs?

Value Stream Mapping (VSM)
Value Stream Mapping does fit Company X, and scores well on all the questions. However, since process mining is used to analyse the data, processes and process tasks that cause waste are already identified. It is also known which tasks should take longer than other tasks. If process mining was not used in the research, Value Stream Mapping would be a good tool. But since process mining is used it to analyse the processes it is unnecessary, and it is not used.

Poka Yoke
Based on the answers on the questions, the tool fits Company X as an administrative organization. It will help solve problems inside the software because there occur a lot of errors and misunderstandings there. Therefore, Poka Yoke will be used in the improve phase of the DMAIC cycle. In the software that is used by the employees, you can for example build in certain messages when strange values are entered. By adding this message, people will check the value again, and correct it if needed. You can also add mandatory field so all the information that is needed will be filled in. By doing this you can make sure that the right information is delivered, and the mutations do not have to be send back to the submitter that often. What kind of error prevention is carried out depends on what kind of errors there are. So, Poka Yoke will help decrease the throughput time and the error percentage, by reducing the amount of errors and misunderstandings than take place in the software. These errors will be identified by testing with the software, by observing the activities of the administrative employees, and by listening to the concerns of the administrative employees. These errors will be discussed with the application manager, and solutions for the errors will be formed. More information about how Poka Yoke will be used is described in chapter 7.

Continuous improvement
Based on the answers on the questions, continuous improvement can be a good tool to use for the improvements on wasteful processes and activities. Continuous improvement can be used to improve the activities of the personnel department. It will be an useful tool for the improvement phase. Since big changes are not in the nature of the employees it is not useful to make big radical changes. There should be continuous changes, and continuous improvement should be a part of the organizational culture. When the activities are improved, continuous improvement should be maintained to further improve their activities. The company should strive for perfection, even when

the problems seem solved. It is easy to fall back into old patterns, and fall back into the old performance. In the Kaizen method, you conduct consistent measures to maintain and raise performance standards. By consistently measuring the KPI's of the processes, problems in the processes are identified in an early stage and you can immediately take steps to improve the process. There will be recommendations towards continuous improvement in chapter 7.

This chapter describes the current situation of the personnel department of Company X. This is the first part of the define phase of the DMAIC cycle. The following research question will be answered: 'What is the current situation?'. This research question is answered based on the answers of the knowledge questions. Section 4.1 is a description of the current organization. Section 4.2 describes all the stakeholders. Section 4.3 is about the daily tasks of the administrative employees and the problems that comes with them.

4.1: Description of the current organization

There is one team leader who supervises both the personnel and the financial department. Per department there are administrative employees and senior employees. The administrative employees do most of the daily administrative tasks. The senior employees do the calculations of the salaries and do a final check on the tasks of the administrative employees. Whenever the personnel administration has questions, they come to the senior employees, because they have more knowledge about the theory. The personnel department has 5 administrative employees. 2 employees do the administration for Group 1, 2 employees for Group 2, and 1 employee for Group 3.

Since the start of 2019, mutations are done via a new digital system. The communication between the school groups and Company X is done via a software called AFAS InSite, and all the data is stored in a software called AFAS Profit. The school groups determine the mutations, and put them in AFAS InSite. The administrative workers receive the mutations in their personal inbox in AFAS InSite, and check these mutations. Mutations can include a change in someone's status as a teacher, a change in hours, the amount of hours someone is sick, change in salary etc. The tasks that an employee has to do depends on the mutation. Some processes only include checks from the administrative employees, but most of the time a senior employee of Company X has to do a final check. Whenever a process is completed, the corresponding data will automatically be changed in the administrative software AFAS Profit. This is because there is a connection between the two software's. The different types of processes will be discusses in chapter 5.

The problems that arise here were discussed in the problem cluster part. These problems cause the poor performance and high working pressure of the employees.

4.2: Stakeholders

'A stakeholder is a party that has an interest in a company and can either affect or be affected by the business.' (Chen, 2019) Everyone that is involved in delivering proper mutations and for a good performance of the personnel administration department of Company X is a stakeholder. Also, everyone who has benefit when the administration is done properly is a stakeholder. The stakeholders are divided in three different groups: Company X employees, school group employees, and government instances. An overview can be found in Appendix A, figure 7.

Team leader Company X (1 person): They have one team leader. He is responsible for the performance of the organisation. He is fairly new in the organisation, so for in-depth questions it is better to contact a senior employee. He mainly directs the people. He is also the person that gave me the assignment, and where I have my meetings with. Whenever I have general questions, or I need help, I can contact him.

Application manager Company X (1 person): The applications manager is the person responsible for the settings in the software. Whenever something in the settings has to be changed, or there are errors in the software, this person has to fix this. She is also a senior employee of the financial department. She has a lot of knowledge about the organization, so whenever I have a more difficult

question, I can contact her. From the start of April, the old application will leave and there will be a new application manager. There will also be a new senior employee for the financial department.

Senior employees personnel department Company X (2 people): They perform final checks on some indicators after the administrative employees checked the mutations. They also calculate the salaries at the end of the month. These employees have more knowledge about the organization than the administrative employees. If I have questions, and the team leader or application manager is not available, I can contact them.

Administrative employees personnel department Company X (5 people): These are the people that check mutation that are put in the system by the school groups. I am allowed to contact these people for my research, and to observe their daily activities. I will need a lot of feedback from them because they are the ones that will do most of the administrative work. I need to know what they find difficult about the current situation and how they work.

Senior employees financial department Company X (3 people): These are the senior employees of the financial department. They do not play a big part in this research, but they are stakeholders. As is mentioned before, one of these employees is also the application manager, who does play a big part in this research.

Administrative employees financial department Company X (6 people): These are the administrative workers of the financial department. They do not play a big part in this research, but they are stakeholders.

School groups (Group 1, Group 2, Group 3): These are the 'customers' of Company X. All the personnel of these school groups are stakeholders, but the most important ones are the directors and the P&O department. They deliver the mutations to Company X. The mutations are about the employees of their school.

Lastly, there are some government instances that are stakeholders. These are pension funds, tax authorities, DUO and Arbo. It is important for them that the right information is delivered, because they use this information for their own activities. For me they are not that important because I do not get to work with them, and do not have contact with them in any way. For Company X they are important because they expect the organization to deliver the right information.

4.3: Daily tasks of the administrative employees

To get a better understanding of the daily tasks of the administrative employees, an ethnographic research is done. This is an in-depth observation of the employees in their natural occurring environment. With this kind of observation you change nothing about the work environment of the employees. The only difference is that somebody is watching what they are doing, and they have to elaborate a bit. By making use of this technique there is minimal influence on the employee and you get the most accurate results about how they normally perform their tasks.

The activities of 4 different employees are individually observed. 1 of the employees was observed in 2 different sessions, and 3 of the employees only 1 session. They will be called employee 1, employee 2, employee 3 and employee 4. The problems that they addressed, and the problems that were observed are written down, and can be found in Appendix B.

As is mentioned in section 4.1, the employees receive the mutations in their personal inbox in AFAS InSite. When the mutation cannot be properly inserted in the software, or it needs multiple steps to complete, they receive the mutations in their mailbox.

Main findings

Based on the observations that were done, there were a few general problems that happened regularly:

- The administrative employees did not receive the right information from the school groups, or they did not receive the complete information. When this happened, the mutation had to be send back to the submitter, and they have to deliver the right information. The administrative employees have to leave the mutation until they get a response from the submitter. This is an error, and this causes the throughput time to increase.
- For some mutations that do not happen every day it is not clear for the administrative employees what to do with them. They have to search for answers in documents, or they have to ask a senior employee what to do with them. This causes the throughput time to increase.
- A certain approval by the supervisor of the school group was not included a few times. When this happened, the mutation had to be send back to the submitter with the question if the approval could be added. The administrative employees had to leave the mutation until they got a response from the school group. This is an error, and causes the throughput time to increase.
- Sometimes there are errors in a certain software that they use. Either wrong information is stored or the software takes over the wrong information. This is an error and increases throughput time because everything has to be checked again.
- Some tasks have to be done manually which is not optimal. When tasks are done manually, there is a higher sensitivity to errors, and it takes longer to finish. This also causes a higher error percentage and a higher throughput time.

4.4: Conclusion

In this chapter the research question 'What is the current situation?' is answered with the help of the knowledge questions that were formulated. First, a general description is given about how the organization does their activities. Then there is a description of all the stakeholders. The stakeholders can be divided in 3 groups. Company X employees, school group employees, and government instances. Each group has their own influence, and their own interest in the results that Company X delivers. In section 4.3 there is a description of the observations that were done, and the main findings were written down. A few problems are already identified here.

5 MAPPING AND DESCRIBING THE BUSINESS PROCESSES

This chapter describes the mapping and describing of the business processes. This is the second part of the define phase of the DMAIC cycle. The research question that will be answered is: 'What is the best way to map and describe the processes, so that the employees can use this as support for their tasks?' The research question will be answered based on the knowledge questions that were formulated. In section 5.1 the processes that need to be described are identified. Section 5.2 is about collecting information to make a decision on how to map and describe the processes. Section 5.3 is about how the mapping and description of the processes are done. After the research question is answered, the business processes will be mapped and a description of the processes will be made. This will solve the first core problem.

5.1: Identifying the processes

To tackle some of the problems that the employees encounter, a clear description of all the processes and all the tasks has to be made. The first thing that has to be done is identifying which processes there are, and which processes have to be described. There is a test environment of AFAS InSite and AFAS Profit, in which the activities that the employees do can be re-created. In this test environment each process can be tested, and a workflow of each process is available. The workflows determine the sequence of the information flow. It determines who gets which information, what they can do with it, and who gets it next. With the help of these workflows a lot of the existing processes were identified. After studying the workflows, a list of processes was made. This was shown to the application manager for a judgement. She added the remaining processes that should have been added. Since the school groups consist of primary school and high school the processes are sometimes a little bit different. When the process is only for primary schools, PS is added after the process. If the process is only for high school, HS is added after the process.

As mentioned before, there are salary mutations, and non-salary mutations. They are given in the table 1 below.

Salary mutations	Non-salary mutations
Assess expiring contract	Address change
Contract renewal	Employee mutation
Change in function	Create and schedule interviews HS
Employee declaration	Request applicant information HS
Report employee back in service	Request applicant information PS
Report employee out of service	Valuation interviews
New employee HS	Create a vacancy HS
New employee PS	Statement regarding good behaviour
Draw up a deed	Gatekeeper improvement act
Account mutation	
Report an applicant in employment	
Create a sub employment	
Roster change (deleted in 2020, in 2020 this is under contract change)	
Contract change (added in 2020, in 2019 this was included in change in function)	
Close employment (added in 2020, in 2019 this was report employee out of service)	
Team change (added in 2020, in 2019 this was included in change in function)	

Manual mutation 1 person (added in 2020, in 2019 this was done via the mail)	
Manual mutation multiple persons(added in 2020, in 2019 this was done via the mail)	

Table 1: Salary and non-salary mutations

5.2: Collecting information

The second step was looking up any existing process or work descriptions and process mappings. The company has a local drive on which they store all their information. This drive is available for all the employees in the organization. There were a lot of descriptions on this drive, but almost all of them were very limited and were poorly written, or they were not up to date anymore. There was one document that was a bit useful, but the rest was of no use. So the process mapping and descriptions all had to be done almost from scratch. With the help of the earlier observations, some of the processes have become more clear but this was not enough to make a mapping and a description.

Therefore, the third step was getting more familiar with the processes. This was done by testing a lot with all the processes in the test environment. Every process was tested multiple times to also get all the variations that were possible. By making use of the test environment in combination with the workflow and the earlier observations a clear picture was formed for each process.

The fourth step is to determine in which format the processes should be mapped. The process mappings are intended mainly for the administrative employees. The administrative employees have mainly done secondary vocational education, and it should be suited to them. Also, preferably no new software has to be purchased to map the processes. Because it should be kind of simplistic, and preferably free, the choice was made to map the processes with the website draw.io. With this website you can make simple flowcharts that are easy to understand.

Then it was determined which level of detail should be included in the process descriptions. After some meetings with the team leader and the applications manager, it was decided that it should not be on field level. So the description will not include which buttons to press etc. It would be a general description of the task, and about the input and output. The employees should know the theory themselves. The description should make it clear to the employees how the processes work, why they do things, what happens with the information before they receive it, what happens with the information after they checked it, and in what order the activities are carried out.

5.3: Making the mappings and descriptions

After answering all the knowledge questions in this phase, the process mappings and the process descriptions could be made. 'The flowchart is one of the most commonly used tools for process mapping, it graphically describes ongoing processes or those proposed by the organisation, showing the sequence of activities through symbols, lines and words, giving way for improvement of such processes' (Harrington, 1991). All the flowcharts are given in Appendix D. A column is made for every employee group the process goes through. A green oval represents a starting point and a yellow oval represents an end point. It often happens that a process (workflow) is triggered by another workflow. The process that triggers the workflow is then given at the start of the process with the orange figure pointing downwards. There are also other triggers for the processes which are not workflows. These are given in a box at the start of the process. When the end of a workflow triggers another workflow, the orange figure is given at the end of the process. White rectangles represent tasks that have to be done by the employee groups, the white diamonds represent that a choice has to be made, and the blue figures represent digital data. All the figures that are used are given below in figure 4.
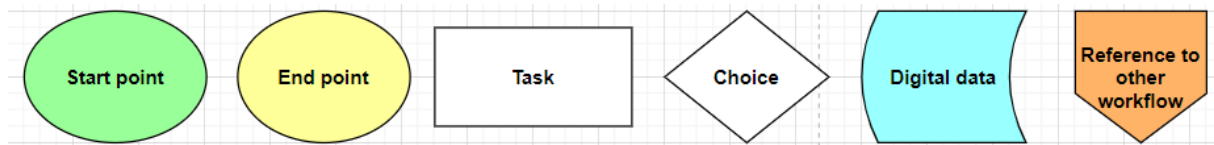
Figure 5: Flowchart figures

The work descriptions are not given in this report. The reason for this is that it is 60 pages of text which are not interesting to read. It is the same as the flowcharts but then a bit more elaborate. For the process descriptions the theory of process management is used as is described in chapter 3.

5.4: Conclusion

In this phase the research question: 'What is the best way to map and describe the processes, so that the employees can use this as support for their tasks?' is answered with the help of the knowledge questions. First, all the processes that need to be described and analysed are collected. In the second section data was collected to determine how the processes should be mapped, and how the process descriptions should be done. The third section is about how the processes are mapped with the help of flowcharts, and about how the process descriptions are done. After this phase is done, the first core problem: 'Processes are not well described and are unclear for the employees', will be solved.

This chapter is about the data analysis. This is the measure and analyse phase of the DMAIC cycle. The second core problem is that the organization does not calculate the values of the KPI's. Therefore, no clear reality could be defined, and it is not clear where the poor performance is coming from. This is necessary to make the results measurable, and to identify which processes and activities are causing the most waste. This chapter will answer the research question: 'What are the current values of the KPI's of the processes?' When this research question is answered, the processes with the worst performances can be identified and the second research question can be answered: 'Based on the analysis, which processes have poor performances and why?'. Section 6.1 is about how the process mining tool is used for the data analysis, and the results of process mining are analysed and discussed. Section 6.2 is a conclusion of the data analysis.

6.1: PM^2

For the data analysis, and to identify areas of improvement, the PM^2 tool is used as is described in chapter 3. This methodology has 6 stages, and each stage has some activities. The stage and their activities that are used are described in this section.

6.1.1: Stage 1: Planning

The KPI's that are important are the throughput times and the error percentages. To identify which processes, which activities, and which employee groups are causing the most waste the following research questions are defined:

- Which processes have the biggest throughput times and why?
- Which processes have the biggest error percentages and why?
- Which employee groups are causing the highest throughput times and why?

The scope of this research is the processes that are carried out via AFAS InSite. These are the processes that need improvement, and which are going to be analysed. These are the same processes that are discussed in chapter 5, and of which flowcharts and descriptions are made. The processes that are carried out via AFAS InSite are all registered in AFAS Profit. This is the information system supporting the execution of the business processes. The process mining software that will be used is Fluxicon Disco. There is a license available at the notebook service centre of the University of Twente.

The project team that is going to do the process mining project is mainly just me. The employees are involved when more information about the processes are needed, but besides that they are not contributing to the process mining process. There are some influences from the team leader, but this is minimal.

6.1.2: Stage 2: Extraction

In this stage the first thing that has to be done is determining the scope. For every process, a line of the event log corresponds to one activity in the process. By having one line per activity you can for each process step determine what the throughput time is, and in later stages you can determine which activities are causing the most waste. The period of time on which the extraction will be done is 2019 and 2020 (separately). Since the start of 2019 the new system was implemented so this is the starting date. At the start of 2020 they made some adjustments to the processes. By taking 2019 and 2020 separately you can identify the differences, and you can identify if the adjustments have had a positive effect. The attributes that are chosen per line of data are the following:

- Which workflow is used (this is the process)

- Start date and time of the workflow
- End date and time of the workflow
- The task
- Start date and time of the task
- End date and time of the task
- Throughput time of the task (which is the end date minus the start date)
- Which action was done during the task
- Which task comes after the current task
- Which employee did this task (employee code)
- What the next task is, which is based on the action which is done during the task

All the event data with the attributes that are stated above are extracted from AFAS Profit. An excel file with all the information is retrieved.

The transfer of knowledge was minimal. For some processes some elaboration was needed from the employees that were experts in these processes, but most of the processes were clear because of the previous chapters in which the processes were identified and were mapped and described.

6.1.3: Stage 3: Data processing

Because the throughput times and error percentages are the KPI's, the view are the file item numbers. The file item is a unique number per single workflow. So one workflow from start to end has the same file item number. When a new workflow starts from the same process this has a different, unique file item number. By taking this number you can calculate throughput times per single run through a workflow. You can also identify variations in the process models that the software generates.

Generally, every process is individually inserted in the process mining software because you want the KPI's per process. As mentioned before there are 3 school groups. Every school group has its own workflow because they have to be send to specific employees. Most of the time, the processes can be taken as one process because they are (almost) identical. But this is not the case for three processes. Therefore, some aggregation has to be done. The following processes are split into 3 different processes: change in function, report employee out of service, roster change. The rest of the processes are not split.

One of the research questions is: "Which employee group is causing the most throughput time and why?". However, in the current logs there is no attribute 'employee group', only an employee code. Therefore, the logs have to be enriched by external data. From AFAS Profit you can retrieve an Excel file in which every employee code is linked to an employee group. With the help of VBA in Excel, every employee code that existed in the event logs was linked to an employee group. The employee codes had a bit of a pattern, so most of the employees could be filled in with a few lines of code. However, there were also a lot of exceptions. These employees all have a different line of code to fill in the employee group for them.

There will also be some filtering of the logs during the process mining process. Generally, all the logs are included because they are all relevant for the throughput times and error percentages. However, for the throughput times of the total process, the workflows that are not finished yet are not included because this will affect the total throughput times. Workflows that are not finished yet will decrease the total throughput times and this is not a good representation of the average throughput times of a process.

6.1.4: Stage 4: Mining & Analysis

After the event logs are inserted in the process mining software (Disco), Disco makes process models based on the event logs. With the help of these process models, variations on the normal process could be identified. These variations are used in the next step: conformance checking.

