

Improving a Data Management Process using Business-to- Business Integration at Bielderman Koetsier Adviseurs



**Bielderman
Koetsier**

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Bachelor Thesis

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I. Preface

In this report for my bachelor thesis for the bachelor Industrial Engineering & Management, I will be researching the data importing and managing processes at Bielerman Koetsier Adviseurs. First, I would like to thank some people who have supported me during this thesis.

First of all, I want to thank my external company supervisor Carl Koetsier, for the opportunity given to me in the company. Additionally, I would like to thank you for the support and insight you have given me whilst researching the process. If I had questions you were always available and additionally if you had questions you also asked me, which also stimulated.

Secondly, I want to thank my first supervisor, Jos van Hillegersberg, for supporting me during the thesis. Thanks for the feedback on the theoretical side of this thesis, as well for the structure during the project. The feedback was very helpful.

Thirdly I would like to thank Erwin Folmer for being my second supervisor. The feedback was very helpful, and also the short reaction times were very helpful to have.

Lastly I would like to thank all the people who I have interviewed for the research at Bielerman Koetsier, Adfiz and the ERP provider, the interviews were very helpful in giving me the insights for the respective research questions.

Arjan van Laar, 2021



II. Management summary

Introduction

Bielderman Koetsier is an insurance broker, which imports all types of data into the enterprise resource planning system. This data is used for various purposes regularly, this makes that the data import process is executed regularly and that quality is also important. This data import process is executed by two department with each their own parts in the process. The process entails gathering the data from different sources, importing the data in the ERP, placing the data in the correct storages, checking and adjusting the data, and the last step is communicating the data with the customer. Currently the process is containing a lot of checking tasks because of the poor quality of imported data, inefficient parts of the ERP system and various other problems. In this research the focus is on identifying the underlying problems of the inefficiency in this data import process, finding possible solutions and improvements for these problems and creating plans to implement these solutions.

Research methodology

In this research the managerial problem-solving method by Heerkens & Van Winden is used. First the current process is evaluated using workflow models, data flow distribution models, the Theory of Constraints and Lean Six Sigma. Thereafter a literature search and benchmarking are used for exploring and describing improvements. The analytical hierarchy process is used for prioritizing the improvements using the three criteria costs, implementation and effectiveness. In the last part of this research three action plans for improvement implementation are created based on the analytical hierarchy process and an ideal workflow is established.

Main findings

In the current process as explained in the introduction, there are several steps with problems which make the total process inefficient. There are problems with data quality, long waiting times, errors in documents, too many differences between employees and insurance companies, many times of data filling and the lack of bulk options. These problems are the causes that employees are working approximately 1.5 hours a day in this process. The problems occur not only internally but also at several external parties which often are bigger than Bielderman Koetsier, such as the ERP provider and insurance companies. The research combats these problems by finding improvements. The key improvements according to the research and the analytical hierarchy process are utilizing the ERP customizability and adjusting translation matrices for the raw data. A second improvement is a two-way data integration between insurance companies and the ERP system, allowing not only communication from the insurance companies to BK, but also the other way around, thereby reducing for example the amount of data filling. A third improvement method is that of implementing bulk options and straight through processing in the newly developing ERP application. There are additional available improvements which also prove useful. Implementation of the improvements is often hard due to the many involved parties which makes relationship building with external parties very important. For implementation there are three action plans to be undertaken by the company and the branch in general, a short-term plan, a long-term plan and a plan focused on chain improvement. From these plans it can be concluded that implementation is widely spread throughout the chain and should therefore not only be limited to implementation internally but should be combined with implementation in the entire chain with the help of other parties, like branch organizations.



Recommendations

Based on the action plans it is recommended that Bielerman Koetsier, follows a short-term action plan: updating translation matrix and establishing a good relationship with the ERP provider. It is also recommended that Bielerman Koetsier follows a long-term action plan helping develop the new features of the new ERP application. A last recommendation is to follow the chain action plan and working together with branch organizations to stimulate insurance companies to upgrade the quality of their data. Through these recommendations and action plans the time spent in this process can be reduced up to 33% in time spent by employees.

III. Table of contents

I.	Preface.....	3
II.	Management summary	4
III.	Table of contents.....	6
IV.	Reading guide	9
V.	Indexes	10
V.I.	Glossary of terms.....	10
V.II.	List of figures	12
V.III.	List of tables.....	13
1	Introduction.....	14
1.1	Introduction Bielerman Koetsier	14
1.2	Reason for research.....	14
1.3	Problem statement.....	15
1.3.1	Problem cluster	15
1.3.2	Problem explanation	16
1.3.3	Measuring the core problem.....	16
1.3.4	Stakeholders	16
1.3.5	Conceptual model	18
1.3.6	Goal and scope of research	19
1.4	Research design.....	19
1.4.1	Research questions.....	19
1.4.2	Key concepts.....	21
1.4.3	Deliverables	22
1.4.4	Validity and reliability.....	22
1.4.5	Knowledge questions	23
2	Theoretical framework for methodologies	24
2.1	Process modelling tool	24
2.2	Data flow modelling tool	25
2.3	Detecting problems in data flow processes	26
3	Current process	28
3.1	Process analysis	28
3.1.1	Input, output and stakeholders.....	28
3.1.2	Context of the process	29
3.1.3	Workflow analysis	30
3.2	Data analysis.....	35



3.2.1	Data types.....	35
3.2.2	Data handling structure.....	36
3.2.3	Data flow diagrams.....	37
3.3	Problem analysis.....	41
3.3.1	Employee problems.....	41
3.3.2	Problems according to TOC and Lean six sigma	44
3.4	Conclusion current process analysis.....	47
4	Improvement methods.....	48
4.1	Best practices	48
4.1.1	Best practices from literature	48
4.1.2	Best practices from the branch	50
4.2	Straight through processing	51
4.3	Chain solutions	53
4.4	Conclusion improvement methods.....	54
5	Selecting an improvement method.....	55
5.1	Determining the criteria.....	56
5.2	Pairwise comparisons.....	56
5.3	Consistency checks	57
5.4	Calculating the results	57
5.5	Conclusion selecting an improvement method	58
6	Implementing solutions.....	59
6.1	Short term action plan.....	59
6.2	Long term action plan.....	61
6.3	Chain action plan.....	63
6.4	Evaluation of to-be scenario.....	65
6.5	Conclusion implementing solutions	67
7	Conclusion, recommendations and discussion	69
7.1	Conclusion	69
7.2	Recommendations for the company.....	70
7.3	Contribution to literature.....	70
7.4	Discussion	71
7.4.1	Validity.....	71
7.4.2	Use of methodologies	72
7.4.3	Interpretation of results	73
7.4.4	Limitations	73
7.4.5	Future research	74

VI.	Reference list	75
VII.	Appendices	79
	Appendix A – knowledge questions	79
	Appendix B – Systematic literature review	82
	Appendix C – Figures	85
	Appendix D – Interview questions	92
	Appendix E – Analytical Hierarchy Process	99



IV. Reading guide

Chapter 1: Introduction

This chapter introduces the company and the researched process. It includes the reasons for the research and the problem statement. Additionally, in this chapter the research design is explained including methodologies and the framework used for solving the core problem.

Chapter 2: Theoretical framework for methodologies

In this chapter the theories and methodologies used in this thesis are discussed on the benefits and cons. Here the methodologies to use are decided upon, these methodologies will later be used for researching the individual parts.

Chapter 3: Current process

In chapter 3 the current process is researched, focusing on the flows of the process including workflows and data flows. Additionally, we identify the causes and underlying problems of the core problem.

Chapter 4: Improvement methods

In this chapter the research focuses on identifying best practices and readily made available solutions from different processes and from the chain.

Chapter 5: Selecting an improvement method

In chapter 5 the earlier determined improvement methods are compared to another using the analytical hierarchy process. From this a ranking of the improvement methods is created.

Chapter 6: Implementing solutions

This chapter focuses on creating plans to implement the improvement methods identified and ranked earlier. A short-term, long-term and chain plan are created.

Chapter 7: Conclusion, recommendations and discussion

In this last chapter the focus is on the conclusions and recommendation for the company. These results are discussed as well as the methodologies used.

References and Appendices

After chapter 7 the reference list and the appendices follow.

An overview of the research is also given in the introduction and also visible in figure 6.

V. Indexes

V.I. Glossary of terms

AHP	Analytical hierarchy process, a technique used to mathematically analyze and organize complex decisions.
API	Application programming interface, the means through which software communicates to other software or to the outside world
BPM	Business process modelling, the creation of a model of one or more business processes. This is done to analyze and optimize processes.
BK	Bielerman Koetsier, the company at which this research is executed.
Credit note	Credit notes are documents which show the financial booking which the insurance company expects of Bielerman Koetsier. The credit notes are used to check the financial data of Bielerman Koetsier.
DFD	Data flow Diagrams, a data flow diagram models the flows of information in a process or system of processes.
ERP	Enterprise resource planning, a central system which organizes and automates processes of a company. It is linked to the central database of the organization.
IC	Insurance company, these are the companies which are responsible for supplying the data. Bielerman Koetsier is an intermediary between these insurance companies and the end customer, thereby forming a chain.
Insurance	Insurances are the “products” in which Bielerman Koetsier deals, they choose the best insurances for their customers. These insurances are offered by the insurance companies. With an insurance comes a policy, which is a document on which the specifications of an insurance are stated. One insurance can have multiple policies.
KPI	Key performance indicator, these are variables that measure the performance of certain processes or organizations.
Lean	Lean is a management philosophy used to optimize processes, it focuses on reducing waste which uses two main factors: just in time and in perfect condition.
Lean six sigma	A management philosophy which combines the principles of Lean with the principles of Six sigma.

MPSM

Managerial Problem-Solving Method, a general problem solving method which can be applied to problems where the outcomes of the research are uncertain.

PMI package

A data package which contains raw data of a policy and credit note, it is send by the ICs, and can be imported in the ERP of Bielerman Koetsier.

Policy

Document which contains the specifications of an insurance. The document has a date, the newest policy is leading.

Six Sigma

A management theory which focuses on reducing the amount of defects in a process

TOC

Theory of Constraints, a management philosophy which focuses on making the worst part of a process better and thereby increasing efficiency of the entire process.



V.II. List of figures

Figure 1 Problem cluster	15
Figure 2 Power-Interest matrix	Error! Bookmark not defined.
Figure 3 Relations and information flow between stakeholders	18
Figure 4 Conceptual model	19
Figure 5 Managerial Problem-Solving Method (MPSM)	20
Figure 6 Problem-solving approach.....	21
Figure 7 Yourdon and Coad versus Gane & Sarson (Online Visual Paradigm, 2021)	25
Figure 8 Input, output and stakeholders.....	28
Figure 9 Customer adjustment context workflow	31
Figure 10 Mail import process workflow	32
Figure 11 Data import process workflow	33
Figure 12 Data flow structure.....	36
Figure 13 ERP structure	37
Figure 14 Context map	37
Figure 15 Level 0: Data import process	38
Figure 16 Level 1: Gathering documents.....	39
Figure 17 Level 1: Checking data	40
Figure 18 Level 0: Uploading data	40
Figure 19 Structure AHP	56
Figure 20 Overview short-term action plan	60
Figure 21 Overview long-term action plan.....	63
Figure 22 Overview chain action plan	65
Figure 23 Data import process to-be workflow	68
Figure 24 Customer adjustment context workflow part 1.....	85
Figure 25 Customer adjustment context workflow part 2	86
Figure 26 Data import process workflow part 1	87
Figure 27 Data import process workflow part 2	88
Figure 28 Data import process workflow part 3	89
Figure 29 Data import process to-be workflow part 1.....	90
Figure 30 Data import process to-be workflow part 2.....	91



V.III. List of tables

Table 1 Stakeholders	16
Table 2 Overview contexts data import process	29
Table 3 Data types	35
Table 4 Employee problems	44
Table 5 Problems from TOC and Lean six sigma	47
Table 6 Overview of improvement methods	55
Table 7 AHP criteria	56
Table 8 Consistency ratio calculation	57
Table 9 Results AHP	58
Table 10 Knowledge questions	79
Table 11 Exclusion criteria	82
Table 12 Inclusion criteria	82
Table 13 Search terms	82
Table 14 Search log	82
Table 15 Search results	83
Table 16 Concept matrix	84
Table 17 Comparison matrix considering criteria 1(C1)	99
Table 18 Comparison matrix considering criteria 2(C2)	100
Table 19 Comparison matrix considering criteria 2(C2)	100
Table 20 Comparison matrix criteria	101
Table 21 Standardized matrix considering criteria 1(C1)	101
Table 22 Standardized matrix considering criteria 2(C2)	101
Table 23 Standardized matrix considering criteria 3(C3)	102
Table 24 Standardized matrix criteria	102
Table 25 Consistency ratios	102
Table 26 Weights of alternatives and criteria coming from comparison matrices	102



1 Introduction

In this chapter we introduce the research and the assignment. We will introduce the company: Bielderman Koetsier, we will introduce the problems which we will tackle in our research, and we will introduce our research design.

1.1 Introduction Bielderman Koetsier

We will start with introducing the company at which the bachelor assignment is done. Bielderman Koetsier is an insurance intermediary, it is a local-oriented company situated in Barneveld, The Netherlands. Bielderman Koetsier, hereafter noted as BK, is an insurance advisor, it manages the risks of the customers and specifies in delivering services in insurances, mortgages and pensions. BK is a partnership with 19 employees, spread out over different services, ranging from advising insurances, mortgages and pensions, managing customer data, ICT and financials. BK's main goals are discovering risks, preventing risks and insuring risks. Customers are both privates and companies, therefore requiring different methods and data.

1.2 Reason for research

Now that BK is introduced we discuss the reasons for doing the research, coming from BK. One of the main services of BK is creating a central insight in managing risks for their customers. A customer can have to deal with multiple insurance companies, BK provides advice and overview on these risks and risk management as well as assistance in dealing with incidents on the financial side. To do this now and in the future, a clear overview is needed of the customers and BKs administration. As BK is independent of any insurance company, hereafter noted as IC, it is important to independently store data and check the insurance companies on benefits for their customers. This is an administrative process reliant on data. However, this administrative process is still taking up a lot of time and causing unhappiness at the employees. As Bk is also growing rapidly, it is important that new employees are not struggling with this inefficient process.

Currently there are a lot of small tasks which are perceived not that time consuming and not that important by a lot of employees. Most of these tasks are administratively oriented and are related to data and information management. However, these tasks do take up a lot of time, thereby also presenting a competitive disadvantage. There are two types of insurance intermediaries: insurance advisors or also known as insurance brokers such as BK, and insurance agents. The difference between these two types is that the advisor is independent of any IC whilst the agents are limited to several ICs, however they have the advantage of better integrated systems, causing a competitive disadvantage for insurance advisors. Whilst insurance advisors are representatives for the end-customer, insurance agents are representatives for the IC.

Here the main goal of the research is introduced, there are (small) bottlenecks or problems which can easily be solved, however there is currently no insight in these bottlenecks of the administrative process other than that there are bottlenecks in the data import process. Following from this is the assignment: Give an oversight of the bottlenecks in the everyday administrative processes that causes that Bielderman Koetsier cannot fully use the data of insurance-companies to automatically enrich his enterprise resource planning (ERP) system. Present the chances to improve this. Additionally, carry out the easy solutions to solving bottlenecks.

1.3 Problem statement

1.3.1 Problem cluster

Now that we have an idea of the problem, we will work the problem out further. We do this using a problem cluster, visible in figure 1. We start with the action problem presented by the director of BK. The director of BK introduced the action problem of the inefficient administrative processes at Bielderman Koetsier. There are three main causes for this action problem: poor communication with customers, too much time spent on repetitive tasks and slow reaction time of external parties.

The poor communication with customers is not addressed in our research, however it is good to show the causes and underlying problems to check for relevance to the chosen core problem. Poor communication with customers is caused by two other action problems: limited useful CRM functionalities available and inefficient data gathering methods, as shown in figure 1. The limited useful customer relationship management functionalities available cannot be influenced by us as researchers directly. However, this should be addressed at the ERP provider of BK. The inefficient data gathering from customers can be addressed, however this problem has less effects on the inefficient administrative process according to the director of BK and is therefore excluded. Both problems are not relevant to the chosen core problem.

Now for the action problem of too much time spent on repetitive tasks, there are many causes. The main solvable causes are the inefficient current account check and the problem of too much time spent on data management. The inefficient current account check is not considered in our research, it will however greatly reduce the time spent by the financial department. However, the time spent on data management is time spent by the administrative department which is bigger and so has a bigger impact on the inefficient administrative process. The underlying problem of too much time spent on data management is the inefficient data import process into the ERP system, this is chosen as our core problem.

The last action problem in the problem cluster is the slow reaction time of external parties, this problem is not directly influenceable as researchers. It is however a cause of the time spent on repetitive tasks, like the chosen core problem.

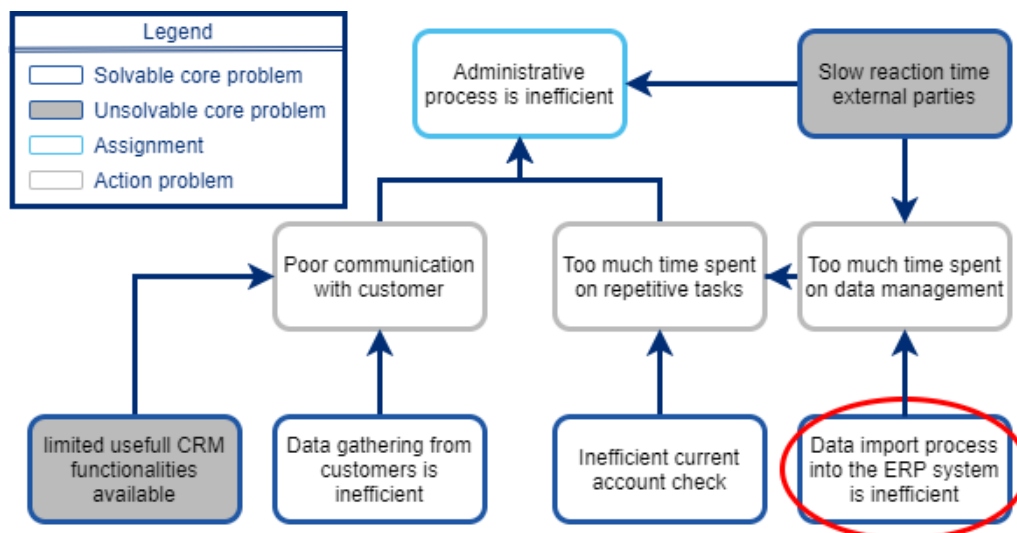


Figure 1 Problem cluster



1.3.2 Problem explanation

Data import process is a broad concept, but in our research we specify it to importing and checking data. Currently the employees are manually filling in a lot of the data in the ERP system. This data can be all sorts of data, from customer data to company data, to financial data. A lot of this data is filled in multiple times at different places, which is one of the causes of inefficiency. Some other causes are discussed in section 1.3.5. Conceptual model.

The core problem entails two aspects: importing and checking the data. Importing the data is defined as gathering the data from different sources and importing this data into the ERP system of BK and putting it in the right place. Second is checking the data, when the data is imported the data is checked, and eventually corrected to keep the independent database of BK up to date.

1.3.3 Measuring the core problem

The core problem can be measured in a couple of ways, for this we will use key performance indicators (KPI). The KPIs are based on relationships described by the employees of Bielderman Koetsier.

A first KPI is the time spent on data importing in the ERP. This KPI is measuring the time employees of BK spent on the importing part of the data import process. This KPI can be further specified in for example clicks needed and difficulty of importing the data. This is time spent by the employees at the reception department. This time is currently relatively low at 0.5 hours a day by an employee of the reception.

A second KPI is the time spent on checking data, this is time spent on checking and eventually adjusting the data, for proper use. Also, this KPI can be split up in smaller factors like clicks used and ease of checking. This time is spent by the employees in the administrative department. Some other KPIs can also be deducted from the conceptual model in section 1.3.5. There are only indications of the time spent on the current process which is approximately 1.5 hours a day by each employee of the administrative department. This results in approximately 1650 hours yearly of time spent in this process.

1.3.4 Stakeholders

This problem involves a lot of different parties surrounding BK, but also within BK. To get a clear overview of all the stakeholders a stakeholder analysis is done. The stakeholders are visible in table 1.

Table 1 Stakeholders

Stakeholder	Role	Internal/ external	Comment	Power	Interest
Reception	Execution internal process importing part	Internal	The reception department is the first department in the data import process within BK. They import the data into the system. They can provide information on their way of importing the data. They are the subjects of the problem.	3	3
Administrative department	Execution internal process checking part	Internal	The administrative department is split in multiple departments for different products (e.g., mortgages, private etc.). This department uses and checks the data, and can provide information on the format the data is needed in. They are the subjects of the problem.	4	8
ICT department	Implementation of solutions and	Internal	The ICT department provides the communication with the ERP systems	6	3

	communication with ERP provider		and other back-office systems. They have experience with the data import process and insight in the needs and can provide information on this. Additionally, they can help implement the solutions.		
Insurance companies (ICs)	Provider of data	External	These companies are responsible for sending the data and formatting the data when entering the system.	9	2
ERP provider	Provider of ERP system	External	The ERP provider can change the ways that data can be imported and is formatted, the ERP is also used to analyze the data.	8	4
Branch organizations	Influencer on IC and are linked to insurance intermediaries	External	Branch organizations have a big influence on the ICs and are currently also increasing the efficiency of information flow between insurance companies and insurance advisors. They also provide services for information communication. There are two to consider: Adfiz and SIVI. Respectively focusing on general improvement and standardization.	9	6

To analyze the stakeholders, we analyze the stakeholders on power and interest. Thereby indicating in what way, they need to be respected in our research. The power and interests scores are addressed on a scale of [0 ; 10]. The higher the score the more power or interests a stakeholder has in the research and the process. The more power a stakeholder has the stronger the impact on solving problems in the process. The higher the interest the, the more stakes a stakeholder has in solving the problems in the research (Slaba & Fiala, 2014). The table is also translated in the diagram in figure 2.

The branch organizations have a lot of power at the implementation stage of the research, they also have high interest as solutions proposed for individual intermediaries can be applied at other intermediaries as well. The branch organizations therefore should be kept close in the process of solving the problems. The ICT department, insurance companies and ERP provider should be kept satisfied, as these all have high power but low interest due to reasons, like where the research is done and their role in the data import process. The administrative department should be kept informed, they are very interested in the research as it will help reduce their time spent on the burden, however they can only provide information and do not have a lot of power in implementing change. The reception should be kept up to date at minimal effort, as they are not that interested and have low power.

The focus in this research will be on the data import process within BK but also on the data flows coming from ICs to BK. The data flows are shown in figure 3, as well as some of the relations between the stakeholders. For the research we will focus on the data flows 1 and 3, while we use the relations 4 and 5 for information while researching and, implementation of possible solutions. As BK does not have a lot of impact on the communication of information between ICs and insurance advisors,

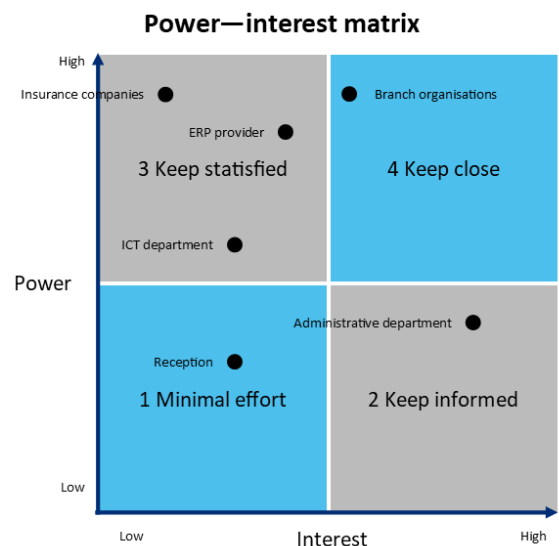


Figure 2 Power-interest matrix

however, the branch organization of BK: Adfiz, and a branch organization in standardization of information transfer: SIVI, do have this influence.

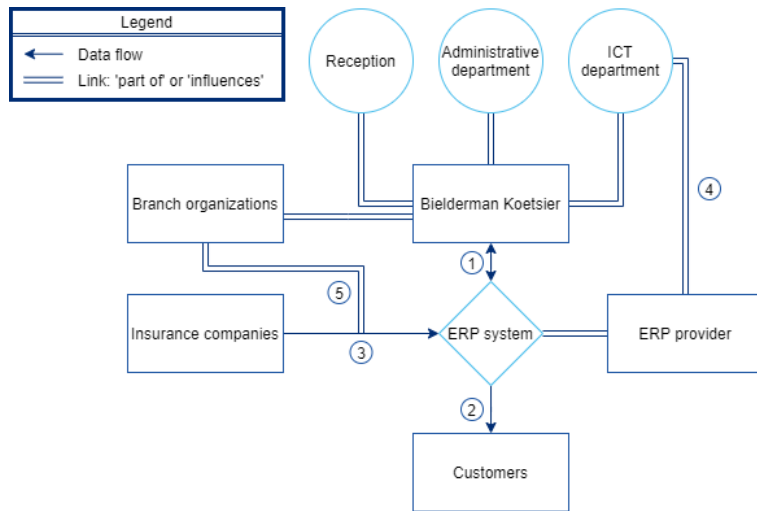


Figure 3 Relations and information flow between stakeholders

1.3.5 Conceptual model

In this part we will investigate the main problem further using a conceptual model in which we show causes and factors which influence the problem. Thereby, laying a basis for a direction for our research. The conceptual model is visible in figure 4, the causes and relationships are based on insights provided by employees of BK. In the model the relationships are denoted with lines with a + or – sign. A + sign means a positive relationship between the factors, a – means a negative relationship.

This conceptual model gives us an insight in the causes of inefficiency at the data import process, we will not go in full detail, however we discuss two key findings from this conceptual model. The first is that reliability of data is low due to the incorrect data in the data files, so called PMI packages. A second issue is that it is still uncertain what types of data are needed. These topics must therefore be considered in our research. Further development of this conceptual framework will be done during the research when modeling the current process.

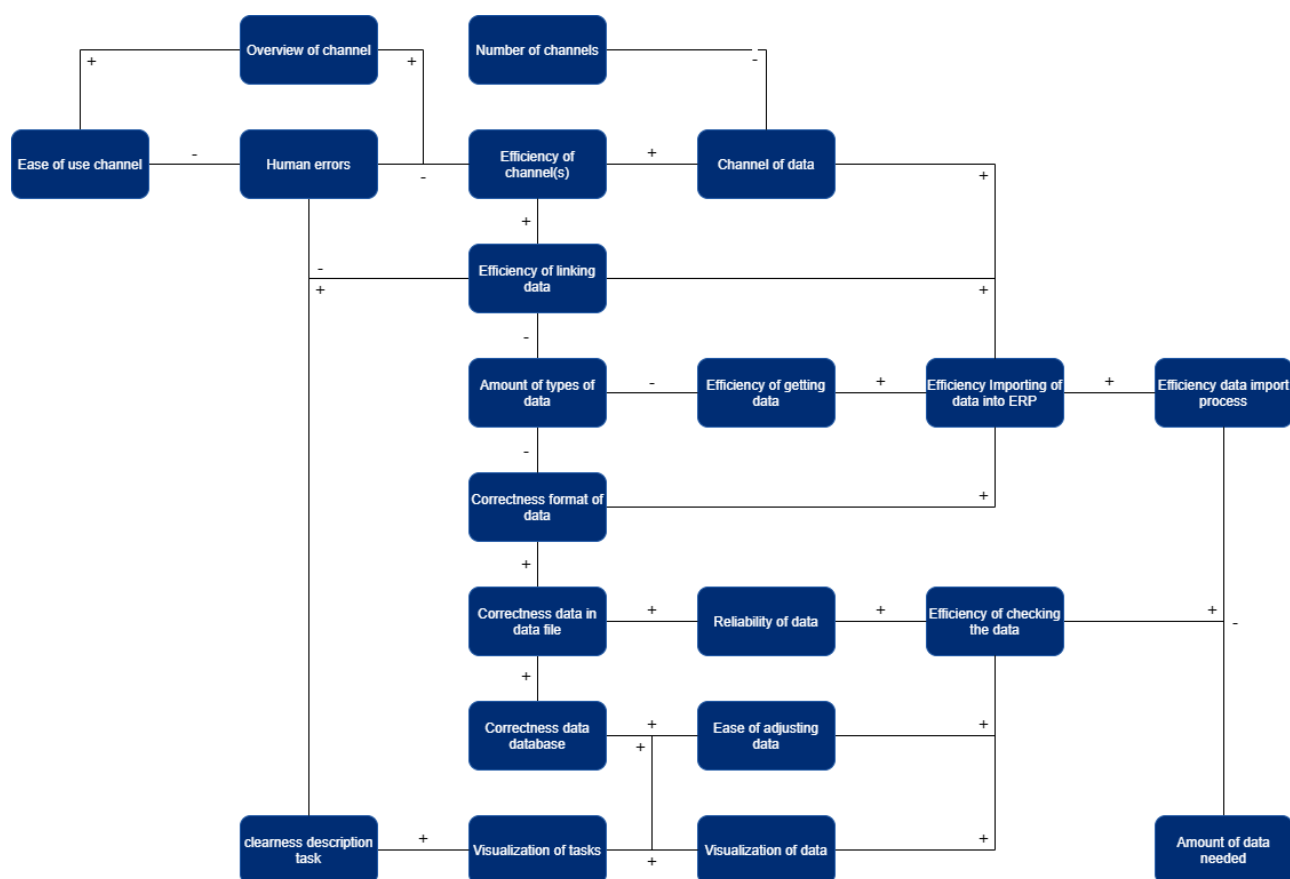


Figure 4 Conceptual model

1.3.6 Goal and scope of research

Although we have determined some causes of the efficiency of the data importing process at BK, it is not clear which causes are causing the inefficiency and what to do about this. Additionally, it is still unsure if these are all the causes. The goal of the research is to find and identify these unknown causes. The research also extends to finding the best plan to tackle the causes of the current inefficiency and provide advice on dealing with these causes for both Bielderman Koetsier, and other stakeholders like the branch organizations on respectively micro and macro level problems.

1.4 Research design

In this part we will discuss the research design we are going to use for the thesis. We will start with discussing the research questions and problem-solving approach. In the theoretical framework in chapter 2 some more methodology will be explained and discussed.