With conformance checking, you compare the created process models with the existing process models. The flowcharts that are made in chapter 5 are compared with the created process models. Variations in processes can now be identified, and the amount errors can be identified.

Enhancement will not be used in this stage. Enhancement is extending or improving the existing process model using information about the actual process recorded in the event logs. The variations in the created process models are sub-optimal process paths. The flowcharts that are made in chapter 5 is how the processes should be carried out. Therefore, the variations are certainly useful to analyse, but in this research it is not useful to match the existing flowcharts to the actual process recorded in the event logs.

There will be additional process analytics. To have a clear overview of all the KPI's in one file, rather than having all the information in the process mining software, an Excel file is made with all the information. The throughput times per process, per task, and per employee group are collected in this file. For each of these, the following values were calculated: the minimum, 1st quartile, median, 3rd quartile, the maximum, and the average. For the whole process the error percentage was also calculated. As mentioned before, an error is when a mutations has to be send back to another party to ask a question, or to ask permission. Whenever the task is send to the wrong person, and this person has to send it to the right person, this was also counted as an error. In this file a graphical representation of the data will be made.

There are also some outliers in this data. Most of the times these outliers exist because the last step of the workflow was not finished. It often happened that a supervisor finished all these workflow at the same time, therefore the throughput times of these cases are very high compared to the rest of the cases of the same process. Because these outlier pollute the data, these were eliminated. A mean is calculate with and without outliers.

Whenever a process, or a process step had a frequency of 10 or less, no outliers were calculated. This is because it is not an outlier if it happens in 10% or more of the values. The minimum value of the throughput times had to lie in between the following values: 1st quartile – 1,7 * (3rd quartile – 1st quartile) and 3rd quartile + 1,7 * (3rd quartile – 1st quartile). The value of 1,7 is chosen by testing out some values. At first 1,5 was chosen, but then too many very high values were still included. After some testing with 2,0 it became clear that almost everything was included. After calculating with some other values, it was determined that 1,7 it gave the best results. The values that lie outside this range were eliminated and a new average was calculated based on the remaining values. Whenever a value was excluded that was not really an outlier based on the values of the data, these were included manually. The same was done for the values that were included, but which were clear outliers based on the data. These were excluded manually.

After all the data was collected, the research questions that were formulated in the first stage were answered. The error percentages and throughput times were calculated, and it was determined how much the processes deviate from the norm. The throughput times per employee group were also calculated per process. Because all the activities were included in the analysis, it could be determined why these poor performances are happening. In Appendix C, the results of the analysis are shown. The data about 2019 is given in tables 3 and 4, and figure 9, 10 and 11. The data about 2020 is given

is tables 5 and 6, and figure 12, 13 and 14. As you can see, almost all the mutations of 2019 are way above the norm. The throughput times of 2020 are a lot better, but the error percentages did not improve at all. The values in green are below or on the norm, the black and red values are above the norm. The black values are less problematic than the red values, but are not optimal. The red values deviate a lot from the norm. Both black and red values should be improved. In the data analysis every process step is also included, so it is clear which process steps cause these throughput times. Some process steps occur in different processes. When analysing the data, it became clear that certain process steps that occur in multiple processes have a high throughput time in all of these processes. By improving these process steps, you solve the throughput time of multiple processes at once. The steps that have a high throughput time in almost every process were:

- The checking steps of the personnel administration of Company X.
- Whenever a process is send back to the submitter for more information, it takes a lot of time before the process is returned to the personnel administration with the answer.

Furthermore, it became clear that a high throughput time is correlated with a high error percentage, as is shown in figure 5 below. By solving the errors, the throughput times will be reduced. There is only one process that has a high throughput time, but where it is not related to the error percentage: End employment.

As mentioned before, most of the time the process goes from the submitter, to the P&O department, to the personnel administration. Because every employee group was included in the analysis it could be determined which employee groups are causing the most throughput times. From the analysis it became clear that all of the high throughput times come from the submitters, and the personnel administration. The P&O department has acceptable throughput times.
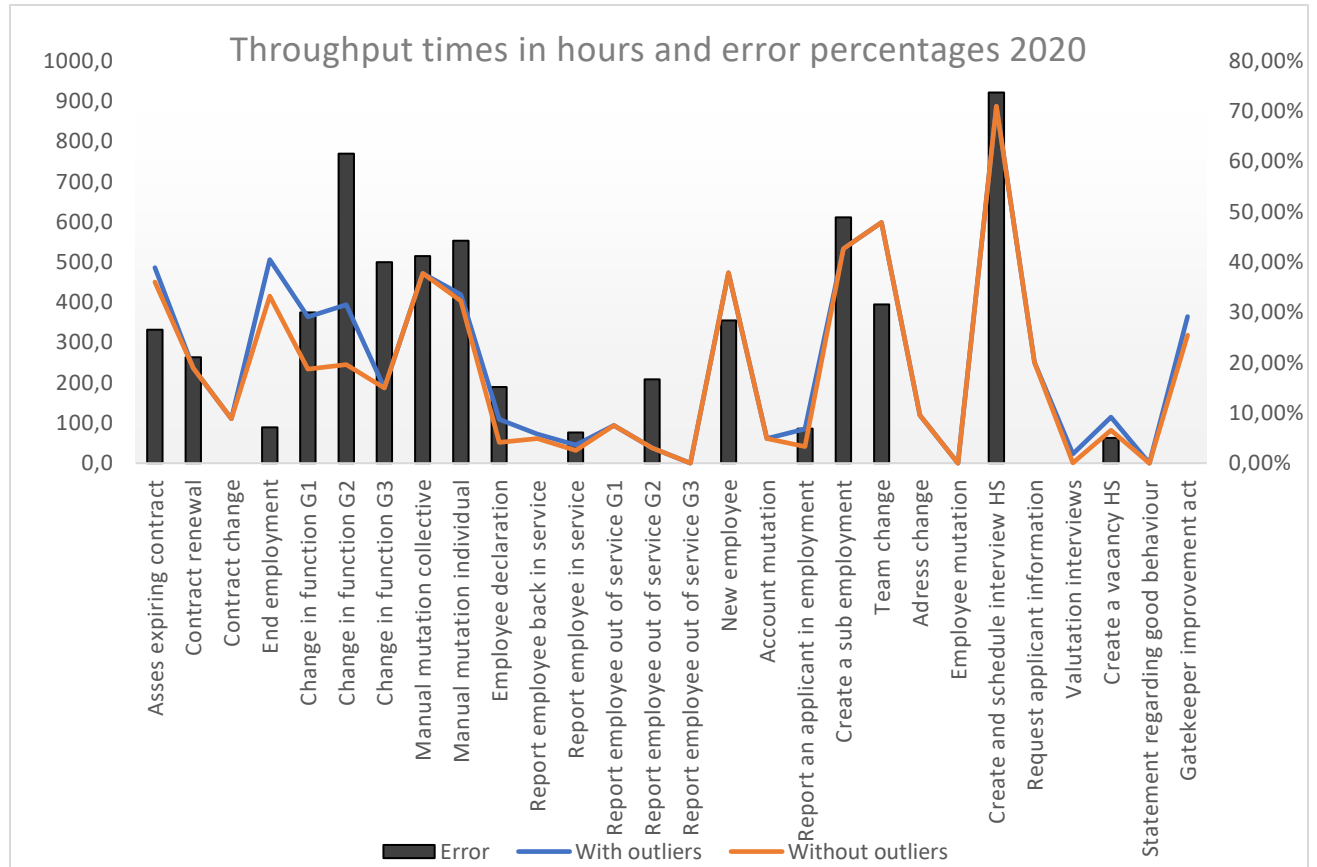

Figure 6: Throughput times and error percentages 2020

6.1.5: Stage 5: Evaluation

The objective of the evaluation phase is to relate analysis finding to improvement ideas. The findings will be discussed here, but since there will be other methodologies used for improvement ideas, these will be discussed in chapter 7.

Errors

An error occurs when the mutations has to be send a step back to ask for more information, or when the workflow is send to the wrong person. Most of the time, the personnel administration sends the mutation back to the submitter. However, the P&O could also be the employee group to deliver incomplete mutations. The personnel administration can also send the workflow back to them. Lastly, the P&O could also ask a question to the submitter.

The errors are on the critical path of all the processes, because the person that sends the mutation back has to wait for an answer of the submitter. If the submitter waits a few days before answering the question, the process is also delayed for a few days. Therefore, the error percentages are a huge bottleneck in the process.

The errors are causing high throughput times because of 2 reasons. The first one is that the process has two extra steps whenever the mutation is send back. The personnel administration has to send the mutation back, and the submitter has to send in additional information. The second reason for the increase in throughput times is that the submitter often takes a lot of time to send additional information.

There could be a few causes for the errors:

- The submitters do not work often with AFAS. Therefore, they are not familiar with the software. They do not exactly know what to do and easily make mistakes.
- The process itself is only done a few times per year. The submitter does not exactly know what information they should provide and what not.
- The submitter thinks to easily about the mutations. They think that the information they provide is sufficient, and if not that the personnel administration will fix their mistake.

The reason for the slow provision of additional information could be caused by the following causes:

- The submitter does not know that the mutation is send back to them.
- The submitter does not think that replying is urgent.

Personnel administration activities

The activities of the analysed processes of the personnel administration are mostly checking tasks. They check if the mutations send in by the submitter contains the right and complete information. They receive these mutations in their inbox in AFAS InSite. The tasks themselves do not take a lot of time to complete, but it takes a lot of time before the tasks are picked up by the personnel administration. This has the following reasons:

- They give priority to mutations that have a due date that is closer to the current date. So they leave mutations that do not have a high priority because they have a high working pressure, and the priority mutations are more important. However, sometime later the mutations that did not have priority earlier, have priority now. Then these mutations have priority and other mutations are left out. This is currently a never ending cycle.
- They need additional information before they can finish the mutation. This is not the same as asking a question to a submitter. They sometimes need additional information from a senior

employee, or they need to call someone. When this person is not available at the time, the mutation is not finished and saved for later.

- They do not have the time to do mutations at a certain time because they are busy with other activities.

It is important to first improve the errors percentages before improving the personnel administration activities. The reason for this is that the error percentages cause a lot of waste in the processes. When there are fewer errors, the work stock of the employees will decrease. When the work stock decreases you can make improvements to eliminate the work stock. The problem that they are facing now is that the work is never finished and it keeps stacking up.

6.1.6: Stage 6: Process improvement & Support
The objective here is to use the gained insight to modify the actual process executions. These will be discussed in chapter 7.

6.2: Conclusion
In this chapter a data analysis is made to get a reality for every process, which answers the first research question. The second research questions: 'Based on the analysis, which processes have poor performances and why?', is answered with the help of process mining. As is shown in Appendix C, almost all salary processes are above the norm, and one non-salary processes is above the norm. Almost all of the high throughput times are related to the error percentages, and the activities of the personnel administration. By solving these errors and activities the performance of the company will increase significantly. This chapter solves the second core problem. The next step is to form solutions to improve the performance of Company X, based on the analysis.

In the previous chapter, an analysis is made and the processes, and activities that cause the most waste are identified. In this chapter solutions are formed for these processes and activities. This is the improve and control phase of the DMAIC cycle. In section 7.1 the main problems are stated. In section 7.2 errors are identified and prevented with the help of Poka Yoke. In section 7.3 solutions are formed to further decrease the error percentages by including the submitters. Section 7.4 gives recommendation on how to increase the performance of the personnel administration activities, by performing well on the principles of Lean. The 8 step change model of Kotter is used to have a systematic approach to the change, and to involve and motivate the employees in the process.

7.1: Main problems

In the analysis phase, the data of 2019 is compared with the data of 2020. It became clear that the total throughput times were reduced, but the error percentages were increased. The reason for the decrease in throughput time is that documents can now automatically be generated in AFAS InSite. In 2019 this was not the case, and this was the cause of a lot of throughput time.

After the analyses phase it became clear that there are 2 main problems causing the high throughput times of Company X:

- The errors
- The activities of the personnel administration of Company X

First, the error percentages will be reduced. It is important to first reduce the error percentages, because this will already decrease waste in the processes. Less waste means less work stock for the employees, and it will be easier to form solutions to decrease the throughput times of their activities. Eventually you want to eliminate the work stock.

7.2: Poka Yoke for error prevention

The first step in reducing the error percentage is the prevention of errors with the help of Poka Yoke, as described in chapter 3. In the define phase when the processes were identified there was a lot of testing with the software. In this phase the findings were written down about possible confusing features of the process, and about errors that were encountered in the process.

The first error that was prevented was the displayed status of the workflow. This status is visible for the personnel administration in their AFAS inbox. Every mutation that is open is visible here with their corresponding subject, corresponding workflow, and the status of the mutation. It often happened that the status was not correctly updated or displayed. This happened when a submitter gave additional information after an error. The status would still be 'In progress at submitter', instead of 'In progress at personnel administration'. The same thing happened when the P&O department was skipped because the submitter was a manager, who does not need that extra check. When this happened the status would be 'In progress at P&O', instead of 'In progress at personnel administration'. This error can be confusing for the employees because they think that the mutation is currently at a different employee group, while actually they have to take the next step. The mutation will not be finished until someone notices that the mutation is still open. The status is fixed in every workflow. This will decrease the throughput times.

Another error that was noticed was in the process of reporting an employee in service. Depending on which option you select, the software will automatically fill in certain information. Some of the options would automatically fill in a function that does not exist anymore. When an employee did

not notice this, they would get an error. The functions that do not exist anymore are removed, and the right information is automatically filled in. This will decrease the throughput times.

For every process there is a short description available which is shown on the screen while filling in the information. In some workflows this information was shown at the bottom of the page instead of on top. This may cause the submitter to miss the information and make mistakes. By putting the information on top of the screens errors are omitted. This will decrease the error percentage.

In many processes there are mandatory fields, but it is not displayed anywhere that these fields are mandatory. When this field is not filled in, an error occurs and you cannot continue the process. Sometimes it even happened that the error did not say what was going wrong. Every mandatory field now has an exclamation mark. If a field which is mandatory is not filled in, a message will pop up. This message will tell which information is missing. This will decrease the throughput time.

One process had a workflow which would send the information to the wrong employee group. This employee group had to send the information to the right group. The workflow is changed and it is now automatically send to the right employee group. This will decrease the throughput time.

In the process of creating a sub employment, you should be able to choose between a replacement or an expansion. The workflow automatically always chose replacement. When the mutations should be an expansion, this created problems. The workflow is modified so you will be able to choose between the two options. This will decrease the error percentage and throughput time.

When an employee that previously has worked at the one of the school groups was reported back in service, the first thing you have to do is fill in the citizen service number and their date of birth. AFAS would automatically choose the right employee. In the next screen you need to fill in the rest of the information. However, in this next screen there would still be a list of employees where you can choose from, even though you already choose an employee with the number and birth date. Submitters could get confused by this, and select a wrong employee. This list is removed from the screen. This will decrease the error percentage.

In 2020 a few processes were changed. If someone had a team change you would do this with the same workflow as a function change. However, in 2020 they changed this so that a team change is a different workflow. However, they never removed the field where you can change the team in the workflow of the function change. Therefore, the submitters could still use the function change workflow for team changes. At the end of the process they would realize that they have to use another workflow, and have to start over again. The team change field is removed from the function change workflow. This will decrease the throughput times.

In InSite there is a place where management can intervene in workflows. They have 2 different buttons. Under one button workflows are shown that are currently at the P&O, and under one button workflows are shown that are currently at the personnel administration. However, this was not always correctly shown. In certain steps of the workflows when the process is at the P&O, it would show in the list that the workflow is at the personnel administration and vice versa. This will make management take longer to identify the workflow that they need. Every workflows is checked and the lists are fixed. This will decrease the throughput time.

7.3: Further error preventions

After that all the error are omitted that can be prevented with the help of Poka Yoke, other improvements have to be made to further reduce the error percentages. A process does not end after an employee group is done with their part of the process. According to the value stream

principle of Lean, there are more stakeholders in the process that all should be taken into consideration. Lean assumes that everyone involved in the process wants to do their job right, and does not intentionally sabotage the process. But if people are not aware that their contribution can lead to serious delays in the process, they will not see a need for change. Submitters should be aware that errors lead to a late payment of the salaries and a bigger working pressure for the personnel administration. This is the first step of the change model of Kotter, 'Sense of urgency', which will be described in the next section. Submitters are often the team leaders of the employees that the mutations are about. Their employees might get their salary too late because of mistakes the team leaders makes. They might be demotivated and make the work of the team leader harder. So there is also a self-interest for the team leader. This is also a 'Sense of urgency'.

The first step here is to identify why the submitters deliver wrong or incomplete information. As is mentioned in chapter 6, there could be a few causes. To identify which are the real causes for the error percentages, interviews have to be held with the submitters. In the event logs which were used in the process mining process, you can identify the employee codes of the submitters who make mistakes. Based on this data 3 submitters are chosen to interview. One submitter per school group. One submitter that works a lot with the software, one submitter that does not work with the software often, and one submitter who has a high error percentage. The following questions will be asked to get a better understanding about their activities:

- How do you experience the process of submitting mutations via InSite?
- Which problems do you encounter while working with the software?
- Do you work often enough with the software that you are familiar with it?
- Do you always know which information you have to fill in?
- How many employees in your school work with the software?
- Do you think it would be beneficial to centralize the input of mutations?
- Whenever a questions is asked to you about the mutations, do you immediately notice this question or does it takes some time because you rarely work with the software?
- Do you send in mutations in batches, or immediately when the information about a certain mutation is known?

After the interviews the submitters point of view is made be clear. There were are few main findings after the interviews:

- They do not have a positive experience working with the software.
- They do not work often enough with the software to be familiar with it.
- They do not always know which information they need to fill in.
- It would be nice if there were only a few people that fill in the mutations, because they will know what to do and work with the software regularly.
- If the mutations is send back to them, they do notice this fast and try to give an answer immediately.
- They send in mutations individually, not in batches.

Based on these answers, 4 points of action are formulated.

- Submitters should be familiar with the software.
- Submitters should have a clear description about what information to provide.
- Information that is crucial should be mandatory to fill in.
- Get the personnel administration involved.

Submitters should get familiar with the software
Right now there are a lot of different submitters. Some of these submitters only work a few times per year with the software. This is not optimal because they will spend more time doing a single mutation, and will make more mistakes. To fix this, two things can be done. The first one is to train the submitters once per half a year, so they will be more experienced with the software. During this training submitters should be given access to the test environment. They can test out workflows that they will be working with, and the personnel administration, or senior employees, will give them feedback about what they are doing right or wrong.

The second action that can be done is to give less employees the power to submit mutations via AFAS. Per school group there should only be a few people that will be allowed to submit mutations. By doing this, people that are submitting mutations are familiar with the software, and know what to do. You can also have more communication with the submitters, because it would only be a few people instead of a lot of different people. Managers or team leaders that want to process mutations send this via a standard format to the people that submit them via AFAS. This standard format should just include the important information about the mutation that are mandatory to fill in. The people that work with AFAS can fill this in an send it to the next employee group for checks. The people that will work with the software should have the theoretical knowledge, and should be familiar with the software.

The second solution will probably give the best results, because otherwise there will be a lot of people that need training. This will cost considerable time every year. The second solution will also give a better result because you will have a few experts per school group, who will be experienced with AFAS.

Submitter should have a clear description about what information to provide
Right now there always is a small description at the top of the page about what information they should provide, but apparently this is not enough to get error free mutations. In chapter 5 process mappings and descriptions are made. These descriptions will be available to everyone that is working with the process. Submitters can use this information as support for their tasks. Additionally, the information at the top of the screen should be modified to make it more clear for the submitters what to do. The description on top of the page should also stand out more. It is easy to skip over it right now.

Information that is crucial should be mandatory to fill in
As described in the previous section, there are some mandatory input fields when submitting a mutation. However, not all information that is crucial is made mandatory. One example for this is with the contract change process. The submitted mutations was that an employee was going to work 3 days a week instead of 2. It was not stated which day the employee was going to work extra. The personnel administration had to send the mutation back to get the complete information. In this process it should be mandatory to fill in on which days the employee is going to work.

Get the personnel administration involved.
After the changes are implemented, the errors will be reduced. The last step is to maintain these results. It will still happen that more information needs to be requested from the submitters. When this happens, the personnel administration should identify why the error is happening, and should communicate this with the submitter immediately. By communicating the remaining errors, the submitters will know what they are doing wrong and can fix this the next time they send this mutation, and not make the mistake again. Communication between the submitters and personnel administration will be important in the future.

7.4: Personnel administration activities

After that the error percentages are reduced, the throughput times are already reduced. This has two reason. Whenever there is an error there are two extra steps in the process, and because the personnel administration has less work stock. However, the throughput times will still be above the norm. To solve this problem there has to be a change in the way the administrative employees work. Right now it is not structured and it is just picking up mutations that have the highest priority. This is not an efficient way of working because this cycle will just continue if nothing changes in the organization.

To solve this problem, Lean will be used. The reason why Lean is a good methodology here is because it is process related, and it also has tools to motivate and change people. In chapter 4 some ethnographic research was done to get a better idea about the activities that the employees do, and to get a better understanding about what is going wrong. In the rest of the research observations were made by using the Gemba Walk. For a few weeks, normal days in the office were observed. One observation that was made is that there is not a strive for improvement at the employees. They have complaints about the current processes but do not take actions to solve the causes of the problems. This is because they have a high workload, their work is never done. Therefore they think they do not have time to do this. But with this mindset they will keep running into the same problems. This can be very demotivating, when your work is done at the end of the day it gives more satisfaction. Also, it is not in their nature to make changes and to think about what can be done better. However they should make time to do this because else the problems will never be solved. By investing time now, there will be less problems in the future.

Because radical changes are not in the nature of the employees, the choice is made for continuous improvement. These are continuous small improvements rather than big radical changes. Big radical changes might lead to demotivation, while it is important that the employees get intrinsic motivation to change. The theory states that an organization is Lean if every employee takes it for granted that there is a strive for perfection. They should want continuous improvement of their activities to make their jobs easier, and to have less stress.

The goal of this improvement phase is that the company eventually performs well on the principles of Lean.

Customer value

The customer value in this case is a bit different than in traditional organizations, because Company X is an administrative organization. The customers are the employees for which they process mutations. One part of the customer value in this situation is that the mutations are processed correctly so that the right information about the employees is stored in AFAS Profit. If the wrong information is stored, the employees might get incorrectly calculated salaries. These salaries than have to be corrected at the end of the month, when noticed. Sometimes it does not get noticed and the employees get a wrong salary. When this happens the salary is increased or decreased the next month, depending if the employee got too much or too little. These corrections are take time and are waste in the process. Another part of customer value is that the mutations have to be processed in time. If the mutations are not processed at the end of the month, the salary is not adjusted. When this happens the employees will also get incorrect salaries. The goal is to always get the right salaries for the employees of the school groups at the end of the month. This will be achieved by removing waste in the value stream, as described below.

Value stream

The value stream is the set of activities that contribute to the customer value. In chapter 5, all the

processes are mapped and described. These steps all contribute to the customer value because these steps are needed for correct mutations. The many checking steps might not seem to contribute to the customer value, but it is stated by law that these checking steps are necessary, because the mutations determine the salary of the employees. Otherwise, a mistake by a single employee can cause serious damage. The goal is to only maintain activities that contribute to the customer value, and the necessary activities. All other activities are waste, and have to be eliminated. This is already partly done in the previous steps of this research. With the help of Poka Yoke, wasteful activities are eliminated. The error percentages are also wasteful activities. These are also reduced in previous steps of this research. Picking priority mutations above other mutations is also waste, because you open and read mutations that are left out multiple times. You open and read it a first time when you check for a date. Then you leave the mutation, and a while later you open and read the mutation again. There is also a lot of switching between activities, they open and close certain screens and information about the mutations multiple times. When doing this regularly, this will costs considerable time and thus is also waste. The corrections on the salaries is also waste because in an optimal process this would not be necessary. The goal is to eliminate all the wasteful activities.

Create flow
After wasteful activities are removed, a flow has to be created. As mentioned before, there is no good structured way of working. They do the tasks with the highest priority, which is a form of waste. This is mainly because they have a high working stock, and there always are mutations that are due in a short amount of time. After that the error percentages are reduced, the working stock of the employees will be reduced. It is important to eventually get a evenly distributed flow of activities. To create this flow it is important to have good communication with the submitters. There should be agreements that salary mutations have to be send in at least a week before the date that salaries are processed, otherwise these have a very high priority and deliver stress for the administrative employees. It should also be identified when there are peaks and valleys of mutations, because then you can anticipate on this and create a flow of evenly distributed activities. In the early stages of the improvement the flow will be completing mutations at a certain pace to remove work stock.

When the work stock is eliminated, the goal should be that no priority is given to mutations above other mutations. Every morning, all the mutations in the inbox should be processed. During the day more mutations may be added, but these mutations should be done the day after. In this way, there will be no working stock and mutations will not be processed too late. This will create value for the customer because the salary mutations will not be too late and will be processed before the employee gets their salary.

Create pull
Creating a pull process, is creating a process in such a way that inventory levels are minimized. You let the customer 'pull' the products, and react on this to minimize inventory levels. Since the organization is an administrative organization, there is no inventory. You cannot produce excessive products. There is already a pull process, because mutations will be processed when they are delivered. For that reason, creating a pull is not relevant in this organization because in a sense there already is a pull process.

Pursue perfection
The first 4 steps remove waste and create a more efficient organization. However, the fifth step will be the most important one. You have to maintain this performance. If you do not put effort in the improvements after they have been implemented, it is easy to go back to the old habits. You have to ensure that there is continuous improvement, and maintain existing improvements. Lean thinking and continuous improvements should become part of the organizational culture. Every employee

should strive towards perfection while delivering the services. The employees should be open to learn, and always try to find ways to get a little bit better or more efficient in the activities that they do.

To have a structured way to implement the change, the 8 steps change model of Kotter is used, which is also described in chapter 3. This model also ensures that employees are involved and help with the changes.

1. Create sense of urgency
The first step in Kotter's change model is create urgency. As mentioned before, every employee group that has to do activities in the processes should be involved. First of all, the submitters should be aware that incorrect input of the mutations can lead to a late payment of the salaries, and a bigger working pressure for the personnel administration. The employees of the submitters might get their salary too late because of the submitters own mistakes, and these employees might get demotivated. The submitter should be aware of this. The errors that the submitters make are solved in the previous section, but they should remain aware that their activities have certain consequences, and should maintain the low error percentage.

As mentioned before, the P&O department has acceptable throughput times, so they will not be taken into account here. For the personnel department, the sense of urgency should also be created. The personnel department is well aware that the organization is currently not performing well. They are also aware that something has to be done. The thing is that they think this is the task of the team leader and the senior employees. They think they are too busy to do anything about this, and think that they do not have enough power to make changes. It should be made aware that their future work can be made a lot easier and less stressful by making changes now. This can be done by showing the data of the data analysis. Main processes that are done regularly have to be shown to the employees, with their corresponding error percentages and throughput times. It should be made clear that the error percentages are a big part of the problem, and that they have to engage with the submitter when there are errors to make their own jobs easier in the future.

When everyone involved in the processes has a sense of urgency you can move onto the next step. It is important to make sure everyone involved has this sense of urgency before moving on.

2. Form a coalition
You do not only need to manage change, you also need to lead it. By leading the change you keep the employees involved. Finding the right coalition in this research is not difficult. First of all the team leader should be involved. He is the manager of the department and is involved in everything they do. Secondly, the senior employees of the personnel department should be involved. They have the most knowledge about the processes out of everyone in the organization. The other personnel department employees should of course also be involved in the change, but they are not in the coalition that lead the change.

3. Create a vision for change
Right now there is not a good working environment because of the high work pressure. This leads to demotivation and a bad working atmosphere. The vision that is formulated is: Create a pleasant working environment, in which the work load is reduced, there is less stress, and where there is a good working atmosphere. This can be achieved by reducing the error percentages and reducing the throughput times, which in turn reduces the work stock. Eventually the work stock has to be eliminated completely. To achieve these goals, the submitters should be a part of the process as mentioned before, waste in the processes should be eliminated, and there has to be a structured way of working which creates a flow of activities.

4. Communicate the vision

3 times per week there is a morning meeting for the personnel administration. In this morning meeting they make agreements about the planning, and are arguing about some issues. There is a big white-board in the room where this morning meeting is held. The vision should be written down on this board. Every morning meeting the vision, and the progress, should to be discussed. The main findings are written down on this board, and are saved for the next meeting to discuss how the progress is going, and if goals are achieved. The employees can share their ideas, and the team leader can share his ideas. It is important to let the employees think about the issues. You should not only tell them what to do because the employees will not be that involved then. If the employees come up with their own solutions, they will be more motivated to implement these changes. It is important to always keep the employees involved and motivated.

5. Remove obstacles

There could be different obstacles that will slow down the progress. These obstacles should be eliminated as soon as possible. One of the obstacles is that employees might be resistant to change. This obstacle can be removed in step 1, create urgency. Another obstacle is that the employees might still think they do not have time to be involved in the improvement process. You can eliminate these thoughts by showing the employees data about what impact the changes could have. It will become clear that processes can be improved by a lot, and that their jobs can be made a lot easier and less stressful in the future. The employees have to realize that investing time now is worth it in the long run.

6. Create short-term wins

To keep the employees motivated, it is important to create short-term wins. These short-term wins should be on 3 of the most used processes. Data should be shown on the white-board in the morning meetings about the throughput times and the error percentages. Goals could be: in 4 weeks the throughput times should be reduced by 20%, and the error percentages by 30%. When these goals are achieved the team leader should treat the employees something nice at the coffee break. It should be noted that these short term wins should be created after the summer break. The reason for this is that the month before the summer break is the most busy month for the department. It is not realistic to create wins, or implement changes in this period.

By creating short-term wins employees will see that the changes are working, and that their jobs will become better over time. They will get more motivated to keep the change going, and will remain involved in the change.

7. Build on the change

After the first wins are achieved within the organization, it is important to continue on these changes. It often happens that a project fails because victory is declared too early. If you want to maintain the results you have to keep improving. Continuous improvement works very well here. You want to continuously make minor improvements within the process to always get a little bit better, and to reduce the work stock until the work stock is eliminated completely.

After the first wins are achieved, you need to analyse what went right and what needs to be improved. Then you set new goals for the coming period. It is important to keep the employees involved, so that they will not fall back into their old patterns.

8. Anchor the changes in the corporate culture

Eventually, it should become part of the corporate culture. Every employee should strive for perfection in everything they do. This is also the 5th principle of Lean. After that they are being

involved for some time, it will become part of their nature to strive for improvements. They should also maintain communication with the submitters about incoming mutations and about the errors.

As mentioned before, after the work stock is eliminated it should be a daily routine to process all the mutations at the start of the day.

7.5: Conclusion

To solve the problems that the organization is facing, a few things have been implemented, and some recommendations are made. First of all, process descriptions are made in chapter 5 that will support the submitters, and the personnel department with their activities. It will be more clear how every process works, and what has to be done within every process. With the help of these process descriptions error percentages and throughput times will be reduced. With help of Poka Yoke the software will be more convenient to work with, and errors and throughput times are reduced. Then there are some recommendations to further improve the performance of the organisation. The first recommendations are about the mistakes that submitters make. After that there are some recommendation to improve the way of working of the personnel administration, with the help of the principles of Lean and the 8 step change model of Kotter. The work stock should eventually be eliminated, so that no priority will be given to mutations anymore. In the future they should strive to process all the mutations in their inbox at the start of the day.

This chapter is about the evaluation of this research. In section 8.1 a conclusion is formed based on the action problem and the research question. Additional deliverables are also discussed. In chapter 8.2 recommendations are given towards Company X based on the improvement ideas in chapter 7. Section 8.3 is a discussion about his research. The limitations and difficulties are discussed here. Section 8.4 discusses the use of this research for future science.

8.1: Conclusion

Since the start of 2019, Company X has a new digital system that puts mutations automatically into the administration software, if done properly. However, this process is not going as was hoped. There are many errors within the process, and the processes take too long to complete. The consequences of these problems in the process is that employees of the school groups get a wrong salary, or get their salary too late. The consequence for the personnel administration is that they have to fix these salaries, so they take even more time with their activities. Meanwhile mutations are still coming in, so their work keeps stacking up and they are never done with their activities. This causes the administrative employees to have a high working pressure, high work stock, and gets them demotivated.

The action problem in this research is: 'The performance of the personnel department of Company X is too low'. The corresponding research questions that was formulated is: 'What are the main causes of the poor performance of company X, and how can this performance be increased?' The goal of this research was to answer the research question, and solve the action problem. This is done by a data analysis, some implementations of improvements, and some recommendations on improvements. The norm for the throughput time for salary mutations is one week, and the norm for non-salary mutations is a month. The norm for the error percentage is that it should be close to 0%.

The first part of the research question is answered with the data analysis. The main causes of the poor performance are the errors made by the submitters, and the activities of the personnel department. These are the main bottlenecks of the personnel administration. The errors are on the critical path of all the processes, because the process cannot continue before the submitters answers the question that is send to him. If the submitters takes a week before answering, the process is delayed by a week. The second part of the research question is solved with the help of recommendations. These recommendations are summarized in the next section.

There are some additional contributions to the company in this research. Flowcharts and process descriptions are made to make the processes more clear for the people that work with them. This will in turn reduce throughput times and error percentages. There is also a data analysis included in which the KPI's for all the processes are calculated. This is a good information source for the company to look back at if they want more information about certain processes.

8.2: Recommendation

Error percentage submitters

To reduce the error percentage caused by the submitters the company should have a centralized submission of the mutations per school group, which consist of a few people. These people will be more familiar with the processes and the software so less mistakes will be made. The team leaders of the schools mail these people with a standard format, including all the information of the mutation.

The personnel administration should have good communication with the submitters. When an error happens, the personnel administration should identify why this error is happening, and communicate this with the submitters. By doing this the remaining errors will be eliminated. The personnel

administration should also identify which field are always mandatory, and communicate this with the application manager. These fields should be made mandatory, so this information will never be forgotten to fill in. There are also flowcharts and process descriptions made available to support the submitters with their tasks.

Activities personnel administration
They should strive to perform well on the principles of Lean. It is important to involve the administrative employees and the submitters here. To lead the change they should make use of the 8 step change model of Kotter, this will keep the employees motivated and involved.

First the personnel administration has to have good communication with the submitters about the errors. When the errors are reduced, the work stock will also decrease. Then wasteful activities should be removed. These wasteful activities are partly removed by Poka Yoke. Prioritizing certain mutations over others is also waste because they open and read these mutations multiple times. However, this habit has to be removed after that the work stock is eliminated. They should first eliminate the work stock by reducing errors. Then they should determine the peaks and valleys of the mutations by having communication with the submitters. They should create a flow of activities based on these peaks and valleys, to gradually remove work stock. After the work stock has been eliminated, prioritizing mutations over others should not be done anymore. At the start of the day they should process all mutations that are in their inbox. They have to do this every day so that no work stock is build up anymore.

8.3: Discussion

Lack of time and information
The first big limitation of this research is that the last 2 months were all done from home because of the Corona virus. There was a lot of communication with the team leader but this was all done by mail and by calling. There still was communication with the employees, but this communication was very slow. Most of the time it took at least a week before they replied. Therefore, some information that was needed for the research was provided very late. This slowed the research down. Since there already is a limited time available, not everything could be done that was initially planned. The flowcharts and process descriptions, and the Poka Yoke findings are implemented, but the rest of the improvement ideas could not be implemented due to time constraints. Therefore these improvement ideas are currently recommendation ideas towards the organization.

Another drawback of working from home is that you cannot observe the activities within the organization. By being present in the office you can obtain a lot more information by observing. You can also just walk to the employees if you have a question, and they can show you how things are done. This was done in the first few weeks of this research, but at that time the problems were not as clear, and there was less information known than at the end of the research.

Validity of the data analysis
The data analysis conducted in chapter 6 determines the throughput times and error percentages of all the processes. Based on these findings the wasteful processes and activities were identified, and improvement ideas were formed. The limitation here was that some processes were done a lot more than other processes. So for some processes, the average was taken from just a few cases, and this may not be a good representation of the process. For example, when the process is carried out 100 times it could give different results. Right now, the data of some processes are based on just a few cases.

However, the process mining technique that is used gives a good solution for the first part of the research question. Processes and activities that have poor performances are identified with fact based input. The input for the software is the actual execution of the processes how they were carried out over the past 2 years. This is a good representation of how the processes are carried out and does not contain wrong information. The organisation can also use this data themselves to identify critical areas that they need to improve on.

Validity of the flowcharts and process descriptions
The flowcharts and process descriptions were made based on how the processes were carried out at that moment. In the future, when removing wasteful activities, these processes might be altered. The flowcharts and process descriptions of these processes will then not represent the actual process. The company should alter these flowcharts and process descriptions themselves, based on the changes in the processes. A description is made on how to do this.

However, the flowcharts and process descriptions that are made give a good solution for the first core problem. For the current situation the organisation now has proper and actual process descriptions that the employees can use as support for their tasks. Whenever the administrative employees are stuck in a process, they can go to the local drive to search for answers. The processes might change a bit, but they can alter the process descriptions themselves. It is a good basis to continue on.

8.4: Contribution to science
The process mining technique that is used in this research is not often used in similar situations. However, it could be an interesting methodology for other researches. A prerequisite for process mining is that you can acquire event logs out of the information system that is used. With process mining you transform event data into knowledge about the organisation's business processes. If the goal of this knowledge transformation is to improve process performance, or compliance to rules and regulations, PM^2 is a good technique to support the process. You can either set a goal to improve certain processes by a percentage, or your goal can be to get better insights into the processes. With PM^2 you formulate certain research questions that you are going to investigate during the process mining project. You can alter your event logs to only have the relevant information in your event logs. You can also use different cases to get information about different parts of the process. For example you can use the order as case if you want to analyse the throughput times. You can also use the resources as case notion to analyse the resource utilisation. Another thing you can do is take the employee group as case to analyse the throughput times per employee group to identify which employee groups are causing the most waste. After answering the research questions you can identify processes that deviate from the normal processes, or you can identify areas of improvement.