1.4.1 Research questions

For this research we will use the managerial problem solving method (MPSM), as described by Heerkens & Winden, (2017). This method is suitable for research where extensive knowledge is needed and with no clear outcome. They identify seven steps for successful research. These steps are also depicted in figure 5. Step 1: defining the problem is done in earlier sections of this thesis. In section 1.4 we will discuss the problem-solving approach, which is step 2 in the MPSM.

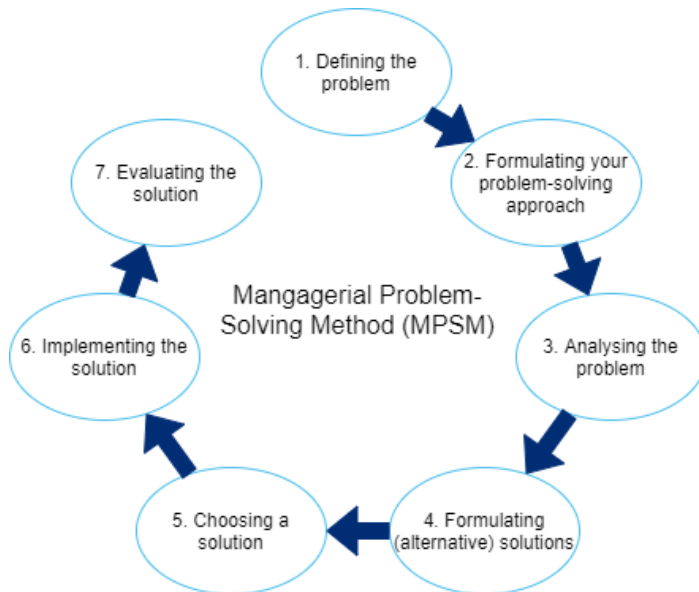


Figure 5 Managerial Problem-Solving Method (MPSM)

For the research we will focus on an exploratory study, in which we will find the best way to deal with the poor data management at BK. To get a concrete study we will first create a main research question, based on the assignment and the core problem:

How can BK improve the data import process?

To complete this research, we are expected to create sub research questions according to the MPSM. Each of these sub-research questions is related to a step within the MPSM. Question SUB1 is related to the third step of the MPSM: analyzing the problem.

What are the causes of the currently inefficient data import process? (SUB1)

To solve this question, we will look at the current process of importing data within BK and the data flow in the chain of BK and internally. Through discovering this process, we can get insights in the causes of the inefficiency. To execute this question some knowledge on methodologies is needed, which is described in chapter 2 Theoretical framework. The information on these processes will be gathered using interviews with BK employees.

A second sub research question is related to step 4 of the MPSM: formulating (alternative) solutions.

Which methods can be used to improve the data import process? (SUB2)

With this question we will conduct a literature search in combination with a qualitative communication approach to find possible improvements for the causes of the inefficiency at the data importing process. For the literature search we will look at best practices in the branch and the possibilities for Straight Through Processing (STP), as well as readily available solutions.

A third sub research question is derived from the fifth step of the MPSM: choosing a solution.

What method solves the inefficiency at the data import process most efficiently? (SUB3)

In this question we will use the solutions and methods gathered in SUB2 and will apply the theory to the case of BK. We will then need to choose an improvement or multiple improvements. For this we need to compare the solutions using a structured analytical method.

The sixth step of the MPSM is implementing the solution(s) which is related to the fourth question.

How to apply the most efficient solution(s) on the BK data import process? (SUB4)

With this question we will apply our knowledge gathered via our research to the processes of BK. To answer this question, we will need to adopt methodologies and work together with the ERP provider and other stakeholders to create an action plan for implementing a solution.

The last sub question to answer for our research is also related to the last step in the MPSM: Evaluating the solution.

What are the recommendations for BK to improve the data import process? (SUB5)

The answer to this question will lead to the recommendations part of our research, in which we will analyze which parts are useful for BK and other stakeholders to know. Additionally, we will need to think of limitations and possible futures, to prepare BK for the future. This also includes discussing the research.

The problem-solving approach is also shown in a diagram in figure 6, following from the steps of the MPSM. In the diagram we left out the steps defining the problem and formulating the approach as well as evaluating the solution, since these parts are already executed or do not include the main research.

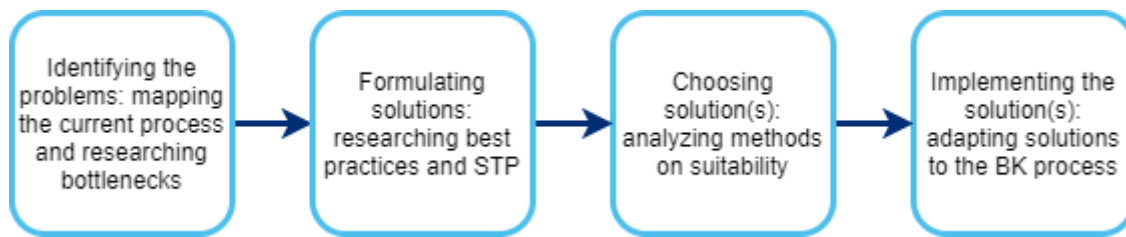


Figure 6 Problem-solving approach

1.4.2 Key concepts

In our research there are several key concepts which we will define and explain here.

A concept often used is the data import process, a similar concept is that of data flow. The data import process is the process of importing and checking the data coming into the system. This data import process is part of a data flow. Data flow is the flow of information and the programs that use, import and export this information. Data flow can represent small single elements like copying a file, but can also be a continuous stream of varying data, like it is the case at BK (Mülle et al., 2019). In the case of BK, we refer to the data import process when we are looking at the internal processes of BK and use data flow for the flow of data at external processes of BK, at for example ICs or the data coming from an IC to BK.

Next up we will explain the first part of the data import process, the data import part of the process, often referred to as data import. This process consists of multiple handlings completed by multiple actors, namely the reception department and the ERP system itself. This process consists of importing the data from external parties into the ERP system and putting the data in the right place. Secondly the information is assigned to members of the administrative department, who do the data checking process.

The data checking process is the second part of the data import process. Here the data coming from external parties is checked on validity and completeness. The data is thereafter stored in the ERP system. Further explanation of the processes will be researched in the analysis of the current process under sub question 1 in chapter 3.



The last key concept we will discuss is that of the data itself. Data is a very broad concept often referred to as information. We will only define the concept in our context. The data within BK has a lot of variances, it consists of incoming documents like bills, insurance policies and emails. With these documents comes additional data, which is of a more regular format, these are so-called PMI packages. This is a data package which can directly be stored in the ERP system. There are also other sorts of data, these will be discussed when analyzing the current process.

1.4.3 Deliverables

The deliverables coming out of the research are related to the answers to the sub questions. The first deliverables are related to SUB1:

- Business process model of the importing and checking data process within BK.
- Data flow diagram(s) of the data chain; already shown in figure 3 on a very abstract level.
- Insight in the key bottlenecks in the import data process.

Other deliverables are related to SUB2 and SUB3:

- Overview and analysis of possible improvements to the inefficient data process.
- Insight in the degree to which the improvements are better than other improvements.
- Insight in the possibilities for applying STP in the data flow.

The last deliverables are related to SUB4 and SUB5, and are the answers to the main research question:

- Action plans to implement the best solution(s).
- Recommendations on implementations and future development.

1.4.4 Validity and reliability

With certain methods of research comes certain reliability and validity of these methods and the outcomes. We will start with reliability; this is a factor which measures the accuracy of methods. If a method is used multiple times and the outcomes out of these methods are close or the same reliability is high, and vice versa. Validity is something else and is on whether the thing you achieve or execute is actually what you want to execute or achieve (Cooper & Schindler, 2011). Further validity and reliability are discussed in the discussions at the end of this thesis.

When applied to our research, reliability is when the interviews, literature reviews and best practices return the same findings when reproduced in for example 5 years. Obviously, best practices are a bit tricky as these often change quickly, as well as the results of certain questions in interviews about for example processes. However, reliability can also be measured in consistency of the answers between respondents to an interview for example, in general if multiple interviews are executed and answers are generally the same, the interview is reliable. The same goes for literature study with the different articles, and the best practices when looking at different companies using benchmarking for example (Cooper & Schindler, 2011).

When we look at validity we determine two types in our research, first is construct validity which is when something measure what it actually claims it measures. We use two KPI's in our research which measure the efficiency of the data import process. Together these two measures the entire efficiency of the data import process, via time spent which is the key element of efficiency, in our case. Therefore, construct validity holds. A second construct is that of external validity, which determines if our research is applicable to external parties and so, is general. Although our evaluation is on the process of BK, key principles can be used at for example other insurance agents which use the same



ERP software, although this amount of agents is limited and therefore external validity is limited (Brown, 2000).

1.4.5 Knowledge questions

To further specify our research, knowledge questions are created, with specific research design specified per knowledge question. This knowledge is needed to answer the main research questions. These questions are answered in multiple sections in this thesis, this location in the thesis is specified in table 10 in Appendix A, which also shows all the additional knowledge questions. These questions vary from general knowledge to case specific knowledge. If knowledge is case specific, methods like interviews and observations are used, to gather information more efficiently and process this information correctly. If the knowledge needed is more general research methods which are proved to be useful for general information and are classified as scientific, are used like literature reviews.

The knowledge questions are used in the background of this research to keep a structured line. However, the knowledge questions are not explicitly mentioned in the further research, answers are given in the main body, without addressing the question.



2 Theoretical framework for methodologies

In this theoretical framework we will look at some preliminary literature research, which is needed for a successful execution of the rest of the research. In this framework we will answer three of the knowledge questions which focus on methodology and tools.

2.1 Process modelling tool

We will start with discussing the question what process modeling tool to use for visualizing the current process. This information is needed to model the current process at BK. To research this question, we will use a systematic literature review. However, we will first discuss the reasons for choosing a modelling tool. As currently there is no real insight in the exact process by the management of BK, there is the need for an understandable method of getting insight in the process. Therefore, the method of process modelling is chosen over for example process description or no process examination at all.

To define the knowledge problem, we will first define the variables. An independent variable in our problem statement is the current process at BK, since this is obviously not suitable as independent variable, therefore we will redefine it to data import process. In this question we have one dependent variable namely business process modeling tool. The relationship between these variables is that the independent variable is used to describe the context of the dependent variable. Our research population is process modeling tools described in literature; in this we will search for the best suited.

Coming from our systematic literature review in Appendix B, we will now discuss the results and the implications for our research. The field of business process modelling (BPM) is changing and innovating continuously. BPM is needed to develop structure for complex information chains and information systems (Kechagias et al., 2020). Within models of business systems such as BPM there are two classifications: as-is and to-be. As-Is models represent the current situation whereas the to-be models represent improved situations. This is also one of the reasons to choose for the use of modelling as BPM is able to both show current and improved situations, as is requested by BK (R C Papademetriou & Karras, 2016; Rallis C Papademetriou & Karras, 2017).

Within different BPM tools there are different aspects to assess. The first aspect is that of functionality in enterprise modelling, this is representing the different parts in processes and companies such as organizations, resources and functions. This is one of the basic capabilities of BPM tools and should therefore be good. It is preferred that the modelling tool supports BPMN 2.0, which is the most recent and most used business process modelling notation or language (Kechagias et al., 2020; Walterbusch et al., 2013). Another key aspect is that of ease to use, there are various aspects to this criterion, for example is there knowledge of coding needed, or other aspects like connectivity (Shitkova, 2014). Due to the limited time reserved for modelling, this criterion is very important. A last important aspect to assess is that of technical and financial requirements. As budget is limited it is important that the tool does not require any outstanding technology or require high investments (Medoh & Telukdarie, 2017).

Coming from the six articles from the systematic literature review, there are several tools to consider, for our research we will discuss the tools: Bizagi Modeler, Lucidchart and ARIS Express. All three are recommended by the authors as well as being free tools. To decide between these three tools, we look at each tool individually. Lucidchart is a web-based tool with an easy-to-use drag and drop system. Next to BPMN capabilities, it also has the capabilities of other notations such as data flows and mind mapping. Functionality of Lucidchart is limited as there is only a limited amount of

shapes as well as limited number of shapes allowed to use in the free version.

Both Bizagi Modeler and ARIS Express are application-based tools, they have all functionalities needed from a BPM tool, as well as an easy-to-use drag and drop system, both tools are also able to model as-is and to-be models. However, as also pointed out by the articles; ARIS Express is further developed and has some capabilities with event-driven process chain modelling, which might be useful at later stages in the research. ARIS Express is also rated the best modelling tool or a very useful modelling tool by Kechagias et al., (2020) as well as Medoh & Telukdarie, (2017). Therefore, based on the theory and personal preference we choose ARIS Express as our modelling tool to use for visualizing the data import process at BK.

2.2 Data flow modelling tool

We now discuss the second question in our theoretical framework: What data flow modeling language and tools to use for researching the current data flow?. This knowledge is needed to successfully model the data flows in BK and to BK. Also, here there is the need for further investigation of the processes and especially in the data flows as these are unknown by the management. The use of data flow modelling allows managers to understand the data flows in the chain and in the internal processes. And keeping the data and the process parted, allows for better understanding of both the process and waiting times as well as easier identification of problems in data.

First it is important to note the difference between data flow and data models. Data flows depict how data is used within an organization, it shows who handles the data, how data is gathered and the transformation of data. Whereas a data model depicts the relations between different types of data and shows how the entities and attributes in data are related (Harrington, 2016). Also, in data flows there are the two categories of as-is and to-be modelling, the meaning of these two concepts is the same as in 2.2.1.

Data flows can be modelled using two methods, general flowcharts and data flow diagrams. General flowcharts are often used for illustrating rough non-complex data flows. This technique is already used in figure 3. Although this way of modelling is easy to use and quick to make, the details and structure are missing, only general context maps can be made using general flowchart models. For more structure, the most common technique is that of data flow diagrams (DFD). DFD are used for multiple purposes one is showing the relations between data provider and data user, within or between organizations, a second purpose of DFD is showing the application programming interfaces these are the links between different data handling systems (Ryabinin et al., 2016). DFD contain multiple components, first is that of entities, entities are for example humans or organizations which can use or provide data. Second are the processes, processes can vary between one single action or multiple actions. Third are the data flows itself, these show the transferring of entities, between processes and data stores. This leads us to the fourth key element, that of the data store, which can be databases for example (BASU, 2000; Harrington, 2016; Online Visual Paradigm, 2021).