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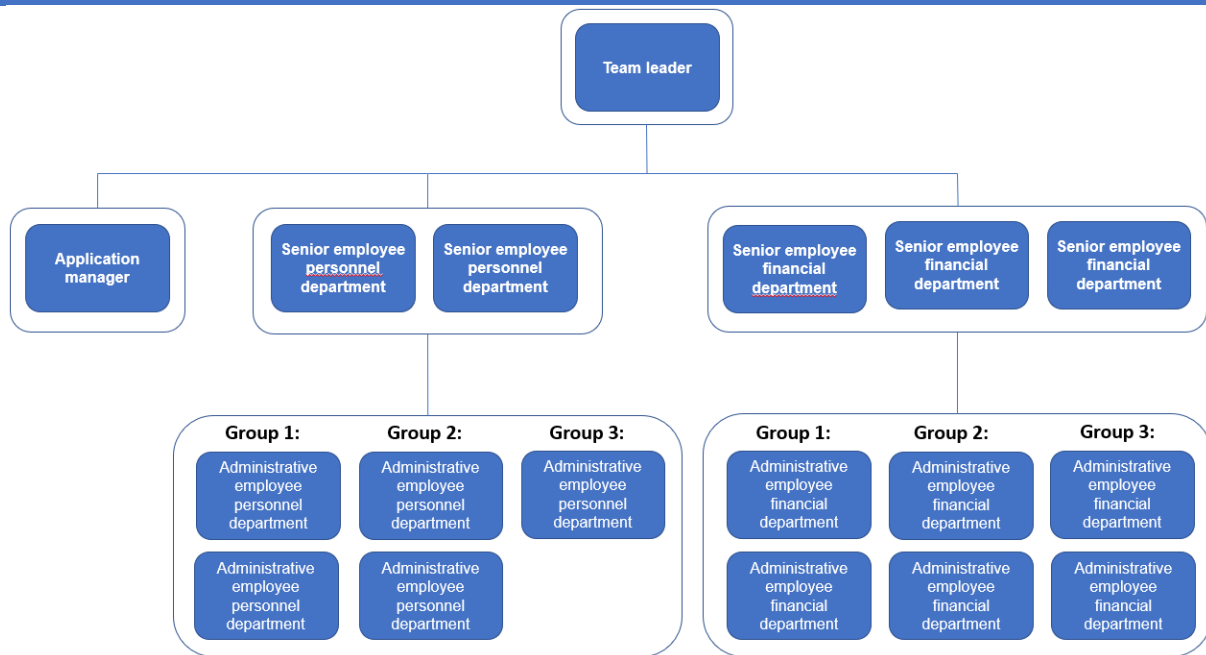
Figure 7: Organizational chart
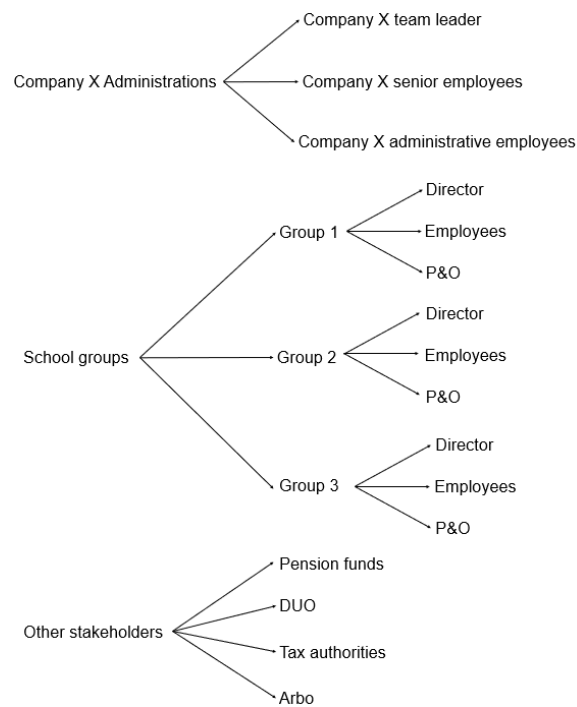
Figure 8: Stakeholders
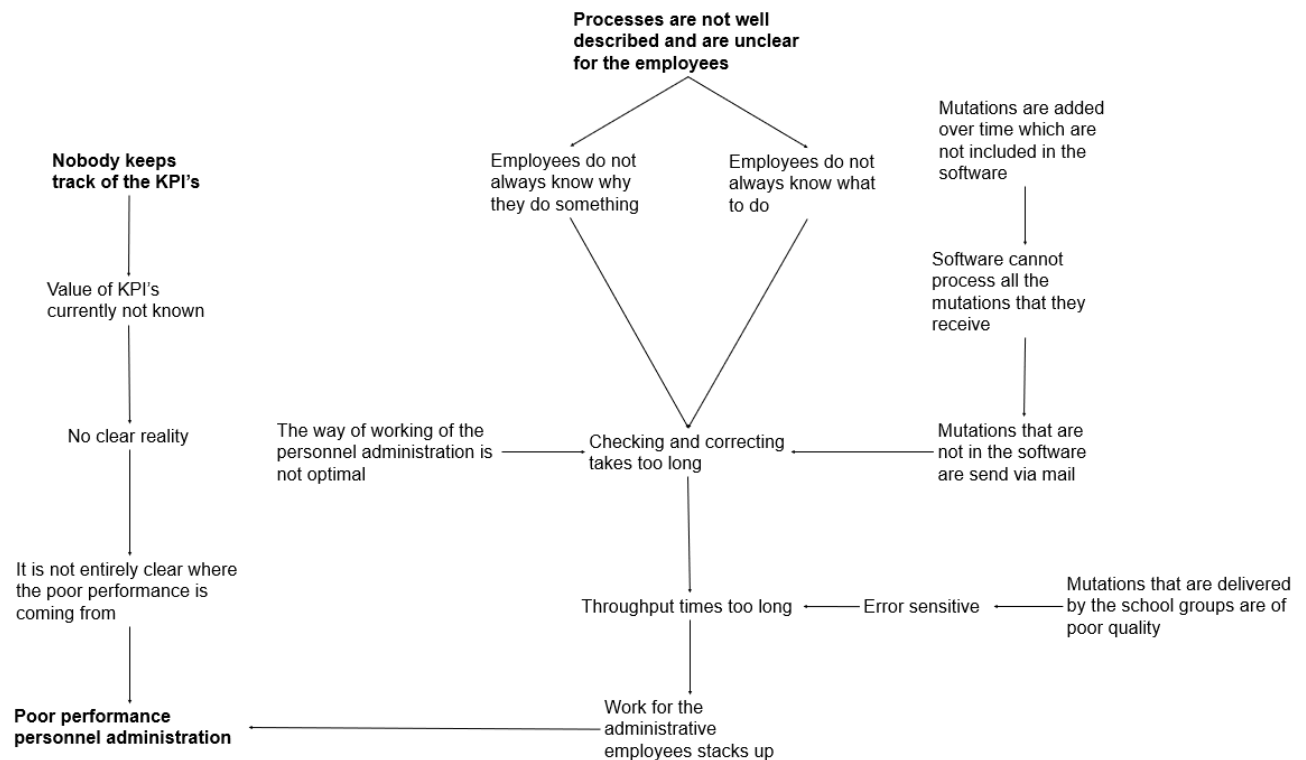
Figure 9: Problem cluster

Knowledge questions per phase

Phase	Knowledge problem
Theoretical framework	**Which theoretical frameworks are best suited for this research?**
	Which tools can be used to improve the wasteful business processes?
Problem analysis	**What is the current situation?**
	Who are the stakeholders?
	How do the administrative employees perform their daily tasks?
	Which problems do administrative employees have on a daily basis?
Mapping and describing the business processes	**What is the best way to map and describe the processes, so that the employees can use this as support for their tasks?**
	What process descriptions are currently available, and are these of any use?
	Which processes should be described?
	Which format is most suited for the employees to work with?
	What level of detail should be included in the process description?
Data analysis	**What are the current values of the KPI's?**

	How can the KPI's be measured?	
	Based on the analysis, which processes have poor performances and why?	
	Which processes have the biggest throughput time and why?	
	Which processes have the biggest error percentage and why?	
	Which employee group are causing the most throughput time?	
Forming solutions	**What are the best solutions for the problem the organization is facing?**	
Evaluation	**What are the main findings of this research?**	
	What recommendations can I give to the company to achieve the goals?	
	What obstacles were encountered?	

Table 2: Research and knowledge questions per phase

Employee 1

Session 1:

In the first observation session the employee received mutations in her inbox regarding changes in someone's contract. The employee then checks if there are no mistakes in the mutation. If the mutation is right and complete, the employee sends it to the next person responsible, or the mutation goes directly to the administrative software AFAS Profit. This depends on the kind of mutation. Mutations regarding a change in hours also have to be checked in a different software called Foleta.

It was noticed that completing one single mutation takes longer than expected. This had the following reasons:

- The employee did not receive the right information. For example, the mutation was that someone got replaced for 10 hours. But this person that was replaced worked more than 10 hours in a week. So the administrative employee did not know which hours she should change, and had to send the mutation back to the submitter (error, throughput time).
- Someone got a contract renewal. However, this person could be going with pension but decided to continue working. It was not clear for the employee what to do with this mutation, so she skipped it until she could ask a senior employee (throughput time).
- She received a mutation that someone was going to work for more than 1,0 FTE. This normally has to include an approval of the supervisor. This approval was not included, so the mutation had to be send back to the submitter with the question if he could add this approval. The same thing happened when somebody had a team change. This also has to have an approval which was not included (error, throughput time).
- Someone was going to work in a new location from 14 February, but 14 until 23 February were holidays. She was not sure if the cost for these 2 weeks had to be booked on the old or new location. She had to wait and ask this to a senior employee (throughput time).
- Sometimes the schedule of a teacher had to be checked for confirmation. This roster was not always available, so she could not check the mutation properly.

Session 2:

In the second session she was also doing mutation regarding a change in someone's contract. The following problems occurred:

- The right information was not always submitted by the submitter. So she had to send these mutations back (error, throughput time).
- A temporary change was submitted as a schedule change. This is wrong because with a schedule change it is permanent. The mutation had to be send back (error, throughput time).
- The mutation stated that someone had to replace a certain class for 3 hours. But when checking the mutation the person that was replaced only had this class for 2 hours (error, throughput time).
- The regular schedule was not equal to the schedule in Foleta. This was probably a mistake in Foleta because it was not maintained (error).
- The mutation states that someone has to replace a class which is in a different team. This is not possible (error).

Employee 2

The second employee that was observed had to set up deeds that had to be send to the directors

and to the employee the deed was about. She also had to correct payslips, and she received mutations regarding the function of employees.

The deeds had to be send to the director and the employee because there were some changes. She had to check the automatically generated deed with the data that was inserted in AFAS Profit. This process went well overall, but it had 2 difficulties:

- Determined/undetermined was often wrongly stated in the deed because the software retrieves the information out of the last mutation rule. The software should get it out of the first mutation rule. She has to check and correct this every time (error sensitive, throughput time).
- Determined/undetermined wrongly inserted by the supervisor. She had to check and correct this in the deed (error sensitive, throughput time).

The correction of payslips, and the mutations regarding a change in function had some problems. When there is a change in function there is also a change in the payslip, so these are related to each other. During the observations the following problems occurred:

- When someone has 2 different functions, there is a certain calculation that you have to do. This has to be done manually and is time consuming and error sensitive (error sensitive, throughput time).
- When someone is a starting teacher, and then has a function change to a normal teacher, this persons contract has to be ended, and a new one has to be set up, which is not optimal (throughput time).
- Some employees worked extra in the holidays. It was not clear which rate had to be taken for their salaries. Non taken holiday days, extra rate on the normal hours or more hours? Had to be asked to a senior employee (throughput time).

Employee 3
The third employee that was observed calculated the amount of days someone could take when they had maternity leave or parental leave. This process is not included in the software, so this was done by mail. The employee received a mail with the request of maternity or parental leave, and had to calculate the amount of days they could get. After calculation he send a mail back with the dates.

There were no real big problems that made the process to cause errors, but the process was not optimal. Everything had to be done manually. Sometimes when holiday days were included in maternity or parental leave period, he approximated the dates. So it was not 100% precise.

Employee 4
The fourth employee that was observed received mutations regarding temporary contracts. This includes replacements when someone has a leave of absence or when someone is sick for example. Replacements are done via a software called Salure, which is linked to AFAS Profit. Salure is a software in which replacements are arranged. When someone calls in sick, they can immediately find a replacement. The employee had to check the replacements, and approve them. This was also not an easy task. The problems that occurred were the following:

- She received errors that she did not understand.
- Some data was wrongly linked between the 2 software.
- The salary was sometimes wrong. This could not really be checked beforehand. They would only find out if the employee that got the wrong salary called them about it.

Salary processes 2019	Throughput time with outliers (hours)	Throughput time without outliers (hours)	Norm throughput time (hours)	Error percentage
Assess expiring contract	1471.2	1471.2	168	8.42%
Contract renewal	591.2	481.5	168	7.69%
Change in function G1	685.4	611.5	168	29.63%
Change in function G2	901.2	901.2	168	21.43%
Change in function G3	614.0	614.0	168	0%
Employee declaration	129.1	41.1	168	8.82%
Report employee back in service	557.9	161.7	168	0%
Report employee out of service G1	3729.8	3729.8	168	8.33%
Report employee out of service G2	2403.7	2403.7	168	12.50%
Report employee out of service G3	3767.0	3767.0	168	0%
New employee	457.0	390.7	168	7.75%
Account mutation	339.1	136.8	168	10.53%
Roster change G1	903.1	731.8	168	32.26%
Roster change G2	1806.0	938.7	168	14.29%
Roster change G3	2994.2	1916.8	168	30.77%
Report an applicant in employment	370.4	227.3	168	2.99%
Create a sub employment	909.1	909.1	168	8.77%

Table 3: Data salary processes 2019
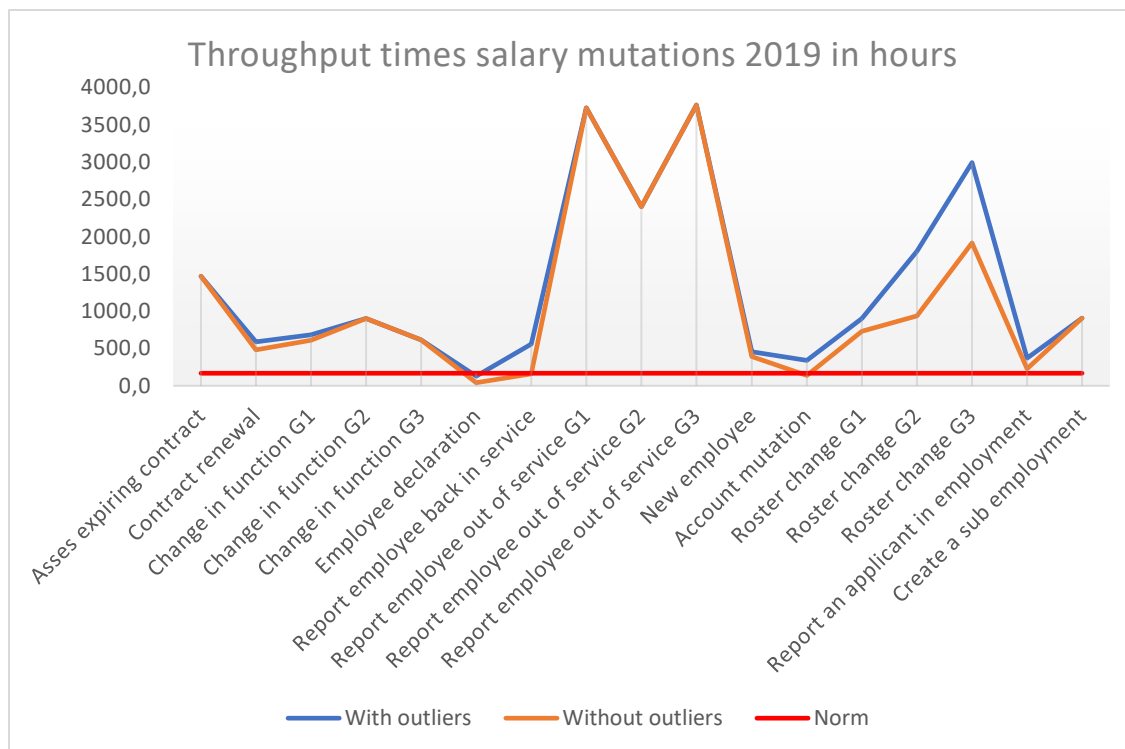
Figure 10: Throughput times salary mutations 2019

Non-salary processes 2019	Throughput time with outliers (hours)	Throughput time without outliers (hours)	Norm throughput time (hours)	Error percentage
Adress change	149.5	120.5	720	1.94%
Employee mutation	9.2	0.0	720	0%
Create and schedule interview HS	1495.7	965.4	720	42.42%
Request applicant information	1013.0	948.7	720	0.79%
Valuation interviews	2459.1	2459.1	720	1.9%
Create a vacancy HS	155.7	128.5	720	8.54%
Statement regarding good behaviour	1.6	0.0	720	0%
Gatekeeper improvement act	1055.5	644.6	720	7.35%