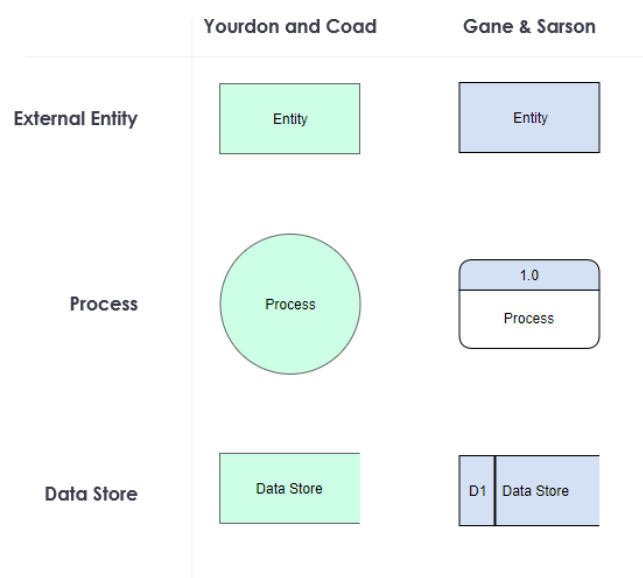


Figure 7 Yourdon and Coad versus Gane & Sarson (Online Visual Paradigm, 2021)



Within DFD there are two main notations. First is that of the Yourdon and Coad Notation, second is the Gane and Sarson notation. The earlier described components are available in both notations. The way they are depicted is shown in figure 7. As the goal of the language is to model the data flow at BK and make the data flows clear for the managers and not programmers, it is important to select the notation which is most suited for managers. We therefore choose for the Yourdon and Coad notation, which is more suitable for managers analyzing processes (Kalashnikov et al., 2021; Online Visual Paradigm, 2021).

There are some tools which allow DFD modelling, however ARIS does not allow DFD, therefore we will use Lucidchart for the modelling of DFD. It allows an easy-to-use Yourdon and Coad notation. Lucidchart also allows the modelling of data models, which might be useful later.

Within DFD there are also compositions as the structures of data flows and processes are often complex. Therefore, DFD are often based on a context diagram, showing general flows, this context diagram refers to processes, which are then specified in separate diagrams. The context diagram also shows external parties and connections. This is a so-called top-down composition (Yoo, 2003).

2.3 Detecting problems in data flow processes

In the last part of this theoretical framework, we look at methods and theories supporting in problem detection in data flow processes. Once we have modelled the current processes and data flows, it is important to recognize the problems, we will therefore discuss the applicable theories. As it is currently not known what the processes exactly look like, we will not select a theory but will suggest multiple suitable theories.

We start with discussing the Theory of Constraints (TOC). The theory of Constraints is a management philosophy which focuses on continuous improvements by looking at the constraints of a process. In contrast to some other management philosophies TOC focuses on increasing throughput rather than reducing costs (Boyd & Gupta, 2004). There are three key aspects to TOC as described by Inman et al., (2009): logistics, performance system, and problem solving/ thinking process. TOC uses KPIs to measure the level of these three aspects and shows which aspect needs working on. From there we can further detect the causes by using TOC again but now within the aspects, which will result in a clear understanding of the bottlenecks within processes. Bottlenecks are the actions/artefacts, which deliver the least throughput. Although TOC is generally used for production processes, it can also be used for more general administrative processes, or at least principles of TOC can be used.

A second management philosophy focused on improving processes we want to discuss is that of lean management. Lean is focused on improvement of processes through elimination of waste. Also Lean is focused mainly on production processes, however, principles of Lean can also be used for other processes. On the contrary to TOC Lean focuses on improvement in multiple aspects instead of one bottleneck. This waste can be of various types, some examples which can also be useful for an administrative process are waiting times, unnecessary activities, transportation and defects. This also shows some similarities between TOC and Lean, as they are both focused on continuous improvement as well as increasing throughput rather than reducing costs. Lean management generally also involves all employees to come up with small improvements (Bhasin, 2015). BK is already using Lean principles, as they have recently addressed a campaign to announce the small tasks, which create an overload of tasks. Although TOC and Lean are different methodologies, they do complement each other (Sukwadi et al., 2021).

The third and last philosophy we discuss is that of Lean Six Sigma. As the name suggests the lean methodology is integrated in this combined methodology. Therefore, all principles mentioned earlier



are used, as well as the principles of Six Sigma. Six Sigma is a methodology which tries to reduce the number of defects among products and services. The goal of six sigma is near elimination of all defects. It achieves this through looking at reducing variation and standardizing, this is done using statistical methods. Also, Six Sigma is a continuous process focused on increasing throughput through reduction of errors. Some aspects of Six Sigma are already present in Lean, as well as Lean principles in the Six Sigma methodology. As Lean lacks some statistical management and is not able to reduce variation, and Six Sigma lacks to fully reduce waste, the two methodologies together combine the even better approach Lean Six Sigma. Also Lean Six Sigma is focused on production processes, however, principles are useful for administrative processes (Patel & Patel, 2021).

3 Current process

In this chapter we create an overview of the current process by looking at three aspects, the process, the data flows and the root problems in this process. This overview will be given using models as described in the previous section: the theoretical framework.

3.1 Process analysis

In this research we are looking at the data import process at BK. A general description of this process is receiving and importing a data package with accompanying files and then assigning a task to check the data and prepare it for customer receipt, thereby adjusting the data. To create a full insight in this process several business process models are created in the figures below. But first it is important to understand what the goal of this process is and what the inputs and stakeholders are.

3.1.1 Input, output and stakeholders

The input of the process has already been described vaguely but are summed together here to create a clear overview. The same goes for the stakeholders as these are all already mentioned however, here we will define the stakeholders which are only applicable for the process and not the research. The outputs of this process have not been discussed yet but are needed to measure the efficiency and effectiveness of the process, also when we eventually change it. The inputs, outputs and stakeholders are visible in figure 8.

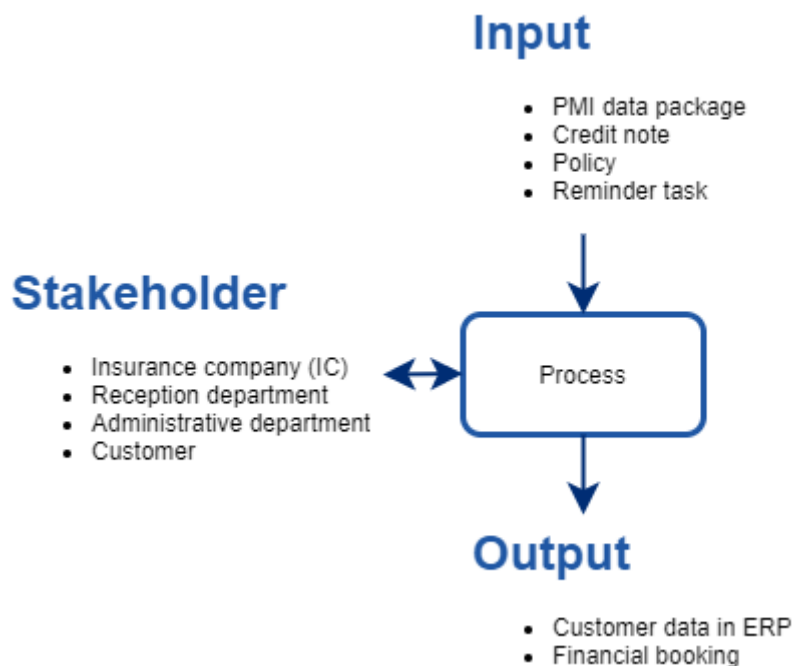


Figure 8 Input, output and stakeholders

The inputs come from various stakeholders. As the first three inputs: PMI data package (PMI), credit note and policy document are all coming from the stakeholder insurance company, whereas the reminder task is input by the administrative department. To get a clear overview of how this input is generated we will also model the full process in which the data import is placed. Although the data import process is a standalone process, it is often part of a bigger process, although these circumstances do vary, as reasons for executing the process can be different. These reasons will be discussed below in the context of the process.

The main stakeholders in the process are the four mentioned stakeholders, these are the stakeholders that act in the process. The other stakeholders mentioned earlier in section 1.3.4 are responsible for the infrastructure which the four stakeholders use in this process.

The output of the process is part of the value that BK wants to give to customers which is a centralized overview of their insurances and other financial products. The result of the process is this data, which is stored in the ERP, ready to be presented to the customer when requested. Another output is often that of a financial booking, as most of the reasons through which this process is executed involves a change in financial state and therefore there is the need for a financial booking which is also executed in the data import process, with this results in an invoice.

3.1.2 Context of the process

We will now discuss the context and background in which this process is placed. As already mentioned earlier there are different reasons why this process is executed. In our research we distinguish 4 reasons for executing the data import process: all within different processes and eventually different inputs or outputs. We discuss the differences between these methods for each method.

The first and most common context is that of adjusting an insurance by the customer. In this case there are also multiple situations, however, the input is always the same, as well as the output. The adjusting an insurance context is executed when a customer wants a new insurance, wants to change an insurance or when the customer wants to stop the insurance.

A second context is when there are adjustments to an insurance coming from an insurance company. These adjustments can vary, examples are changes in the premium, changes in the conditions or stopping of the insurance. This context has a different input as there is no reminder task because there is no process executed by BK before the data import process and therefore this task is not generated.

A third context which is close to the previous contexts is that of insurance prolongation. Each expiration period an insurance is renewed when it is not cancelled. This is automatically done by the ICs; with this prolongation the ICs send a special PMI package and a credit note for the new premium for upcoming period. The same case applies here as the context with the adjustments by the insurance company, that there is no reminder task. Additionally, there also does not have to be an insurance policy as these are only required with change.

The last context is that of adjustments to linked data. When for example an insurance is stopped, this can influence the discount ratio of other insurances, thereby increasing the premiums. There are also other instances through which insurances are indirectly changed or the accompanying coverage data. When the data import is executed in this process, the process is often more complicated and requires more data input also from the adjustments to the linked data.

To give a complete overview, the input data and differences are shown in table 2. Stakeholders and output are not shown as these are all the same for each of the 4 processes.

Table 2 Overview contexts data import process

Context	Customer adjustments	IC adjustments	Prolongation	Linked data
Input	PMI Credit note Policy	PMI Credit note Policy	PMI Credit note (Policy)	PMI Credit note



	Reminder task			
Frequency	Common	Uncommon	Common	Least common
Particularities	Data import process is part of bigger process	Data import process is first process	Data import process is first process	Often linked to other processes which in turn also use the data import process

Next to understanding the context in which the data import process is placed in, it is also important to look at types of data which are used in this process. For now, we will only briefly look upon the data. Further analysis including data flow and data structure will be discussed in section 3.2.

In our research we often refer to customer data, this is data which is customer specific. Examples of this are the license plate numbers for car insurance, the address, for house insurance etc. This data basically creates the specific insurance and is needed to request the insurance and to keep this insurance up to date. Closely related to this customer data is the insurance policy, which is a document created by the insurance company, portraying basically the same data as the customer data, only this information is stored in a document in the ERP instead of directly in the ERP system of BK.

Another type of data is financial data including premium data. This data is all focused on the financial side of insurances, so how much does a customer need to pay to have a certain insurance, it is stored in the ERP system, this is also known as coverage data. Closely related to this are credit notes, which are documents created by the IC to indicate what the customer must pay for the adjusted insurance for example. The PMI package includes both the data on the policy and on the credit note and is also created by the IC. This package is imported in the ERP and replaces the customer data and financial data if accepted into the system by the administrative department.

3.1.3 Workflow analysis

We will now discuss the process and give insight using workflow models. For this we will use the business process modelling notation 2.0, which is used in ARIS Express, which is the tool we use to model the as-is process and also the to-be process. To give a complete insight we also model the four contexts in which the data import process is placed, to get a full overview of the consequences of changes and get a complete understanding.

We start with the context of the customer adjustments which has already been discussed earlier. In this process the data import process is a process which is executed at the end of the full process. Another sub-process of the customer adjustment context is that of the mail import process. The customer adjustment context is modelled in figure 9, whilst the mail import process is shown in figure 10. For a more zoomed in view the figures in Appendix C.

The second context of IC adjustments is very general, and this process consists only of the data import process. Here there is no reminder task and thus some tasks in the data import process are then left out. For prolongation, the workflow of the context is also absent as it only exists of the data import process.

The fourth context of linked data is more complicated. Linked data are for example multiple insurances of one relation in a package together. Due to this package, there can be discounts on premiums, however this discount is often dependent on the amount and kind of insurances in this package.