Table 4: Data non-salary mutations 2019
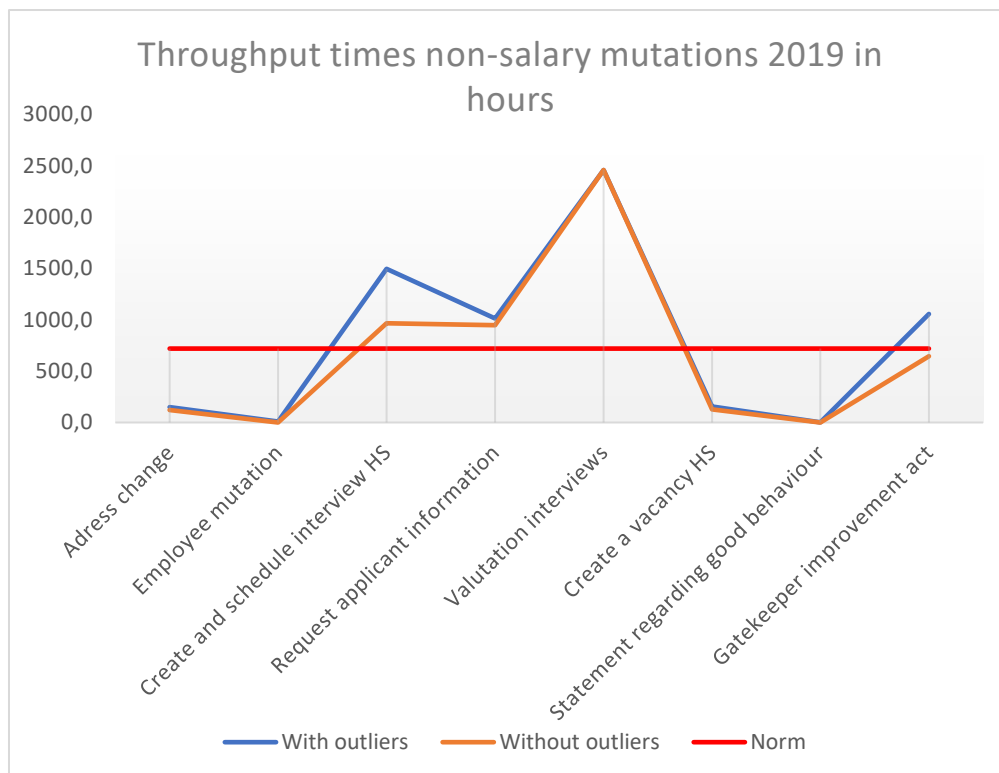
Figure 11: Throughput times non-salary mutations 2019
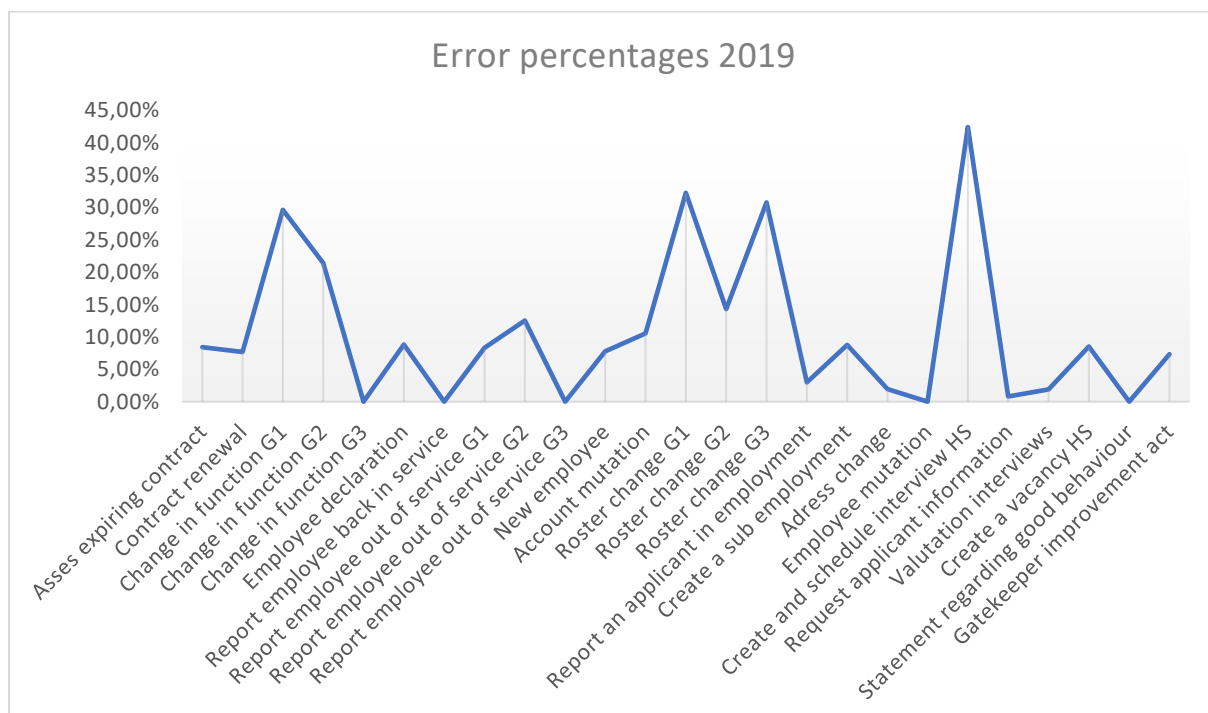
Figure 12: Error percentages 2019

Salary processes 2020	Throughput time with outliers (hours)	Throughput time without outliers (hours)	Norm throughput time (hours)	Error percentage
Assess expiring contract	486,2	450,0	168	26,55%
Contract renewal	236,1	236,1	168	21,05%
Contract change	110,4	110,4	168	0,00%
End employment	506,2	415,1	168	7,14%
Change in function G1	363,6	233,7	168	30,00%
Change in function G2	393,7	245,1	168	61,54%
Change in function G3	186,7	186,7	168	40,00%
Manual mutation individual	471,4	471,4	168	41,18%
Manual mutation individual	419,4	403,5	168	44,23%
Employee declaration	108,7	51,4	168	15,16%
Report employee back in service	72,5	61,1	168	0,00%
Report employee in service	45,2	31,9	168	6,12%
Report employee out of service G1	94,0	94,0	168	0,00%
Report employee out of service G2	37,9	37,9	168	16,67%
Report employee out of service G3	n.v.t.	n.v.t.	168	n.v.t.
New employee	473,3	473,3	168	28,36%
Account mutation	61,4	61,4	168	0,00%
Report an applicant in employment	85,1	41,6	168	6,90%
Create a sub employment	533,2	533,2	168	48,89%
Team change	598,3	598,3	168	31,58%

Figure 13: Data salary processes 2019
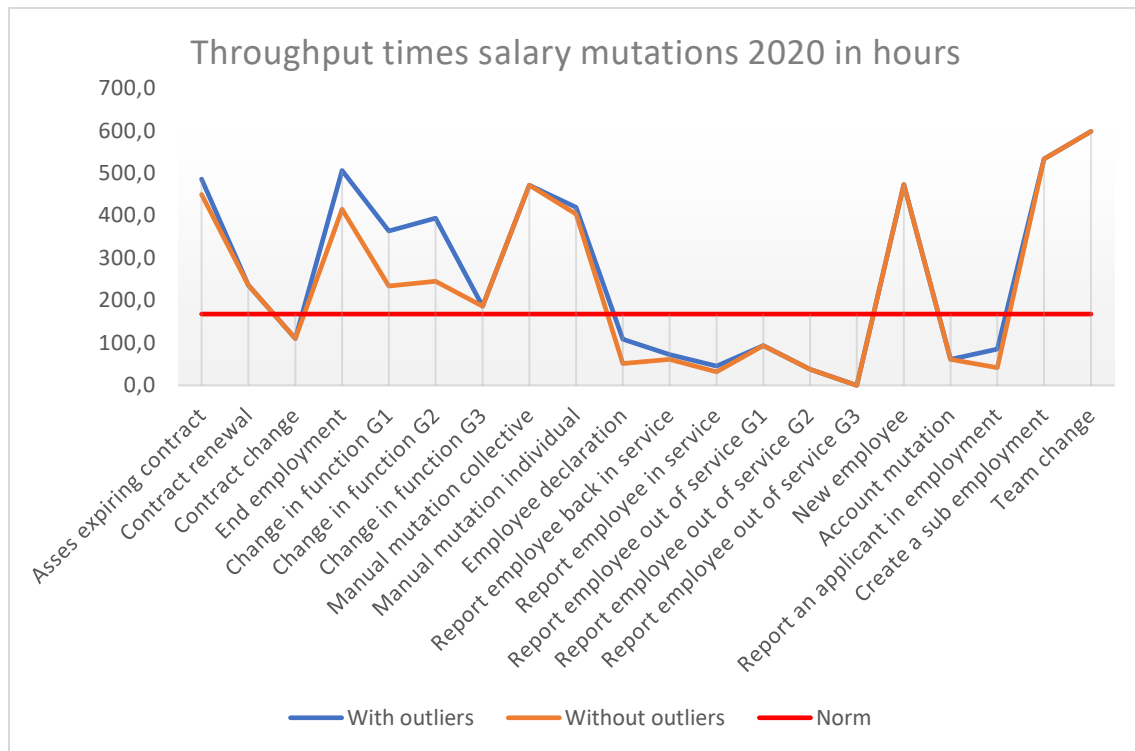
Figure 14: Throughput times salary mutations 2019

Non-salary processes 2020	Throughput time with outliers (hours)	Throughput time without outliers (hours)	Norm throughput time (hours)	Error percentage
Adress change	119,6	119,6	720	0,00%
Employee mutation	0,0	0,0	720	0,00%
Create and schedule interview HS	887,4	887,4	720	73,68%
Request applicant information	250,6	250,6	720	0,00%
Valuation interviews	23,2	0,5	720	0,00%
Create a vacancy HS	114,4	81,8	720	5,00%
Statement regarding good behaviour	0,1	0,0	720	0,00%
Gatekeeper improvement act	364,6	318,1	720	0,00%