Customer adjustments context

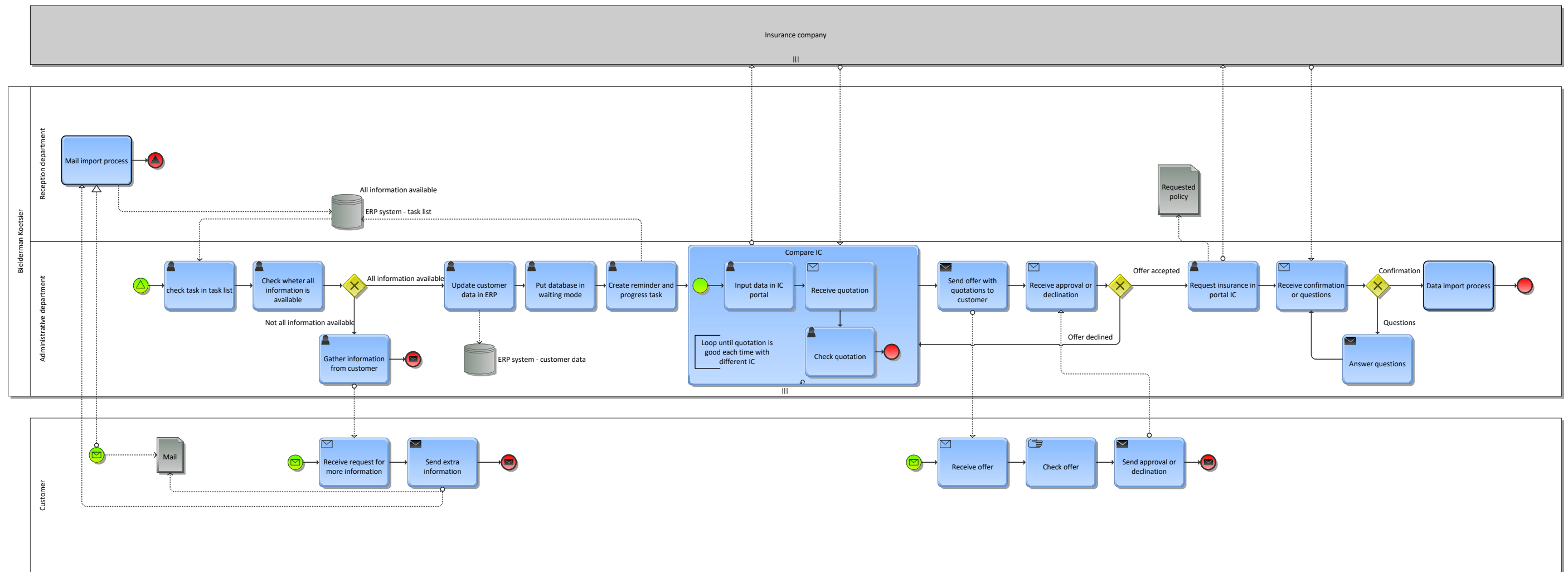


Figure 9 Customer adjustment context workflow

Mail import process

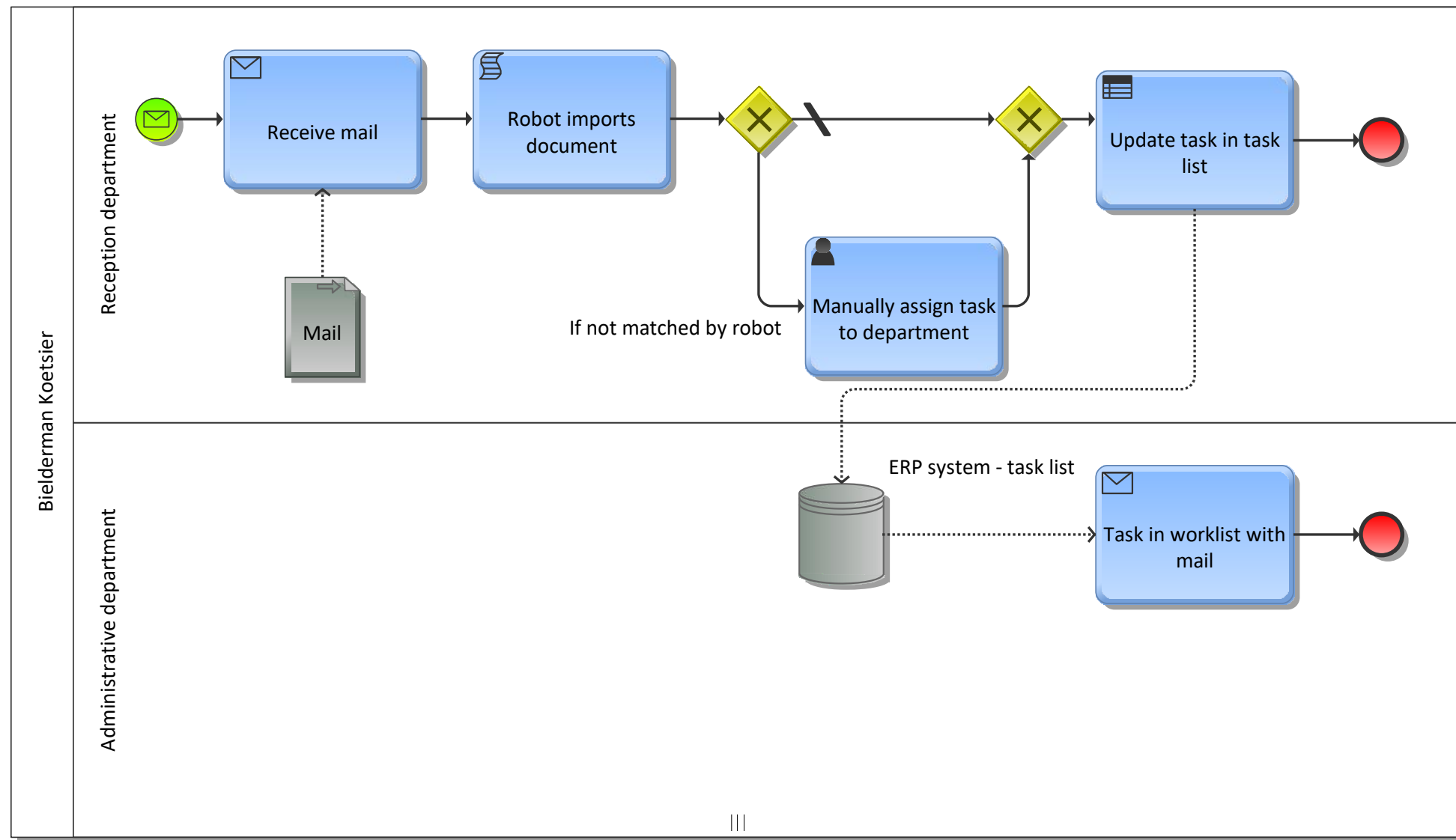


Figure 10 Mail import process workflow

Data import process

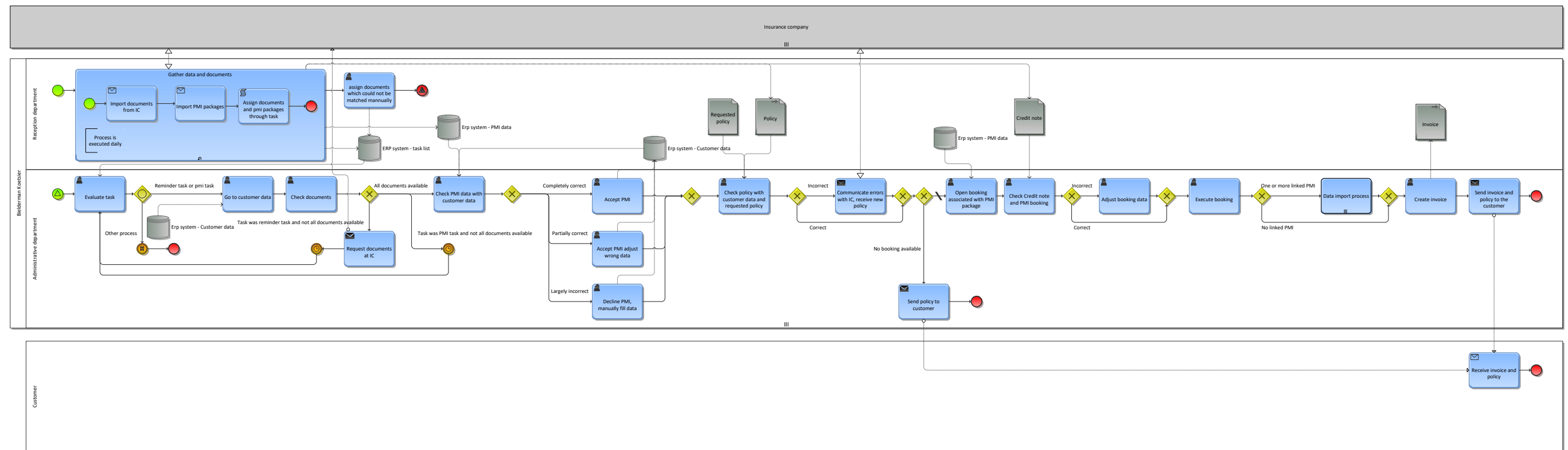


Figure 11 Data import process workflow



So, when this changes through either reason, the data import process must be executed for each of these insurances in the packages. Although there may not be a policy for each insurance which will also differ the data import a bit as certain customer data is not changed then, only financial data. There are also other cases of linked data for example the link between the insurance customer data and the persons customer data like age and gender, which can influence insurances.

The data import process is modelled in figure 11, a more zoomed in view can be found in Appendix C. We will now discuss the steps in the process to get a complete overview of the processes. As expected the customer adjustment process starts off with the customer who informs BK of a change or new policy, it does not matter what this change is. From here we enter the mail import process, which is mostly done by a robot. In this mail import process the mail is transferred into the ERP system, the robot tries to select the customer which the mail is assigned to as well as the policy. If the robot cannot match the document this is done manually by the reception department. Thereafter a task is created for the administrative department, which is placed in their task list. In this task it is shown which document has come in. Here the mail import process ends.

The customer request process then continues when the administrative department addresses the task assigned through the mail import process. A sequence of gathering all the needed information is then done. Once all the information is available the first point of data storing is done of the initial insurance data like a license number, address or other information through which the insurance can be recognized. The database is then put in waiting mode, this is a mode which allows the user to easily modify and store data without filling the complete database. With this waiting mode the administrative department creates a progress task or also referred to as reminder task. In this task they keep the current state of the request, which helps keep the progress and they set a reminder whilst waiting on answers for example. The administrative department then goes on to requesting quotations, which introduces the second point of data entry. The best quotation is sent to the customer for approval. Once the customer agrees the insurance is requested at the IC and a requested policy is created. The reminder task is also updated for reminding of the requested policy. The customer adjustment context ends, and the data import process is then started from there.

The data import process is initiated by the reception department. Each day they execute the gather data and documents process, through this process they import all the documents like policies and credit notes in the ERP system as well as the PMI packages. Also, here the robot takes the main parts of the assigning and importing, whilst the parts which cannot be matched are solved by the reception department. When a document is assigned to a customer or insurance the existing tasks are updated, for example the reminder task which was created in the customer request context. If there is no existing task like it is the case when the second or third context are applied, a new task is created and placed in the task list of the administrative department.

If the task indicates the data import process, it is started by the administrative department. They first check whether all documents are available as these are all needed. If the task is a reminder task and not all documents have come in, the IC is reminded, and the process is stopped until there is a new task with either the documents or another reminder. When all documents are gathered the PMI is executed which is the third point of data entry. Dependent on the correctness of the PMI package it is accepted or declined, the rest of the data which was wrong or not filled in yet is then manually filled in the customer data. After this first check there is a second check which checks whether the policy resembles the requested policy. If there is a booking a third check is done which is related to the financial booking, this booking is also imported with the PMI package but is checked against the credit note, once this booking is correct it is executed.

Now we have come to the context of the linked data, if his context should be applied the data import process is also executed for the other insurances in the package for example. Dependent on the changes there can be policies available, however if these are not available some checks are not executed obviously. All these linked data points are checked to create one invoice from all the bookings. For this the administrative department must go into a different mode of the ERP, through which they create the invoice. For sending the documents to the customer, which is the last step in the process, the administrative department must go back to the customer data again. Once the process has ended there can be questions of customers of course or new changes, however this part of the process is very variable, and is therefore not considered in this research.

3.2 Data analysis

Now that we have modelled the workflows in the process and its contexts, we have a look at the data flow. As has already become clear from the workflow analysis, there are all sorts of data, previously we already mentioned the main types of data. However, we will first look at the types of data in this analysis, this is then followed by the company structure to create a clear overview of the stakeholders in the data flow handling. Lastly this is followed by data flow diagrams indicating the flow and thereby creating insight.

3.2.1 Data types

We will start with discussing the data types, for a complete overview table 3 is created in which the key points of each data type are shown. In this table there are three data sorts. The first is document which does not need any explanation. Another data sort is that of the transferable data package which is raw data stored in a package which can be imported and exported in data bases. The last data sort is raw data which we refer to as data, which is stored in a data base, these are all types of data like strings, integers and variants. Each data type has its own purpose, these are also shown in table 3, as well as the creator or sender of the data.

In the ERP system of BK, mails are turned into documents by the robot, and are therefore referenced as a document in table 3.

Table 3 Data types

Data	Sort	Purpose	Created by
Policy	Document	Leading document, overview of complete insurance	IC
Credit note	Document	Overview of financial booking	IC
Requested policy	Documents	Overview of complete requested insurance	BK through IC portal
Quotation	Document	Overview of possible insurance with financials	IC
PMI package	Transferable data package	Easy data import in BK's database	IC
Customer data	Raw data	Overview of policy data, used for communication and information storing	BK
Booking	Raw data	Financial statement registering invoices	BK
Invoice	Document	Overview of required money for insurance	BK
Task	Raw data	Progress statement, serve as a to-do list, can be reminder or other actions	BK
Mail	Document	General, for example questions	BK / IC / Customer

3.2.2 Data handling structure

For the data handling there are multiple actors and software technologies which are used. To make this clear we model the data flow structure in figure 12. As can be seen there are four main channels which are used for communication in the data import process. The first channel is ADN this channel is used for communicating PMI packages from the ICs to the ERP system of BK. Via this channel BK employees can directly import the PMI packages into the ERP system towards the customer data. The second channel is Aplaza, this is the main channel for communication of documents from the ICs to BK. The documents which come in are first matched to the right customer and departments by the robot. This channel delivers the policies and credit notes. Both Aplaza and ADN are using protocols created by branch organization SIVI.

Another common channel is that of the mail, this channel is often used for general items like questions for example. Mail is sent directly from the employee and enters BK's ERP system via the robot which assigns it to the customer dossier and the employee. For mail BK uses Microsoft Outlook. The last channel is that of the IC portals, these are portals accessed via internet, in which employees can for example request insurances or quotations, as well as download policies and other documents. Requested policies and quotations are gathered through this channel. The IC portals are maintained by the ICs themselves. The robot is maintained by an external company which is a partner of the ERP provider and of BK. The ERP system is maintained by the earlier mentioned ERP provider.

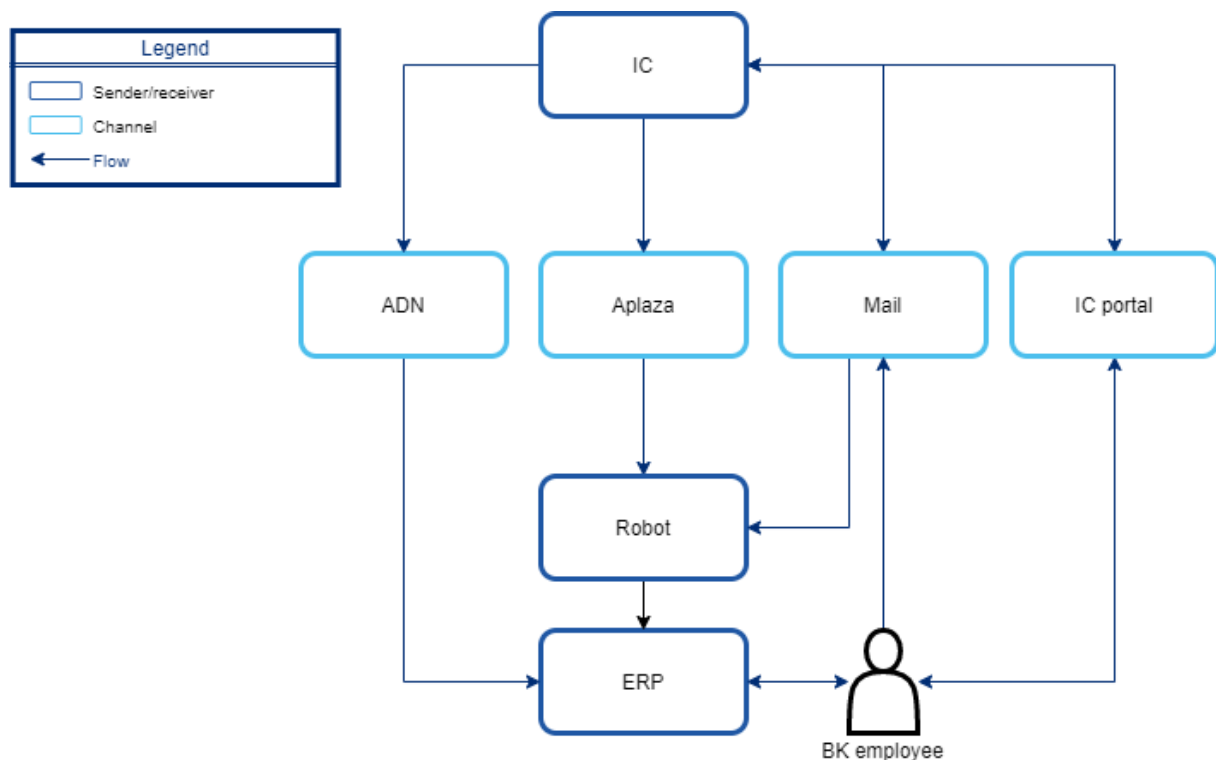


Figure 12 Data flow structure

For a better understanding of the data flows we also look at the ERP structure, this is visible in figure 13. Here we can see which data type is stored in which part of the ERP system and which data stores are all used or accessed in the Data import process. As can be seen all data types of the sort of document are stored in the dossiers of the customer data. In the customer data store itself, the raw customer data like license plate and address are stored. Tasks are stored in task lists and bookings are stored in the financial data. This booking data is then used by the financial department to keep

the financial planning up to date and remind the customer if they must pay for example, this is a separate process. The PMI packages are stored in the PMI store, from which they can be imported in the customer data. The dossiers and customer data are often referred to together and are therefore referred to as customer data.