Table 5: Data non-salary processes 2020
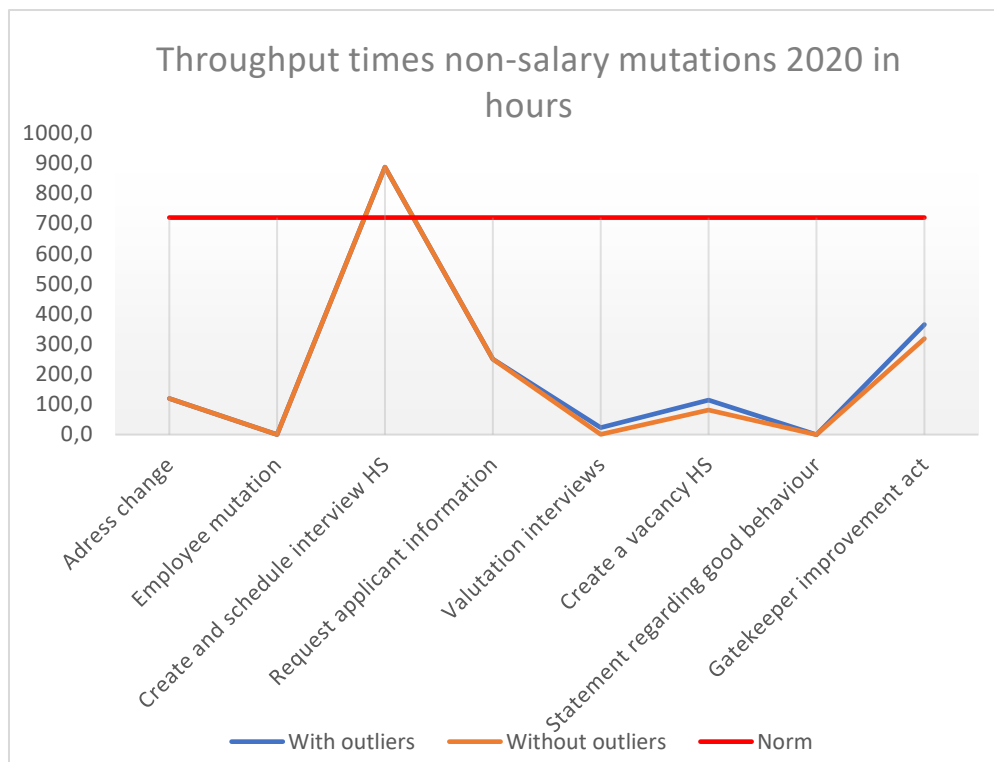
Figure 15: Throughput times non-salary mutations 2020
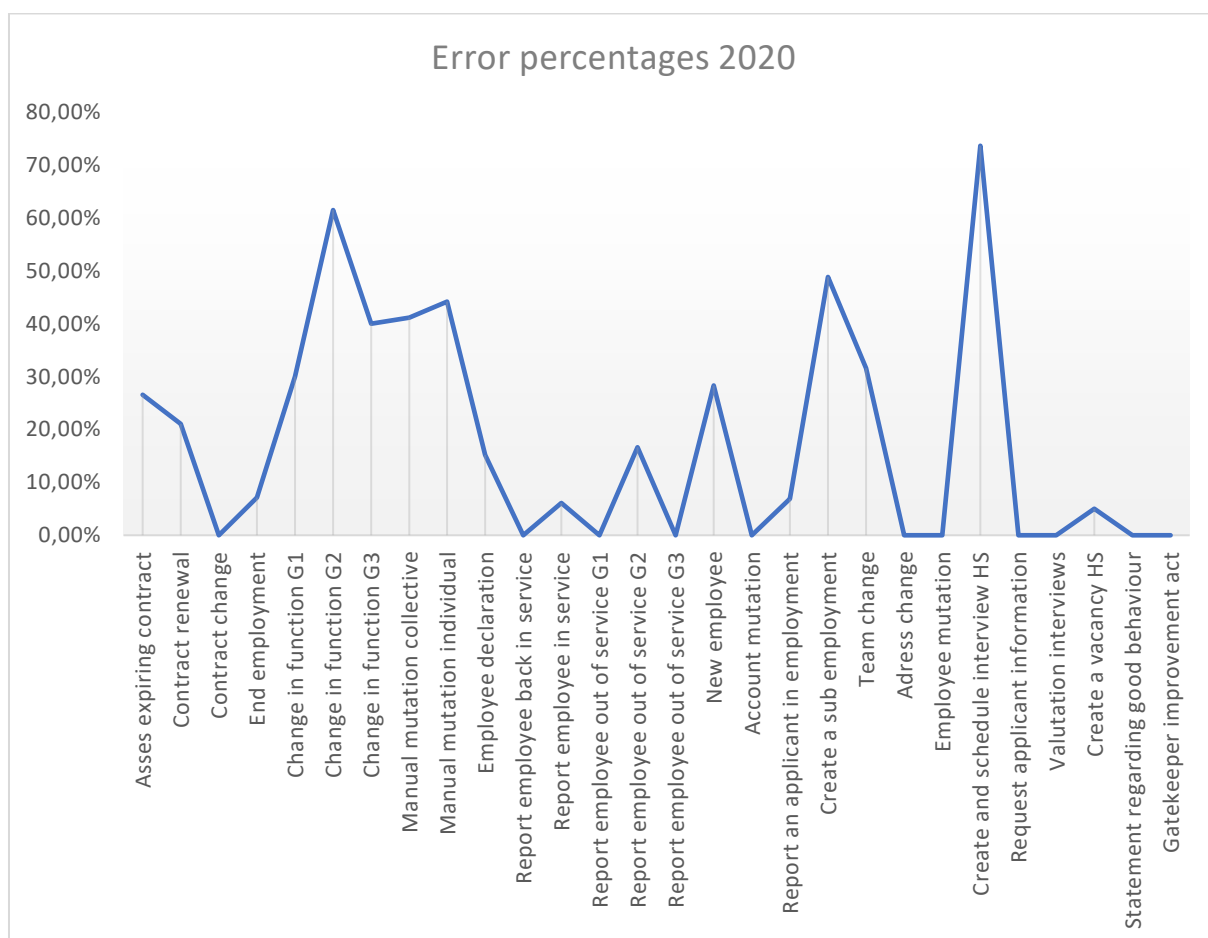
Figure 16: Error percentages 2020
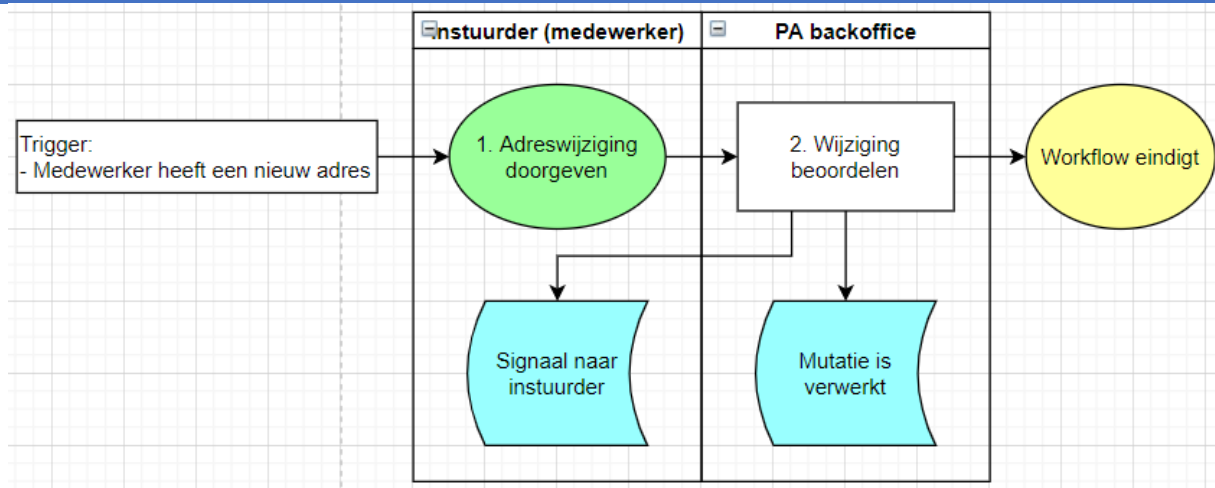
Figure 17: Flowchart change of adress
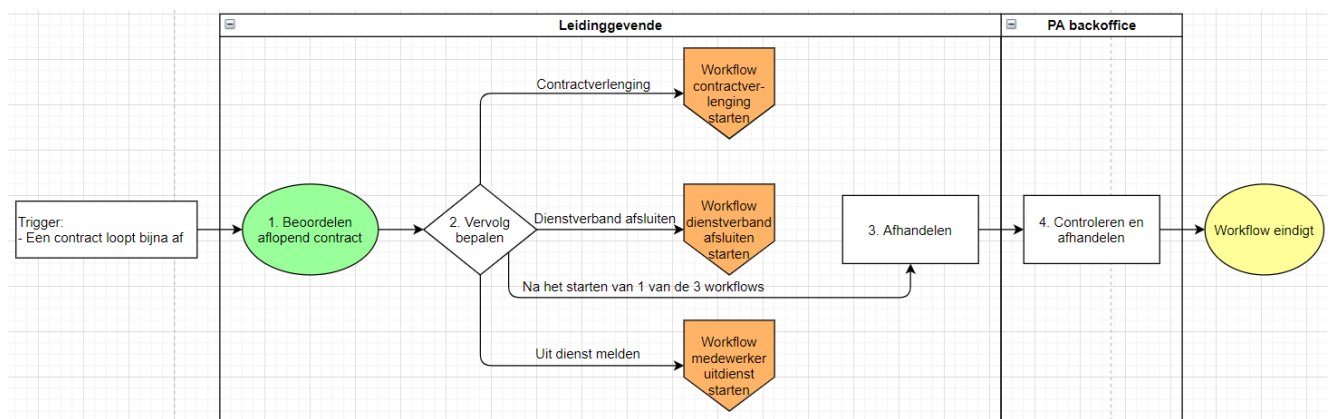
Figure 18: Flowchart assess expiring contract
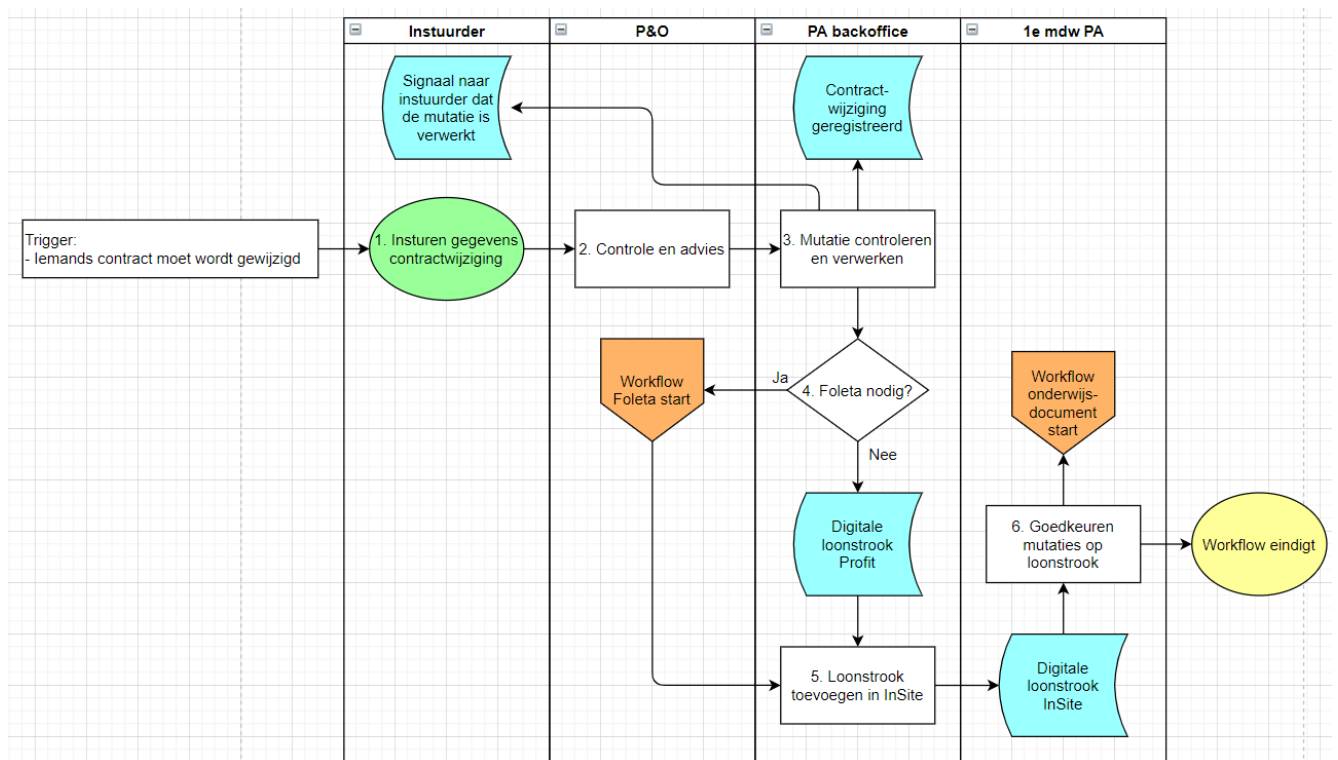
Figure 19: Flowchart contract change
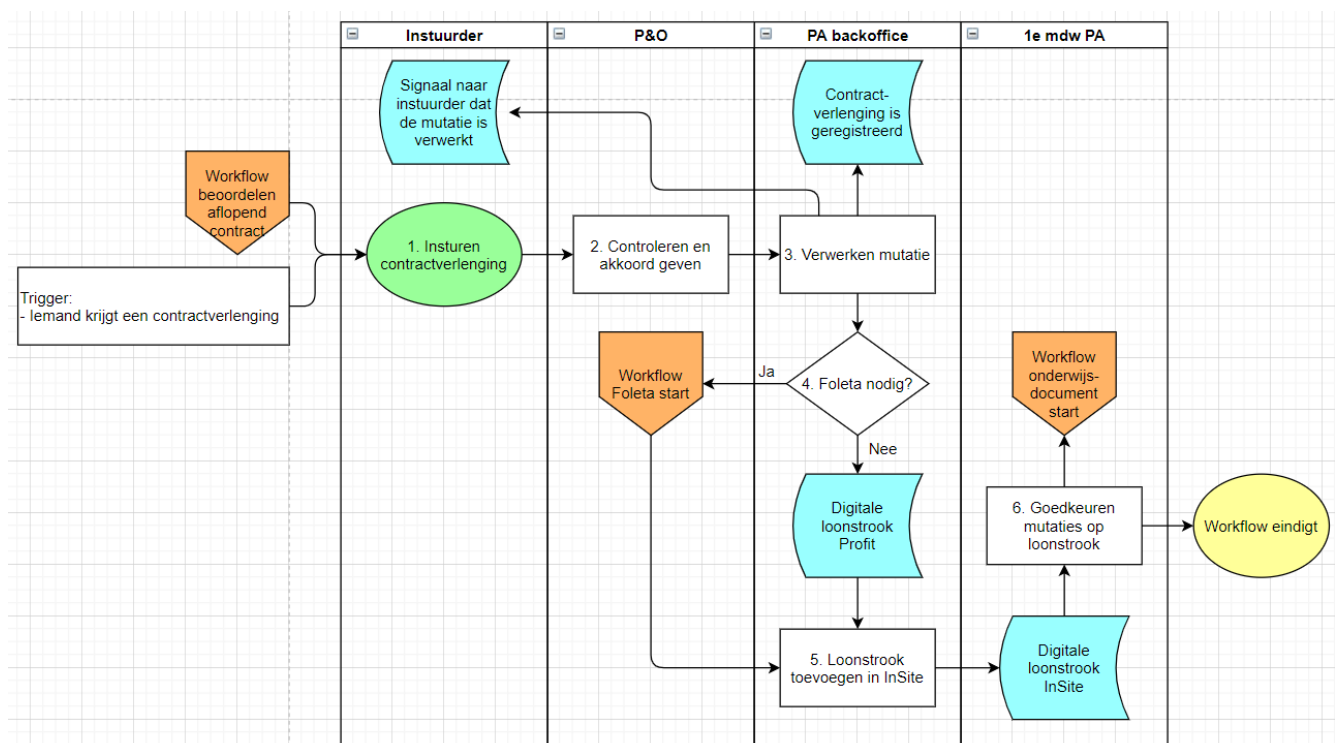
Figure 20: Flowchart contract renewal
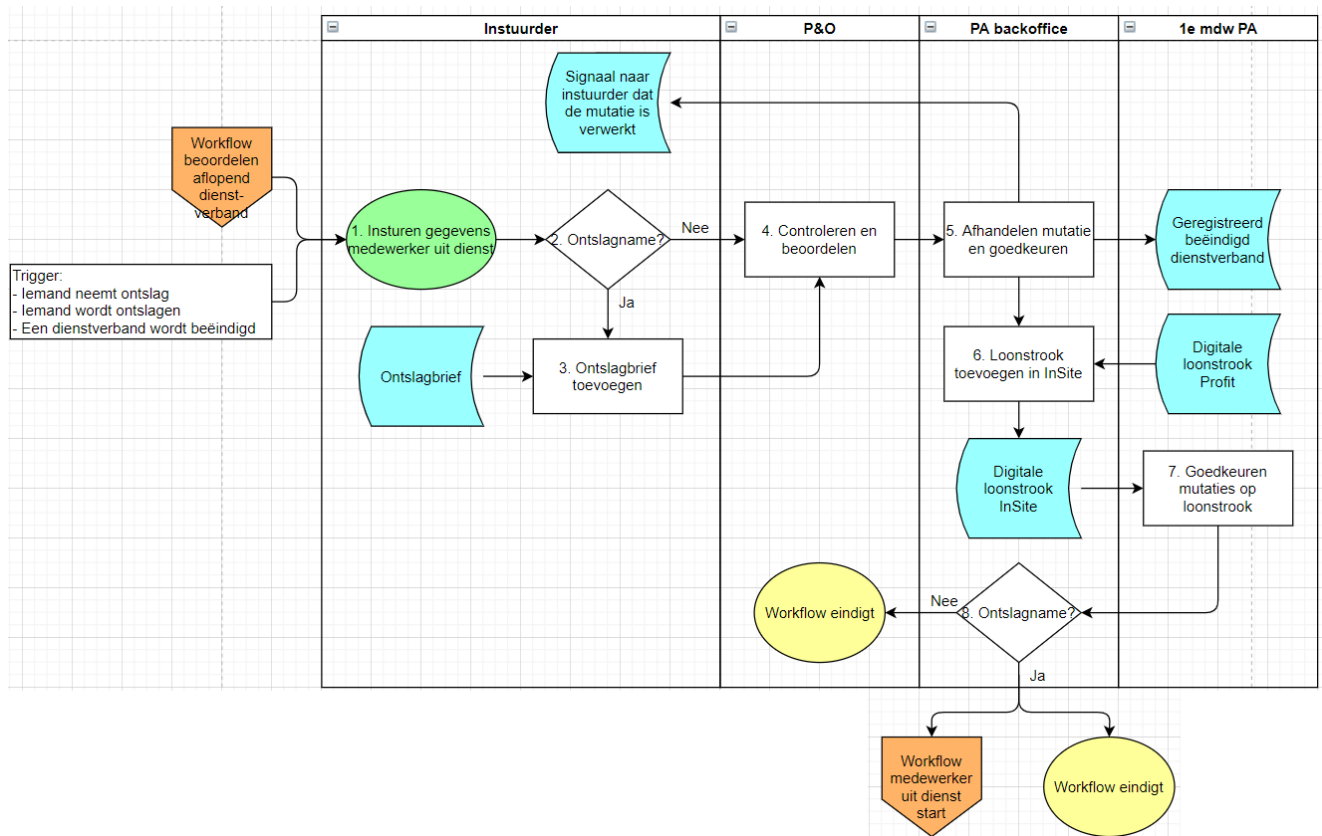
Figure 21: Flowchart end employment
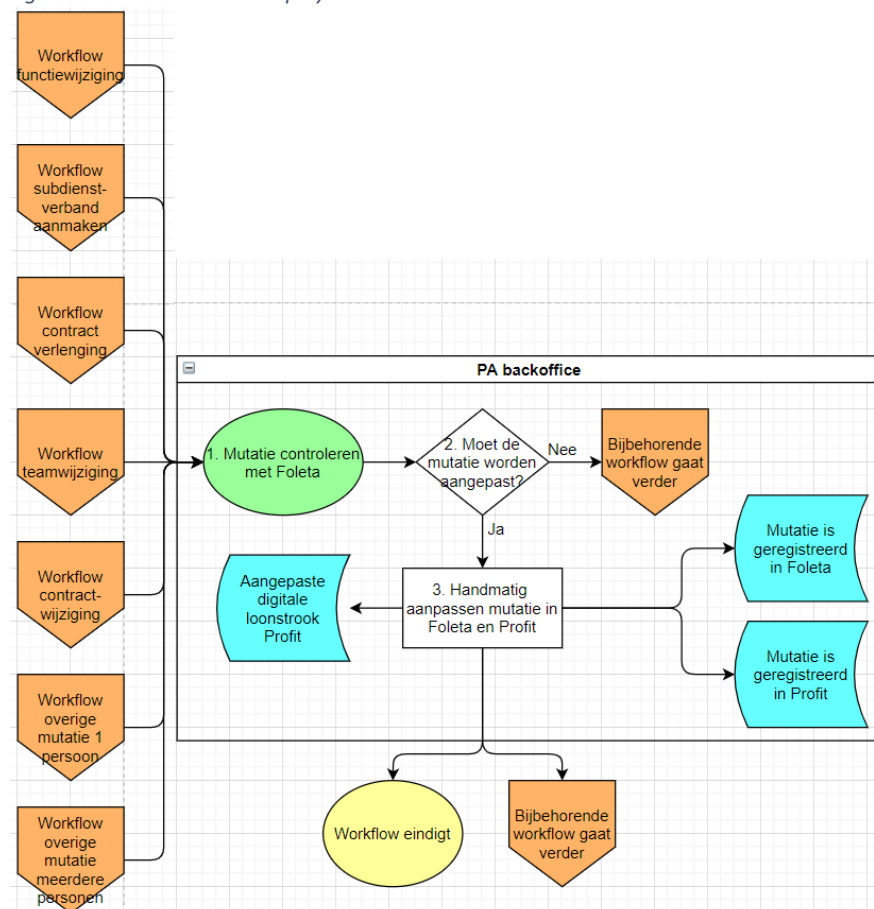
Figure 22: Flowchart Foleta
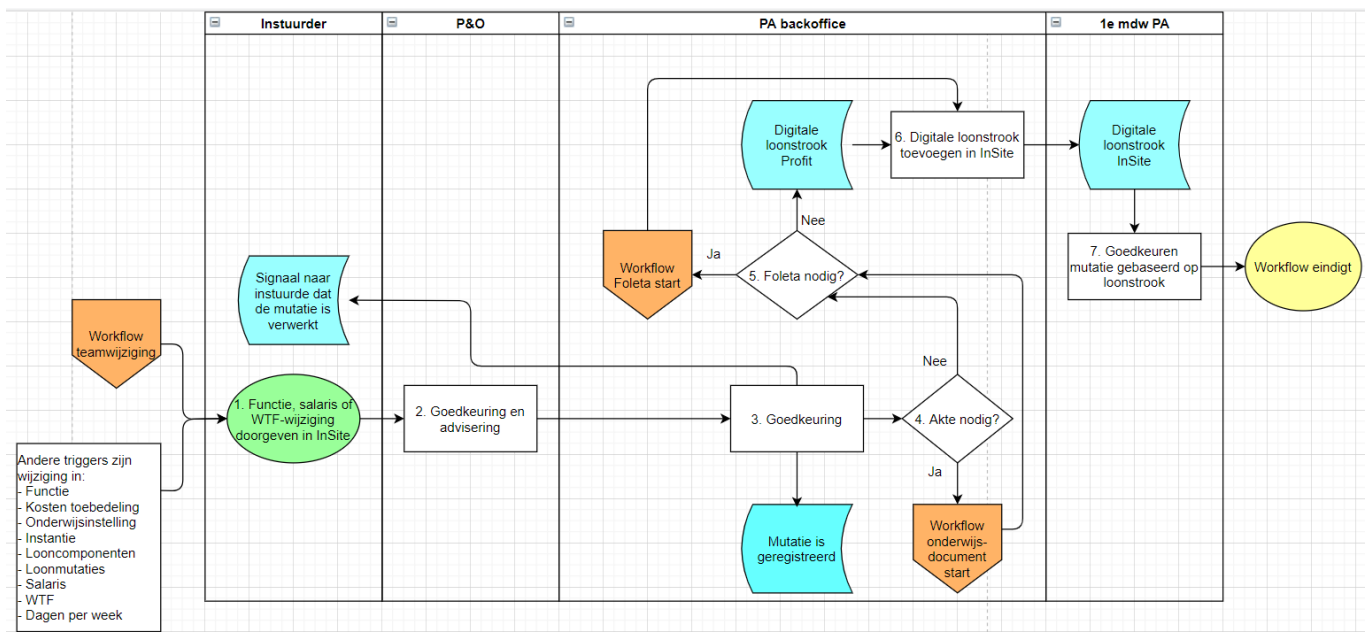
Figure 23: Flowchart change in function
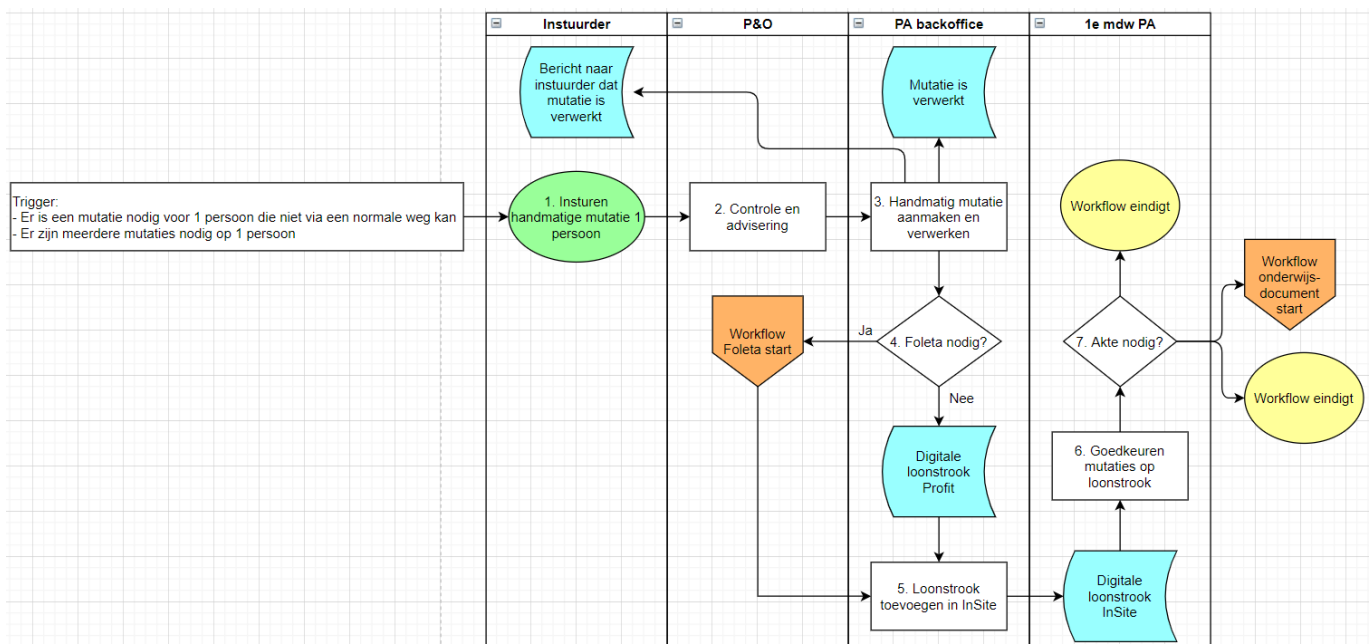
Figure 24: Flowchart manual mutation individual
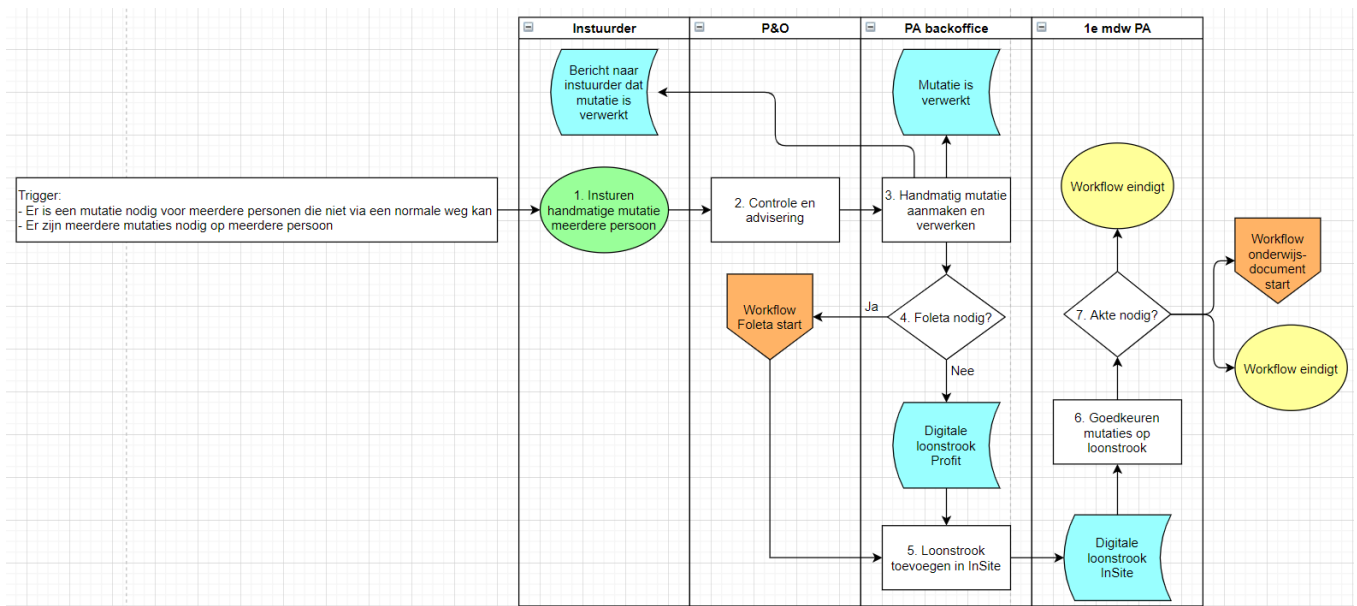
Figure 25: Flowchart manual mutation collective
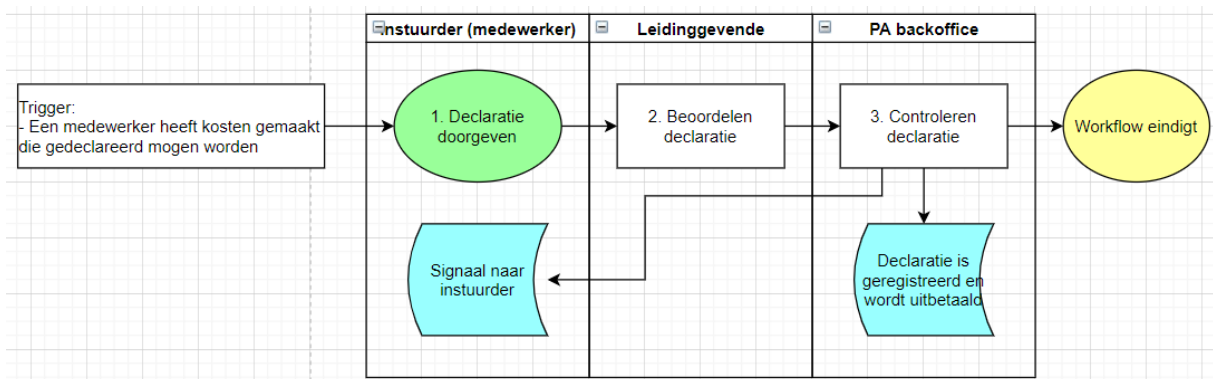
Figure 26: Flowchart employee declaration
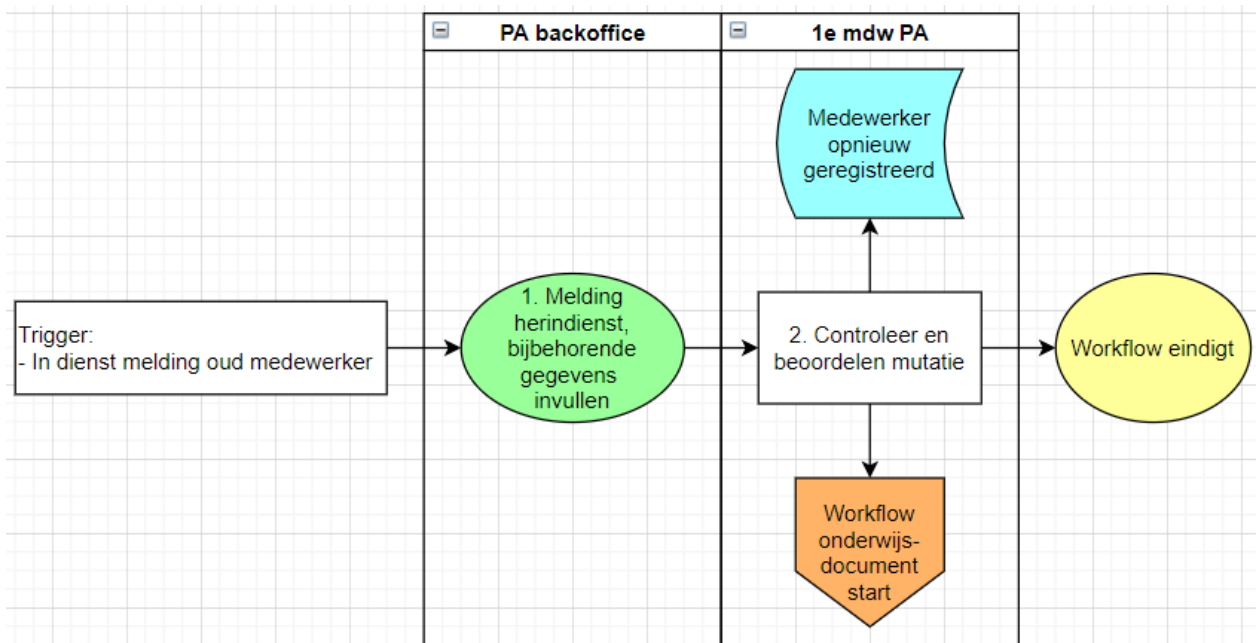
Figure 27: Flowchart report employee back in service
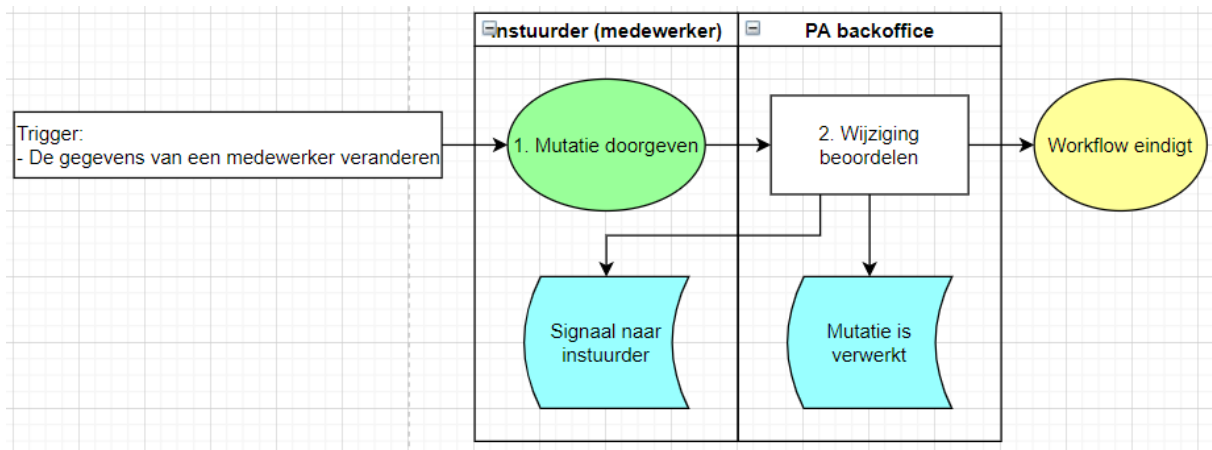
Figure 28: Flowchart employee mutation
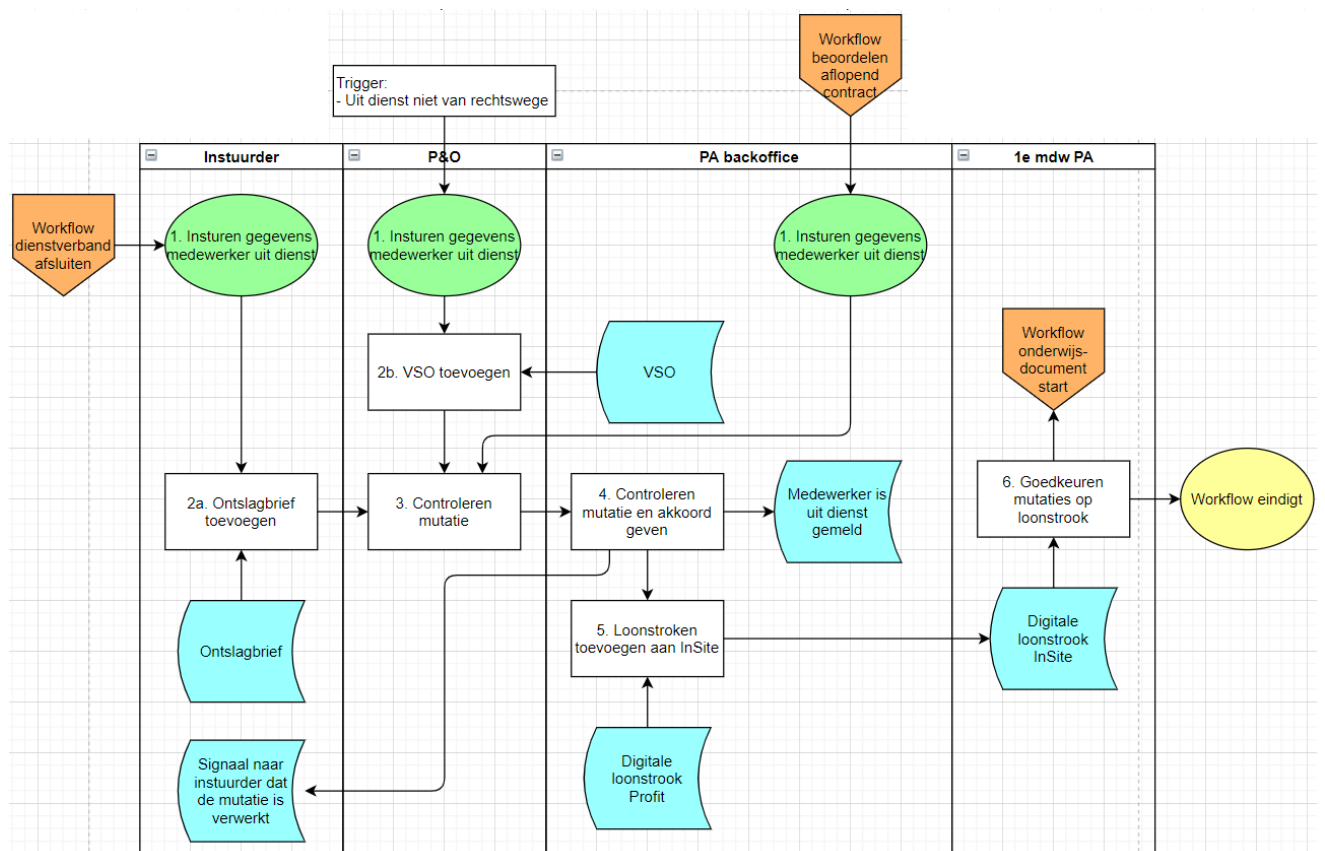
Figure 29: Flowchart report employee out of service
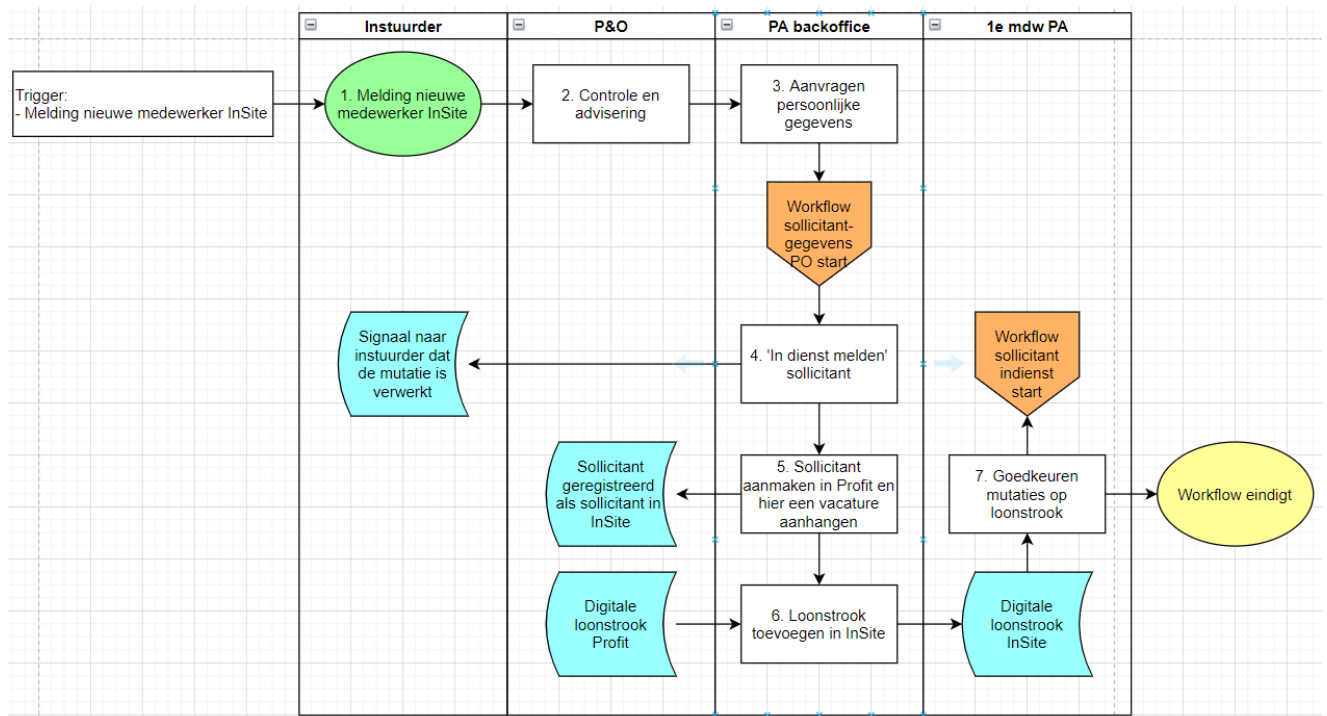
Figure 30: Flowchart new employee PS
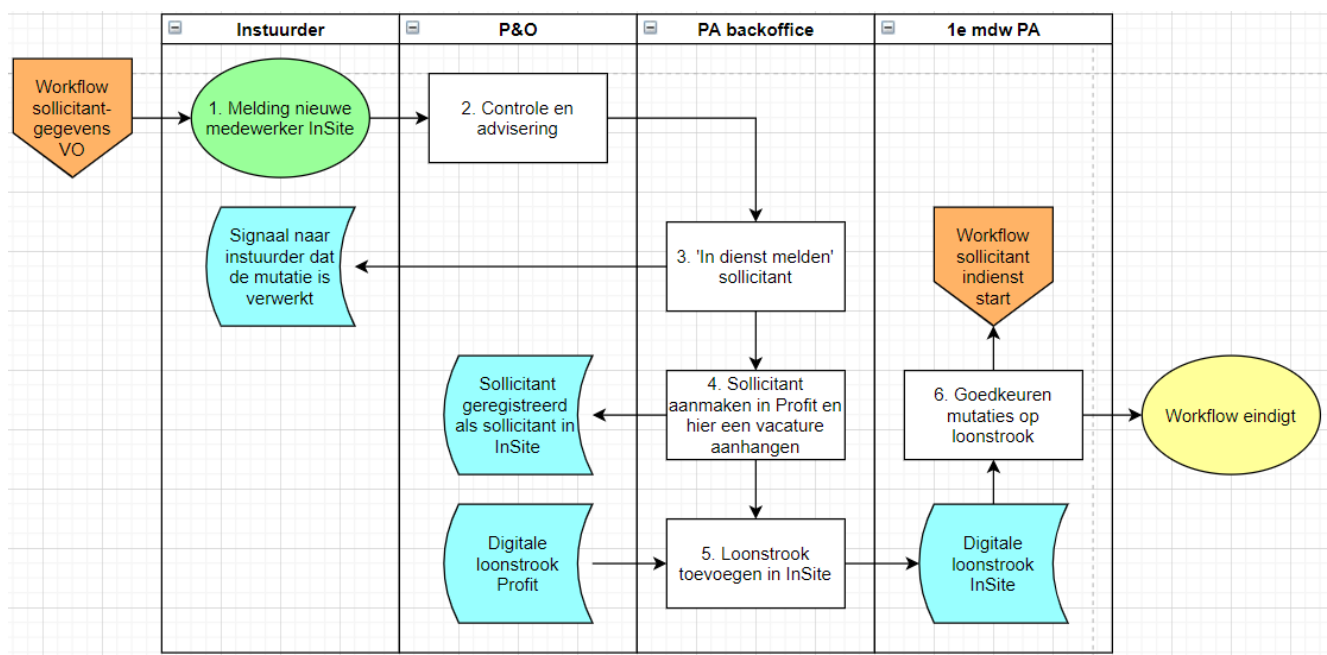
Figure 31: Flowchart new employee HS
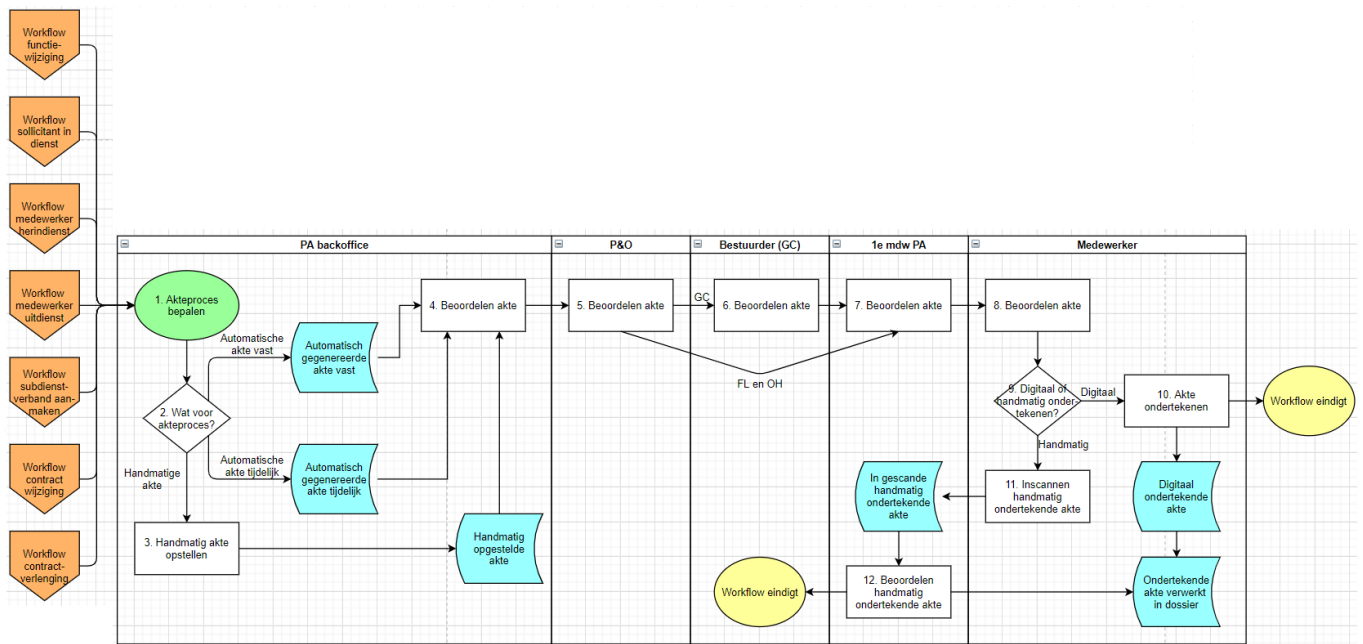
Figure 32: Flowchart draw up a deed
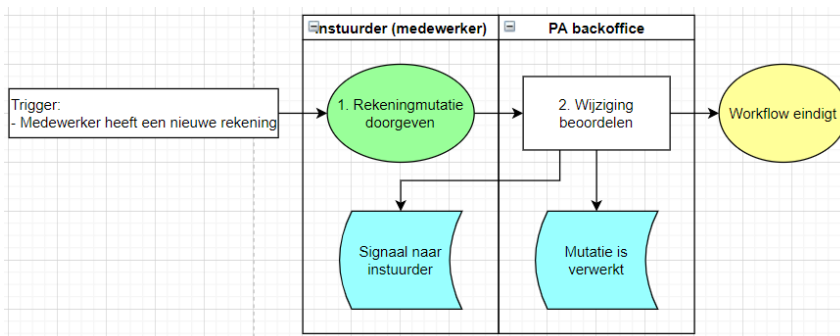
Figure 33: Flowchart account mutation
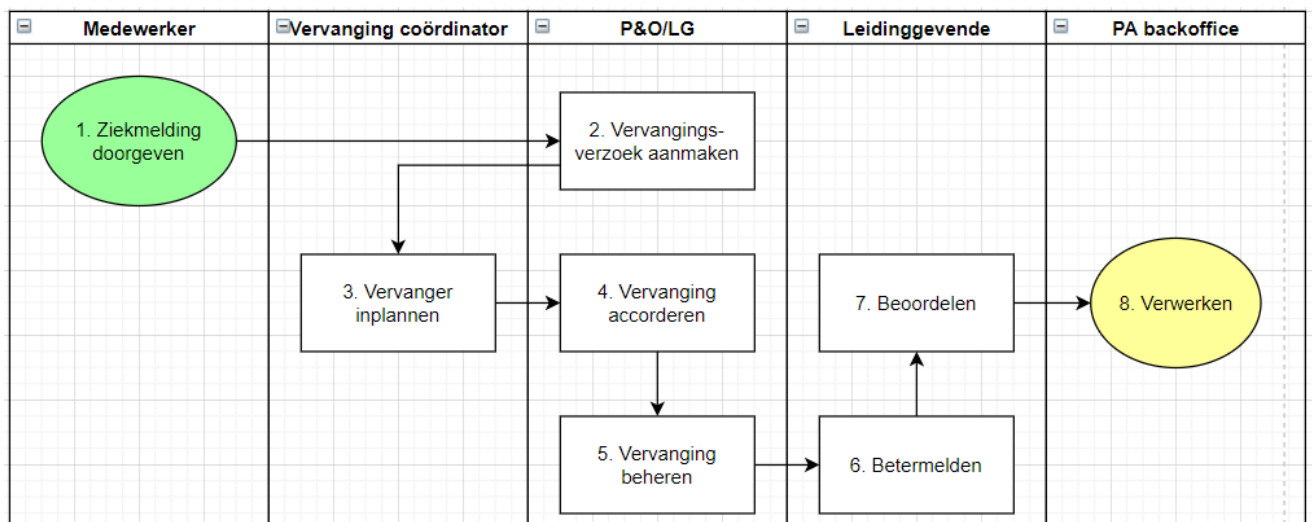
Figure 34: Flowchart Salure
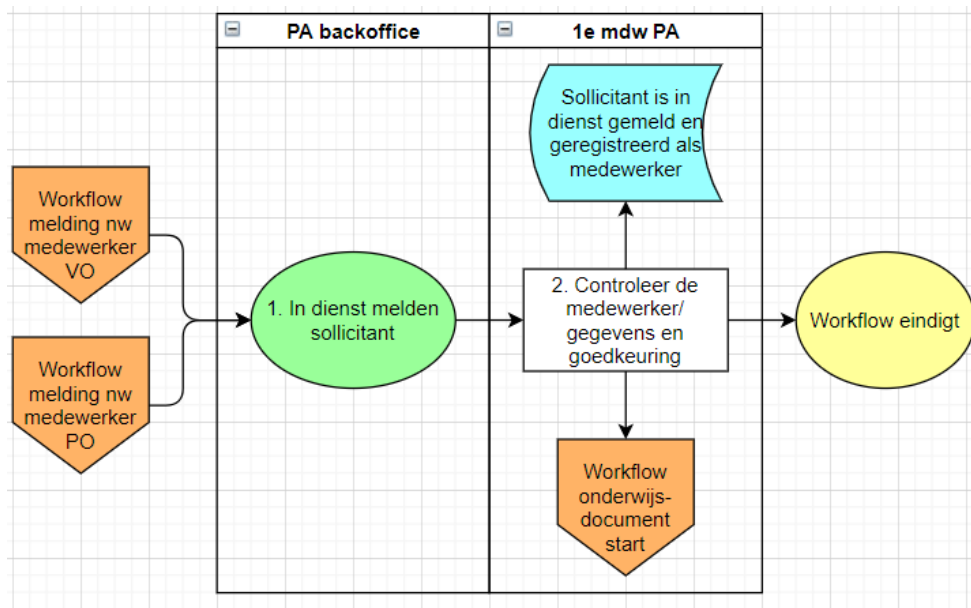
Figure 35: Flowchart report an applicant in employment
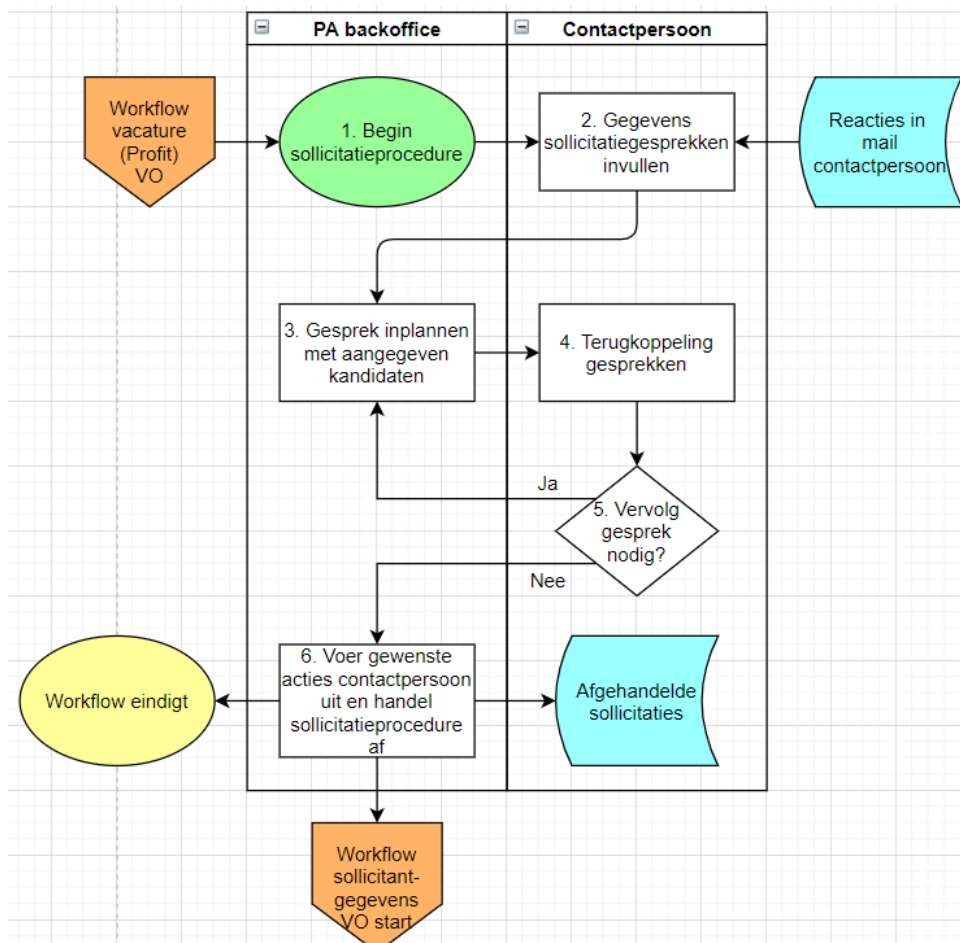
Figure 36: Flowchart create and schedule interview HS
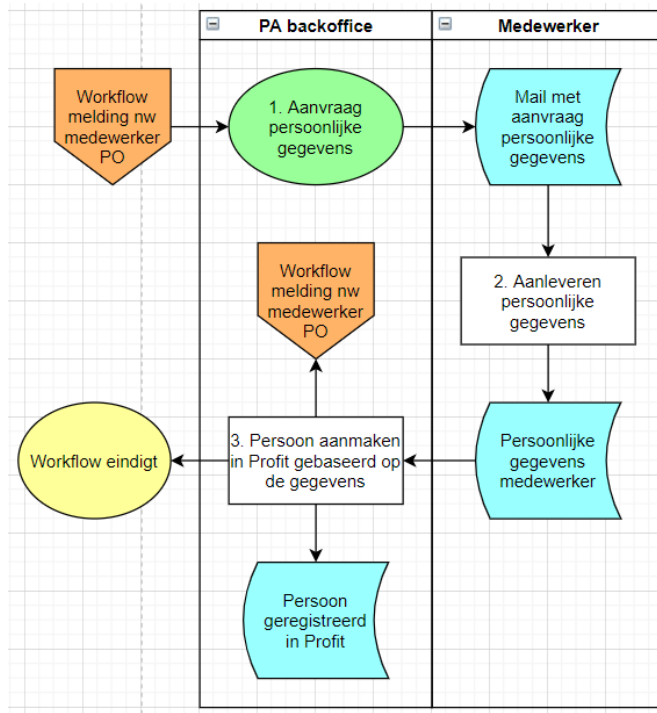
Figure 37: Flowchart request applicant information PS
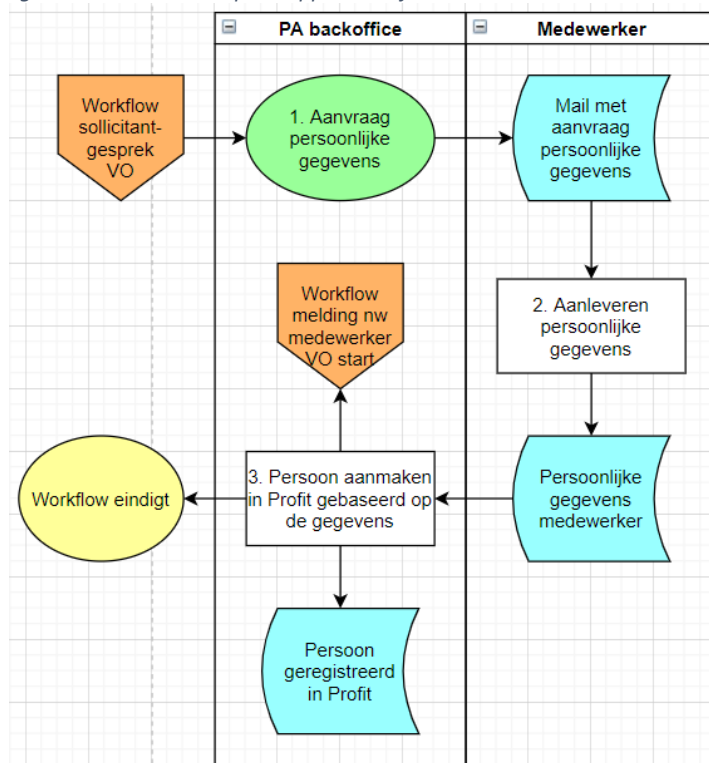
Figure 38: Flowchart request applicant information HS
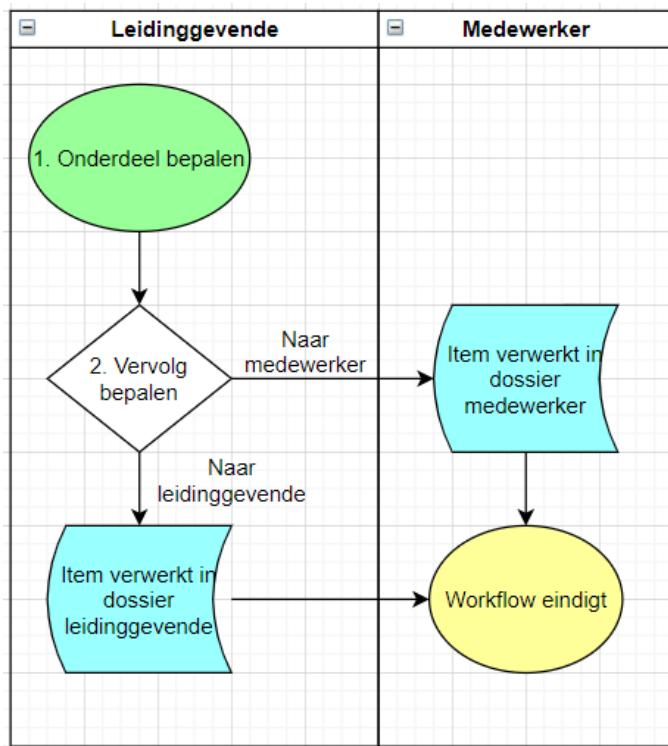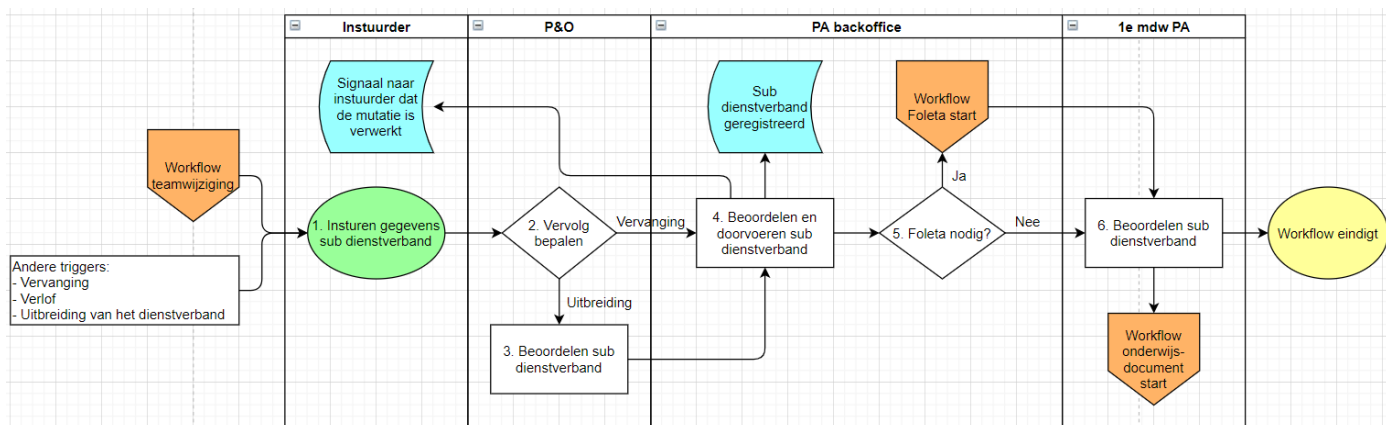
Figure 39: Flowchart valuation interviews