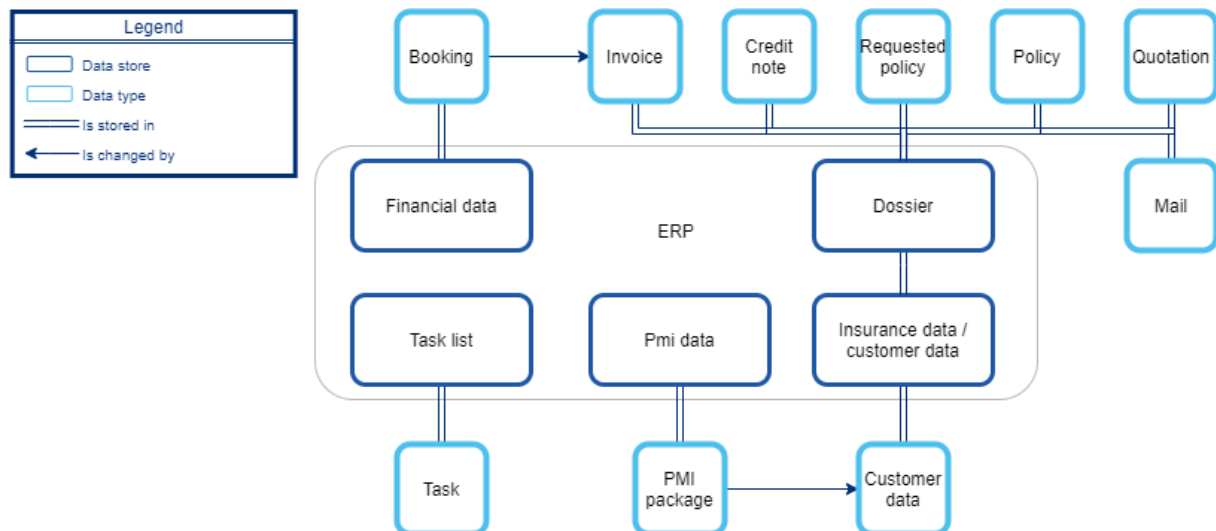


Figure 13 ERP structure

From these two models it becomes clear that there are a lot of stakeholders which work together to create an efficient data import process, however the main role is that of the ERP system. Through this system communication and documentation is done and stored. This system also shows a lot of application programming interfaces (API), a lot of these APIs is maintained by big parties like ICs. And are therefore difficult to change, however, if there are issues with these APIs they need to be changed.

3.2.3 Data flow diagrams

We now analyze the data flows between the ICs and BK. We do this using data flow diagrams (DFD), which are models showing the flow of information and information types between entities, like BK and the ICs and databases and channels, as well as processes. For these DFD models we will be using the Yourdon & Coad notation which is most suitable, as described in the theoretical framework (Kalashnikov et al., 2021).

For the models we use a top-down composition, this means we start with a so-called context map. This shows the start and end entities as well as the main processes. After this we are working down from an abstract level to a more detailed level. We do this through highlighting each process taking place in the DFD. In the diagrams the processes are marked as a circle, if the circle is white then the process is worked out

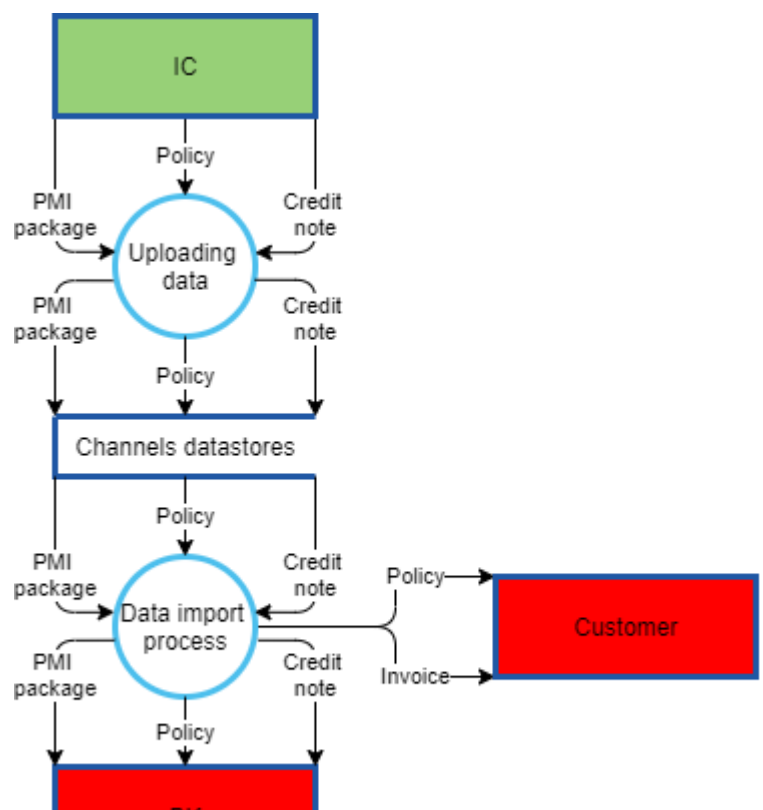


Figure 14 Context map

further in a later DFD. If the process is grey then the process is clear on its own and does not need any further data mapping. The goal of this section is to have all the models fully explained so that all the processes are grey.

The context map of the full process is visible in figure 14. As can be seen the three entities are the ICs, BK and the customer, with the data store of the channels where the data is temporarily stored until BK retrieves it from these channels. The only data shown in figure 14 are the three main components in the data import process. It does not include for example mail or requested policies or quotations, as these are part of the contexts and not of the main process. From our context diagram we distinguish two main processes, first is that of uploading the data, which is done between the ICs and the channel data stores, and secondly the data import process between the data stores, BK and the customer. In all the DFD, the initiating entity or data store is marked with green, whilst the end entity or datastore is marked with red.

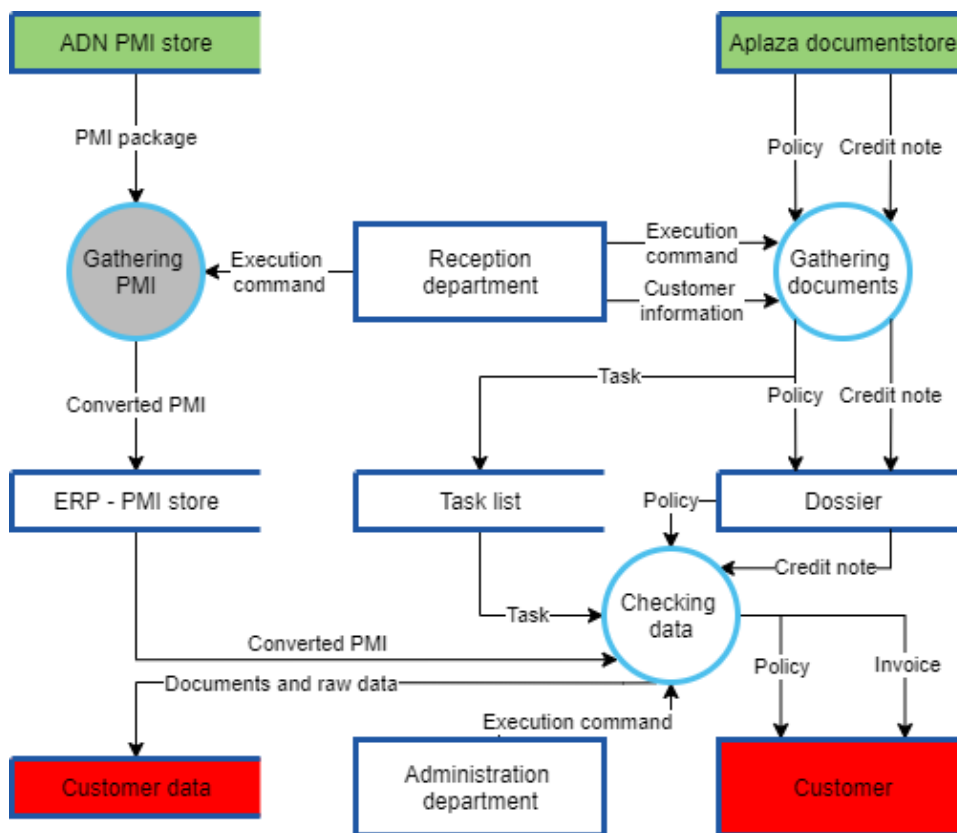


Figure 15 Level 0: Data import process

We now work the Data import process part of the context map out further. The level 0 diagram is visible in figure 15, this is the first level after the context map. Here we can see that there are a lot of different data stores working together. We start with the two datastores of the channels. These two stores are respectively the PMI store and the Aplaza document store. The first is responsible for transferring PMI packages between ICs and insurance intermediaries whereas Aplaza is responsible for large amounts of document sending between earlier mentioned parties as well as some PMI packages, but for the sake of convenience we will ignore these as the importing process is the same as the ADN store.

From the AND PMI store, the PMI packages are gathered and send to the ERP of BK via the gathering PMI process. This is a very simple process which is fully executed by the ERP itself, the reception department only gives the command to start this fully automated process. The ERP then takes all the

PMI in the store and imports them. When these are imported they are linked to the customer data they entail to. They are now accessible to be implemented in the customer data if this is wanted of course.

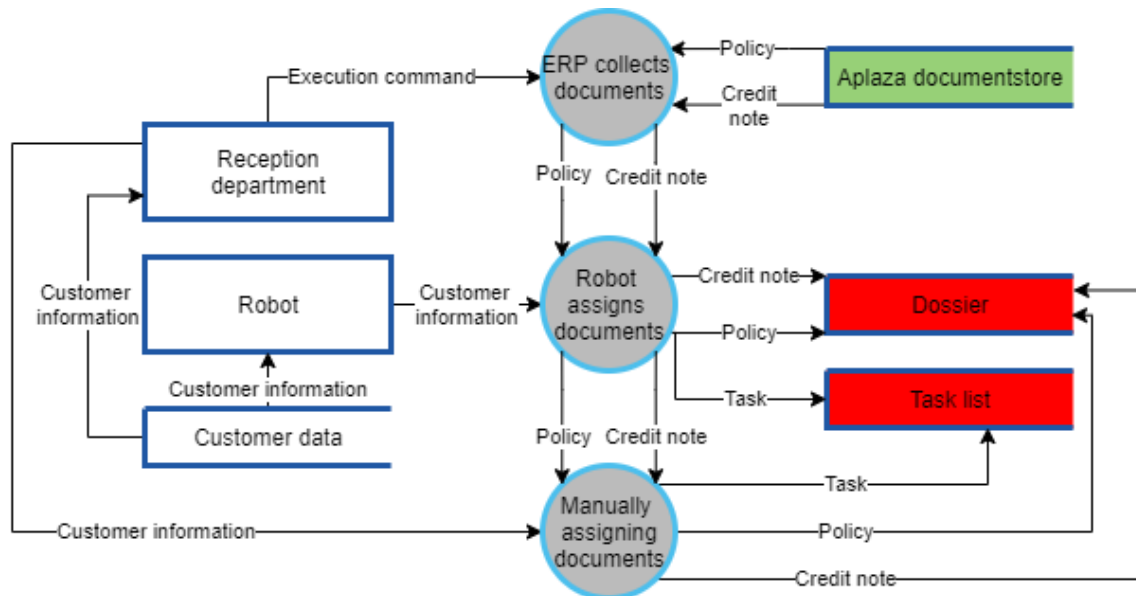


Figure 16 Level 1: Gathering documents

This leads us to the next process which is the gathering documents process. This process is further detailed on level 1 in figure 16. From Aplaza the policy and credit notes are gathered, and eventually other documents, however these are not relevant for our research and are therefore left out. This process is also, like the Gathering PMI process in figure 15, fully automated in the ERP. The ERP takes all the documents from the store and inputs them into the robot assigns documents process. This process has an internal data store which is not modelled in figure 16, however this is a temporary data store where these documents are stored until the robot, or the reception department assigns these documents.

Logically the next process is Robot assigns documents which is also a clear process and therefore grey. In this process the robot which works for BK analyses the documents and scans for multiple aspects. For example, policy number, license plates, names or addresses. Based on this information and the metadata which was send with the document, it tries to match the document and the customer in the customer database. If it does match it will put the credit note and policy in the dossier of the customer data, and it will create or update an existing task, for the administrative department with the message that these documents have come in and need to be looked at.

If the robot cannot assign the task, the documents must be assigned manually, this is done by the reception department in the earlier mentioned temporary data store. In this data store, which is linked to the customer data, the reception department can manually find the customers. The reception department then uses either their knowledge of the customer or asks for the respective handler of this document to which insurance these documents belong. If the robot has found all the customer information but does not know to which part of the administrative department it should assign a task, it will also send the document to the reception department. If this is the case the reception department only must decide for whom to create a task. This process is also modelled in the data import process workflow models.

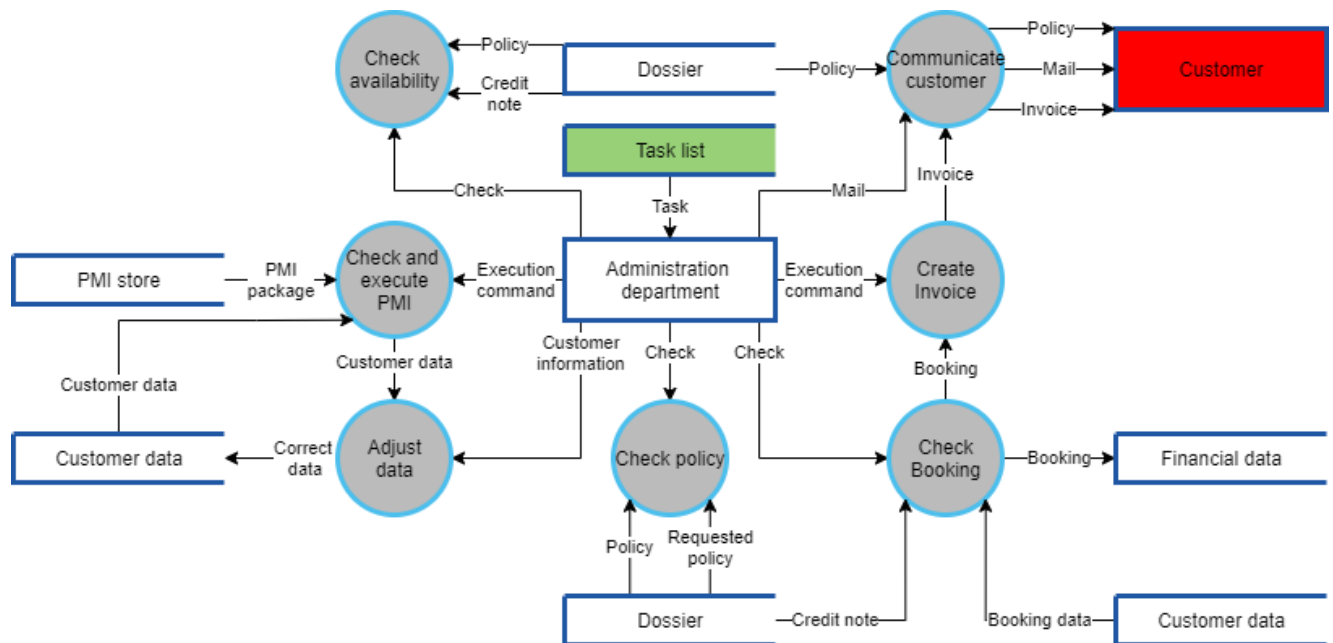


Figure 17 Level 1: Checking data

This leads us to the other process in figure 1, the Checking data process. This data flow is depicted in figure 17. We start with a task in the task list of the administrative department. In this task either the robot or the reception department noted which document has come in. Based on this information the administrative department starts with checking if all the documents are available, they therefore need both the credit note and policy. If both are available they go on to check and execute the PMI package, as already described in the workflow analysis, the same goes for the following process, Adjusting the data. Thereafter the policy and requested policy, if available, are needed to check the policy.