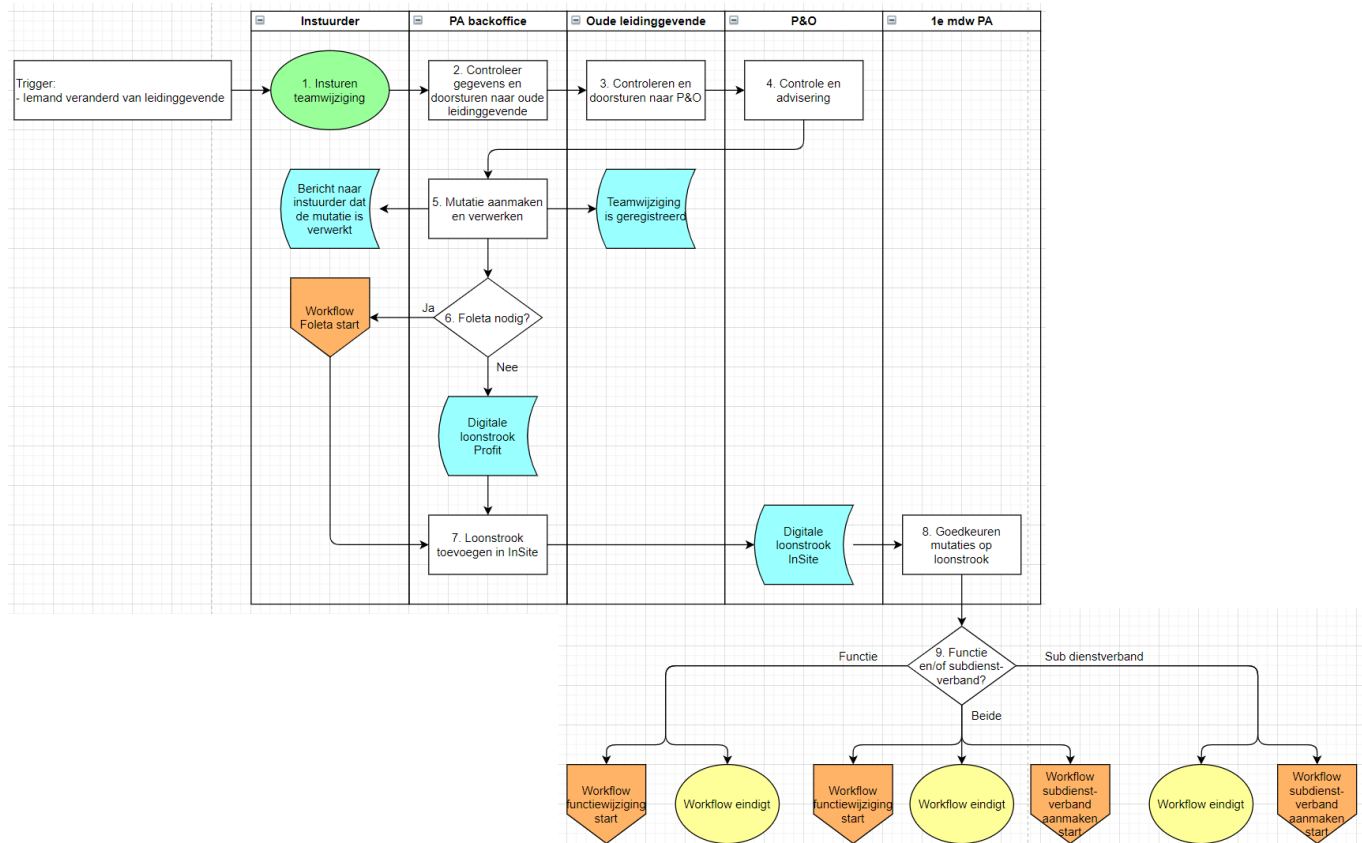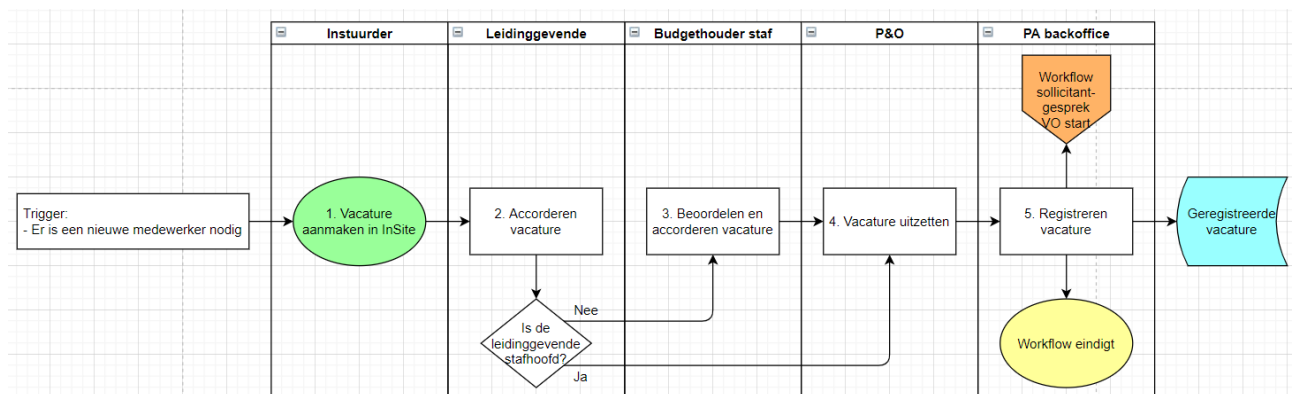*Figure 40: Flowchart create a sub employment*

Figure 41: Flowchart team change

Figure 42: Flowchart create a vacancy