Thereafter we go to financials, where a booking is made using the data coming from the customer data, implemented by the PMI. This booking is checked with the credit note, and if correct an invoice is created. Then there is the last step where the administrative department communicates the policy and invoice to the customer. This is done via mail. Which brings us to the end entity of this process but also the last entity of the entire context map in figure 14.

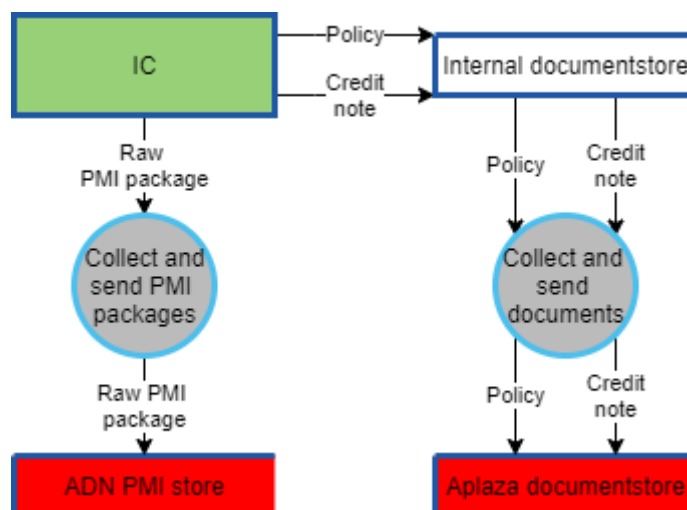


Figure 18 Level 0: Uploading data



The last of our DFD is shown in figure 18, this diagram shows the Uploading data process shown in the context map in figure 14. This process is relatively simple but can become very complicated very rapidly since IC refers to all insurance companies, and as each of these companies has their own method of communicating with the channel data stores, the diagram cannot show all this. Therefore, we have modelled the most common and most useful approach for understanding where we need to change our process if we want to change factors in this data flow. The process is simple in that both documents are stored in an internal document store of the ICs. They then transfer or create these documents in batches towards the Aplaza document store. The PMI packages are generated with these policies and are then send to the ADN PMI store. They can then be retrieved from there, this process is often executed at night, and the results are then extracted the next morning by the reception department.

From these dataflows we can see that the process uses a lot of data, but also that this data is stored in a lot of different stores. The entry points are also more than one which is also a sign that the process can be optimized more as one is the optimal amount for data entries. Using the created diagrams, we can analyze the impact of eventual solutions or coordinate where we can implement solutions, faster or better methods.

3.3 Problem analysis

We now go on to discuss the problems arising in the data import process. Via this step we can identify improvement methods for the points where the bottlenecks occur. Bottlenecks are according to the Theory of Constraints (TOC) the constraints on the throughput of a system or a process. If this process or system is optimized or improved in general it has the largest value for the entire process in comparison to other systems (Zhai et al., 2011). As already discussed in the Theoretical framework there are three theories which are suited for detecting these problems in our process. The first is the already mentioned TOC, this theory focuses solely on the least performing part of the process. A second theory is that of Lean which focuses on reducing waste which is everything that is not needed for the process to succeed. The last theory is that of Lean Six Sigma, which also focuses on waste reduction but also the reduction of defects.

In this section we will look at these bottlenecks and occurring problems in two different ways, both inspired by the earlier mentioned methodologies. In our first section we are looking at the problems occurring according to the employees of BK, which is stimulated by Lean management as it proclaims to involve everyone, especially the people working with the processes. In our second section we will have an analytic look at the process, using our earlier created workflows and DFD, whilst applying scientific theories.

3.3.1 Employee problems

Based on principles from Lean management some interviews with the employees from both the administrative and reception department are held. In these interviews we talked about the current process and the problems they felt there were or other inefficiencies, we also talked about some solutions or work around's although there were not much. The complete questions can be found in Appendix D. These interviews have been held in the period 22-4-2021 till 17-5-2021 and the process is modelled accordingly in the previous parts to the process's state in this period. The problems can be categorized in three categories: filling the data using the PMI packages, moments spend waiting, and problems regarding documents.

The first category contains all the problems which are related to filling the data in the customer data and financial data of the ERP system of BK. We will start with discussing the most often mentioned problems and work towards the least mentioned problems. The most often mentioned problem is



that the PMI package does not correctly fill the data in the customer data base. This problem is mentioned by all interviewed employees in the administrative department. When the PMI package is accepted into the customer data, it replaces the current existing data with the data from the PMI package regardless of what the old data was or if it was even filled. This is if the part of the package is not deleted from the package, which is also extra work and attention. In this new data coming from the PMI package there are mistakes such as wrong addresses and wrong coverage coming from the conditions. It also occurs that the PMI package cannot fill the data and removes the old data either way, so replacing good data with empty data. Also, the coverage and premiums are filled wrong. Often an insurance is subject to insurance taxes, however there are some exceptions. With some of these exceptions the PMI does not keep up, and it fills the values in the field on which taxes are calculated leading to the wrong summed premiums. This is the case with some special insurance options. If we look in our workflow models in figure 11, this problem thus occurs at the step of either “Accepting the PMI” and eventually “Adjusting the data” or “Negating the PMI”.

A second problem in this category is that of the PMI package not filling the financial data correctly, with this problem come two subproblems. The first and most common subproblem is that for a customer who has multiple linked insurances and there are PMI packages for each of these insurances, basically earlier explained context 4. In this case the main PMI package, so the package, which is at the insurance which caused the change, does not have the same amount of money as stated on the credit note. This is due to the discount because of multiple insurances at one IC. Therefore, there are also changes on other insurances which in turn have PMI packages which contain only small financial adjustments. If all these adjustments are booked the invoice will exist of many small amounts but the invoice will be correct compared to the credit note. Another option is booking everything on the changed insurance; however, this is administratively not entirely correct, and financially there will be some small amounts of money which are not right. The second sub problem mentioned by the employees is that of missing bookings. With some insurances when there are changes and a PMI package is received, there comes no financial data within this package, this leads to the fact that the employees must calculate the exact values manually, instead of only checking it against the credit nota. Both these problems are visible in figure 11 in the step “Check credit note and PMI booking”.

Then there is one problem left in this category which is that of the warnings received when accepting the PMI. When the PMI is accepted into the customer data the ERP gives a warning for every field which is not filled and should be filled, or for data which could not be recognized and accepted into the customer data. This amount of warnings can go up quickly and the warnings are not fast in closing. Since the customer data is checked with the policy after accepting the PMI, the warnings are not necessary as it would also be seen otherwise. This problem also occurs at the step of “Accepting or negating the PMI package into the system”.

Then there is a second category of problems mentioned by the employees of BK, these problems all have to do with waiting. The first problem in this category is also the most often in this category, it is the fact that the PMI package, the credit note, or the policy have not yet been received, whilst the other parts are in. As all three parts are often needed, the employee must wait when the other data types have not yet been imported in the system. There are multiple causes to this problem: either the IC has not sent or created the data yet, or there are problems in the channels. With this waiting comes the second problem which is the reminding of the IC. This occurs less frequent, and is done when there is nothing that comes in. In this case the IC is reminded and basically the whole process is paused for this time spent in between. Both these problems occur at the step “Check documents”, in the workflow model in figure 11.



The last three problems mentioned by the employees, can be categorized as problems with regards to documents. The first most occurring problem is the fact that there are documents which are linked to other types of data, which is unwanted. An example is when the policy document is sent over the mail instead of via the Aplaza document store. In this case the document is linked to the mail, which means that the mail is stored in the same file as the policy document. Since Bk wants to provide a high-quality service it is unwanted to send this linked mail to the customer, but they want to send the policy, document. This means that there is extra work in splitting up the document from the mail. The same goes for other documents like policies and credit notes put together in one document as well as other document types. This problem is an external problem as the problem originates at the ICs. But the problem becomes a problem at the step “Send invoice and policy to customer”, in figure 11.

Another problem mentioned by the employees is the poor process of creating an invoice. This has to do with two factors, when creating an invoice, it is important that there are not a lot of small values like it was mentioned earlier, but that the invoice is clear. But also, the creation of the invoice when this is done correctly is tedious, as the employee must leave the customer data set and must go into a different module of the ERP to create the invoice. When creating this invoice, the command given can only create all invoices which are available to be created at that moment, so if another employee is busy with financial booking it also creates an invoice for them, even if they are still combining different linked insurances and bookings, which causes issues with their invoice. This problem occurs at the “Create invoice” step in figure 11.

The last problem mentioned by the employees is that of differences between ICs, which is also part of the category documents. There are ICs which have very detailed credit notes whilst there are other ICs which have barely any information on the credit note. The same goes for other documents where sometimes even the customer information is left out, which makes linking harder. The differences between ICs, also makes that there are a lot of different working methods per IC between employees. This problem occurs at multiple places in the process as it happens at the steps “Assign documents which could not be matched manually”, and the steps “Check policy with customer data and requested policy” as well as “Check credit note and PMI booking”.

All the 10 problems are summarized and numbered in table 4. As can be seen most of the problems occur at the administrative department steps. The process for the reception department is already very efficient except for problem 10. Another conclusion is that there are a lot of problems at the steps which involve checking or occur at checking steps in the process.

Table 4 Employee problems

Nr.	Category	Problem	Step	Department
1	Filling data	Wrong filling of customer data by PMI	Accepting the PMI	Administrative department
2	Filling data	Wrong filling of coverage data by PMI	Accepting the PMI	Administrative department
3	Filling data	Linked insurances require PMI acceptance	Check credit note and PMI booking	Administrative department
4	Filling data	Financial data is missing in PMI package	Check credit note and PMI booking	Administrative department
5	Filling data	Many warnings whilst accepting PMI	Accepting the PMI	Administrative department
6	Waiting	Not all documents and PMI packages are in	Check documents	Administrative department
7	Waiting	No data is received	Check documents	Administrative department
8	Documents	Documents are linked	Send invoice and policy to customer	Administrative department / IC
9	Documents	Creating an invoice is inefficient	Create invoice	Administrative department
10	Documents	Differences between ICs.	Assign documents which could not be matched manually / Check policy with customer data and requested policy / Check credit note and PMI booking	Administrative department / Reception department

3.3.2 Problems according to TOC and Lean six sigma

We now analyze the process using the earlier created workflow and data analysis. For this we use the earlier described TOC, Lean and six sigma methodologies. We analyze in the same order of methodologies, starting with the theory of constraints. We start with the logistics in our process. In our case this is the logistics of the data and documents. Some problems already mentioned by the employees earlier are subject to the constraint of logistics, as the problems mainly in the category waiting so problems 6 and 7 are problems caused by poor logistics between the parties in the chain. According to Inman et al., (2009) buffers can help with increasing the logistics of an organization. At BK there are no real buffers available as it is also hard to implement since each data item is unique, however the task list does function as a buffer with the reminder task, as that determines the deadline of data availability and so can operate as a buffer, in that a longer deadline increases the buffer.

We then go on to the second aspect of TOC, which is performance measurement. This part of the theory of constraints focuses on throughput so the rate at which the process can be executed. It focuses on measuring the time spent on the different activities in the process and finding the poorest activity. In collaboration with employees of BK, we found that most time is spent on correcting the data after the PMI is accepted in the system together with executing the multiple bookings if there are linked insurances. However, no new problems are found using the performance measurement aspect.



The last aspect of TOC is that of the thinking process and problem-solving methods. An interesting problem occurring from here is that of the differences between the employees of BK. As employees from the administrative department have different approaches or skip steps whilst others execute these steps. An example is a small difference in when the PMI package is checked, as there is a special pop-up screen available which compares the data from the customer data and the PMI data, some employees check the PMI in here, whilst others just accept the PMI and check the now overwritten customer data. As there are different methods at the employees, there is still room for improvement in the thinking process of the concerned employees as one method is better than the other. There are also some differences between the parts of the administrative department. As the private department works with less IC types and more often invoicing which is done by the ICs themselves, the process also consists of shorter checks than the corporation department.

Now that we have addressed the range of problems which could be discovered through TOC, we move on to discuss the problems if we use the lean six sigma methodology. We will discuss the seven wastes proposed by Skhmot, (2017), included in these 7 wastes are the defects proposed by six sigma.

We start with transport, which introduces the principle that each time a product, employee or other object is transported further or more than necessary it is waste and should be eliminated. Generally, in administrative process, this entails those employees who work together often, should be close together. In our process this is however not the case, but a point of transport is the transferring of data between ICs and BK. In the process there are multiple ICs which are considered for the data import process, which in turn causes a lot of transportation of for example quotations, whilst only one quotation is chosen. Although this is part of the independent service of BK, it would cause less transportation or issues with transportation if less ICs are considered (Patel & Patel, 2021). However, this is not considered as a viable option due to the nature of insurance broker BK.

A second waste is that of inventory, when inventory of products is more than necessary there are higher chances on defects as well as overproduction. In an administrative setting this is tasks that need to be worked on, but are currently on a stockpile for example, or customers waiting for service. But another perspective is that of unnecessary data in a database which is not used. In our case this points out the problems that there are raw data fields which are not used and are therefore unnecessary. There is also a problem with tasks which stay in the task list for too long, this is however more of a workload problem, and is being fixed by increasing the workforce size as well as creating a more efficient process which delivers time for these tasks.

A third type of waste is that of unnecessary motion. Waste in motion is the unnecessary movement of people, objects or equipment. So, for example the exiting and reopening of a menu in an administrative context. In the process of Bk, a very clear problem and waste in this process is that of invoice creation, where the employee must exit the customer data module of the ERP, to enter a completely different module for the creation of the invoice, and then must return to the customer data to get access to this created invoice. This was already mentioned by employees in problem 9. This process requires a lot of motion which can be reduced through for example straight through processing options. Another problem which is discovered through waste is the lack of bulk options, an example is the acceptance of multiple PMI packages in linked insurances. Currently this is done through opening each insurance and executing the PMI separately. Another bulk option would be helpful in deleting the PMI packages which could not be matched to insurances and are therefore defects. We will discuss defects later, but each of these packages can only be deleted per 1, however there is no need to check what is deleted, which makes deleting this a wasteful tedious task.



The fourth waste is that of waiting, which involves people waiting or equipment not being used. A big issue already mentioned by the employees is obviously the waiting on the insurance companies. On other aspects like when the packages or documents are in the tasks are relatively quickly in the task list of the correct department. However as also already mentioned when tasks stay in this task list, it is also a type of waiting waste, so problems 6 and 7.

The fifth waste identified through lean six sigma is that of overproduction, which is producing more products than needed. Or in the case of administrative processes this is delivering more services than that are asked for, for example creating reports which are never read. In the case of the data import process and its contexts a problem occurring from here is the times of data filling, which is done in this process. At least 3 times in the process some data is filled in, with a large chance of even more times due to quotations. This is all not necessary if there is integration between the data filling points (Sukwadi et al., 2021).

The sixth waste is all about over-processing, which is producing higher quality than is needed. In an administrative environment this entails creating a more detailed report than needed, but also having an extra step in a workflow which does only add value which is not required. In the case of BK some problem with overprocessing is the checking of the PMI as already mentioned in the problem signaled by TOC. As you can check the PMI but accept it either way. The check does not add any value as you still must change it afterwards. The same goes for keeping a reminder task, if the task is never needed to remind, than it is wasted effort.

The last waste coming from lean six sigma is that of defects. Defects refer to all products which are not of high enough quality, or in an administrative environment, reports which are not of quality, data which is unusable etc. In the case of BK, the already mentioned PMI packages which could not be matched to an insurance are a type of defect. These defects are already kept out of the process and stored in a separate database; however, they still need to be deleted. Another defect is that of errors in the documents as already mentioned in problem 8 by the employees. There are obviously also other defects in the process like typos and miscommunication, however these problems can be solved whilst solving other issues like better integration between the parties and the systems. Therefore, we do not see them as key problems (Patel & Patel, 2021).

This analysis using the theory of constraints and lean six sigma, leads us to 7 additional problems which are visible in table 5, with the additional information of department and step in the data import process, as described in figure 11. Also, here we can see that most of the problems are oriented at the administrative department and the checking part of the data import process.

Table 5 Problems from TOC and Lean six sigma

Nr.	Methodology	Problem	Step	Department
11	TOC	Differences between employees	N.A.	Administrative department
12	Lean six sigma – Inventory	Data fields which are not used	Accepting the PMI	Administrative department
13	Lean six sigma – Inventory	Tasks staying in the task list	N.A.	Administrative department / Reception department
14	Lean six sigma – Motion	Lack of bulk options	Accepting the PMI, PMI deletion process	Administrative department
15	Lean six sigma – Overproduction	Times of data filling	Accepting the PMI, Adjusting wrong data, Update customer data in ERP (Figure 9)	Administrative department
16	Lean six sigma – Overprocessing	Extra process steps	N.A.	Administrative department
17	Lean six sigma – defects	Not matched PMI packages	PMI deletion process	Administrative department

3.4 Conclusion current process analysis

Now that we completed our current process analysis we can conclude several factors. We first started by modelling the workflows of the administrative and reception department in the data import process, but also in the contexts that we discovered. We discovered four contexts when the data import process is executed, these are visible in table 2. From there we modelled our process in figure 11. From these workflows we get a clear overview of the steps undertaken in the process as well as some initial problems occurring in the process, and how they are handled.

The second part of this analysis is the analysis of the data flows in this process. We first modelled the current data structure in the company and for the external parties involved. We then modelled the data flows in the process using data flow diagrams. From here we can see that there are a lot of databases put into use, as well as all types of data that is being used, or at least being send. Also, there are multiple parties involved in this process, which leads to more difficult communication.

In the last part of our analysis, we look at the problems that we identify in the process, which cause the inefficiency of the process. We do this through two methods. First we discuss the process with the employees active in the process, from here we discovered 10 problems, mainly coming in the steps executed by the administrative department. These problems are visible in table 4. We then used the theory of constraints and lean six sigma management methodologies, to identify 7 other problems, which were more globally oriented, but were also largely oriented at the administrative department. These problems are available in table 5.

Overall, it can be concluded that the process has become complex in time and is subject to becoming more complex in upcoming years, if nothing is done about it, therefore there is the need to act now. There are several problems in the process steps and also in the data flows associated with the data import process. There are problems in wrong data being imported, errors in documents, waiting on documents or processes, differences between different entities and the lack of quick bulk and STP options. From this analysis we can work further to focus our research on improvement methods and solutions for these problems in the upcoming chapters.



4 Improvement methods

We now go on to discuss the improvement methods which we can use to help solve the problems discussed in the previous chapter. We look at methodologies as well as solutions. In this chapter we have three sections in which we discuss best practices, straight through processing (STP) and solutions through the chain. We then use some improvement methods in the next chapter. In this chapter there are two key terms, first is that of best practice. Which is a methodology used by other companies or branches which works good for these parties. We can use principles and ideas from these methods; however, we can often not apply them directly to our chain. The second key term is that of solution, these are ideas which can directly help in solving or reducing our problems, they can directly be applied in our chain.

4.1 Best practices

We start with discussing the best practices found in literature and in the comparable branches. The approaches taken in the other practices are not necessarily best practices, but they do show several advantages and disadvantages of different approaches, which can when combined lead to some best practices, or other useful insights. We do this through looking at two lenses, we start with literature and then use benchmarking and observation for best practices in the branch.

4.1.1 Best practices from literature

A first best practice which has already been applied to a lot of processes in this branch and which even has its own specialized organization in the insurance branch, is that of standardization. Standardization in the insurance branch is often coordinated by the organization SIVI in the Netherlands. Standardization can be applied on multiple aspects, we will discuss several opportunities, which can be helpful for solving the problems in our process.

The first kind of standardization is the standardization of products, or in our case of insurances. This is already in an advanced state in the Dutch market. There is still a large difference between the private and the corporate section of the market, as corporate insurances tend to lean more towards specialized insurances rather than standardized products. The further standardization of insurances is therefore hard, and the disadvantages of standardization must be considered. The first is the complexity and size of the market. The market is regulated by big insurance companies for which standardization has become a regular procedure. However due to the different sizes and the amount of these companies, there are a lot of factors to be considered for a standardized market (Odinkova & Dvoryadkina, 2020).

A second form of standardizing can be seen in communication between the insurance companies and the intermediaries. This standardization is currently done through the SIVI koppelingsprotocol. This standardization method creates a format through which the insurance companies must communicate data to the intermediaries. Through this method, the data can be imported by a standardized process, with the ERP systems of the intermediaries. The PMI packages are currently also sent with the same methodology. The channels Aplaza document store and ADN PMI store are both created from this methodology (SIVI, 2021).

Standardization can also come in a third form in standardizing processes. This is often done through automation and procedures. Standardizing the process of data importing can for example solve the issues of the differences between the employees and the eventual other questions that (new) employees have in the process. With this standardization of processes also comes the standardization of data. And so, it also influences both the earlier types of standardization as all three are dependent on one another. With the standardization of data it is easier for further



digitalization in processes, communication and insurances, which in turn can help speed up processes and procedures (Digitect, 2021; Odinkova & Dvoryadkina, 2020).

A second series of best practices can be found in communication. Communicating effectively and efficiently, has a positive impact on the chain connection in the whole chain. We can distinguish two types of communication: internal communication in organizations and external communication between organizations. Communication has a direct influence on employee satisfaction and other human resource KPIs, which in turn have together with effective communication an impact on chain integration (Jacobs et al., 2016). As already mentioned the chain is becoming more complex with all the insurance companies and channels which means we are currently in a many-to-many communication system between the intermediaries and the ICs. This means communication is also becoming more standardized and automated for bulk processing as already briefly mentioned earlier (Peltier et al., 2020). Also, internal communication at BK is becoming more important as the company has doubled its size in the last 5 years, thereby also becoming many to many communications between the departments.

A first best practice to discuss in communication is that of chatbots: an example of automated responses and the implementation of artificial intelligence in the form of communication. An example is the use of artificial intelligence in the financial markets by IC but also financial broker Allianz. They have trained a robot which can evaluate the best investments and can identify risks, through forecasts and calculations (Allianz Global Investors, 2021). With this predictive robot also comes a communicative chatbot which functions as advisor for customers and employees of Allianz. In the insurance industry such technologies are not yet present on this scale, however as the industry is closely related to the industry of financial markets, we can learn some lessons from this transformation towards digital technologies. Also, in the insurance industry there are already chatbots available, however acceptance and sending of data is often done by employees of the ICs, or these messages and documents are at least checked by employees (Verbond van Verzekeraars, 2020). Working with bots and AI also brings some new concerns, as people want to know if they are talking to another human or a robot, this information also must be provided. Another issue is in the abstract sense of thinking of a bot, it is difficult to take emotion in consideration. A major benefit of these bots is the reduction of waiting time for the employees of BK, as they can provide access to for example information on status or direct access to the requested documents. However, the major benefits of these chatbots are their multifunctionality which is not that useful in this process, but is more useful for example the end customers, as the employees of BK already know a lot of this information. Also, implementation of these bots is hard, as they need to be implemented by ICs.

Another best practice in communication in a service market is that of relations between parties. In an optimal situation all the parties can fully trust each other, which in turn will stimulate respect and friendship (if possible). Another major benefit of strong relationships is the joint solving of problems. Also, here is external and internal communication. As we can look at trust between ICs and BK but also trust between the administrative department and the reception department or between the administrative department and the ERP system. If the ERP system can correctly handle the incoming data, the employees can trust the ERP and the checks are less needed, creating more time for other processes. To create this trust, we need to improve the ERP system though, which we will discuss in part 4.3.

A last best practice to discuss has to do with the so-called smart contract. The European Union has recently addressed this innovation in the international insurance markets. The smart contract is one contract which contains all types of information and bindings. It is fully digital and so is easy to keep up to date. A smart contract is based on blockchain technology, which is a developing technology.



This blockchain technology represents a person's database and keeps tabs on digital information flows and stores this information which is openly available then. It builds these so-called blocks, which it can also terminate. The smart contract is such a block and can therefore be integrated in this technology. The advantage of this integration is the availability of data in the blockchain, which allows for quick calibrating and communication between the insurance companies, the customers and the intermediaries. This innovation is however still in development as it is not yet secure enough and not fully implementable yet due to ethical issues as well as legal issues (DLA Piper, 2021; Gatteschi et al., 2018). For BK, this innovation would change the entire process, thereby eliminating issues such as accepting the PMI, as these are now integrated from the blockchain rather than from the ICs. This could however introduce other problems like privacy. However, the costs of implementation are high, and implementation should be done in the entire chain and is therefore hard.

Overall, we distinguished four best practices from literature which could help us in creating an optimal solution for the problems that occur at BK. These best practices are also visible in table 6.

4.1.2 Best practices from the branch

We now look at best practices which are applied in the branch already and not only from literature. This is done through internet research, and an interview with an employee of branch organization Adfiz, which is available in Appendix D. We will first discuss a similar process between insurance companies and the other type of insurance intermediaries: insurance agents. The difference between the two types of intermediaries was already briefly explained earlier. In short an insurance broker like BK represents the customer and is independent of any insurance company, whilst an insurance agent is linked to an IC and represents that IC. The advantage for insurance agents is that they can also bind a contract like an insurance, whilst brokers are not allowed to do that.

Due to this more connected relationship between the ICs and the insurance agents, and the limited amount of ICs and agent works with, there is often a better integration between the two parties, also on the front of data transferring. Insurance agents can directly work in a system designed by the ICs for such agents, since they can accept and make a quotation at the same time, this process is very efficient. Which makes the first context already more efficient, as insurance agents often work with less ICs, the data is also more constant and has therefore less problems due to variance between ICs. However, there is no option for BK to reduce the number of ICs to work with as this will lower the customer value. We can however learn from the process especially on the front of data filling, as currently there are multiple points of data filling in our process whilst in the process of insurance agents, the data is directly filed in the IC system allowing only one data filling session.

Another best practice from the branch can be found in the previous approaches which were used before the current process. One of these methods is the system known as Postex, which is still used for certain sensitive documents, as the service is very secure. Postex operates in the principle of a digital portal. The ICs place a document in their side of the portal, the insurance broker then receives a message that there are documents waiting for him in Postex. From there these documents can be downloaded. Although this process may be more secure it also has a lot of limitations as there are a lot more tasks than using the Aplaza document store. It can also only send documents and not handle PMI packages. Additionally, implementation needs to come from ICs.

The same goes for another used option which is using the mail systems, this also lacks from being unable to receiving PMI packages. Mail is not used a lot anymore for data communication, only in exceptions like if a policy was not sent via Aplaza and was only sent after special request by BK. Mail is not suited for the batch mail as importing into the ERP system is a manual task and is therefore not



suited for bulk options. However, communication is quick and there is the possibility to add a message with for example explanation.

A last best practice from the branch we look at is the system of other ERP providers, as these play a big role in handling the packages and document, as they create the internal infrastructure for handling. All the major ERP providers use Aplaza as their main connection for document communication with ICs. Some software providers state that there is the possibility to eliminate data filling in IC portals and that the ERP can communicate from the broker to the ICs through Aplaza. This shows a further integration with the ICs through Aplaza (Dias Software, 2021; Faster Forward, 2021). There are also possibilities for extracting data directly from an IC into the ERP systems, which allows for example data entry at the quotation stage (Anva, 2021; Nationale Nederlanden, 2020). These integrations allow the ordered sending of PMI packages in the system, which will eliminate some of the problems regarding data filling but will still contain problems if the data is not correct or fully available.

Other views from the ERP providers are that of automated PMI package acceptance. Whilst some ERP software allows the use of macros and others the use of AI for this task, there does not seem a consistency where all the options are used to its full potential. As the automated versions are still subject to error if the package does not contain the correct information. This may occur due to the paradox of the first mover advantage, which has its benefits but also major cons (Deloitte Consulting, 2017).

Overall, there are several practices which can be experienced as best practices, or from which some core principles can be taken to solve our problems. A complete overview of these best practices is visible in table 6. For full disclosure, there are several other best practices which could be considered but are not evaluated due to time constrictions.

4.2 Straight through processing

We now look at the possibilities for Straight Trough Processing (STP). We first dive deeper in the core principles of STP, and the impact it has made on other industries. We then look for the possibilities in the current situation and in the ideal situation.

Straight through processing is a term coming from the banking industry. In short STP is a service which allows customers to interact with the company fully automatically, so without human intervention from the side of the company. STP is "Processing a business trans-action automatically, without requiring people to be involved in the process. The purpose of STP is to create efficiencies, eliminate mistakes, and reduce costs by having machines instead of people process business transactions." (Schabell & Hoppenbrouwers, 2009, p. 19). As can be seen STP also entails some parts of the lean six sigma lean methodology in eliminating defects. There are some important factors regarding STP, as communication with a customer is also standardized, it is important to know what the service is going to communicate and when it needs to communicate what information. Additionally, not every process can be resolved with the use of STP as some complex tasks require human thinking and handling. This can however be solicited by the STP service, with information on which the service could not handle or where an error occurred.

STP has thus been applied frequently over the last years in the banking industry. Every major bank in the Netherlands has STP services implemented in their processes. An example of STP in the banking industry is visible in the process of transactions between banks, which is fully automated. Other instances where STP is applied is in the brokers industry, with brokers we mean broking in shares and obligations, which can also be done by banks, but can be seen as a separate industry. In this industry



it is used to buy or sell shares for example. This process can even be helped by artificial intelligence on deciding when to sell or buy. A last industry in which STP is used more often over the last years is the insurance industry, of which BK is a part. However, STP is currently mainly used at big ICs, in the very standardized processes like the acceptance and underwriting of individual life and damage insurances as well as some private claims. For more complex insurances like corporate insurances, STP is not yet applied. This is because STP is very efficient when four conditions are met (Harry Huberty, 2021):

- The risks in the process are fully discovered
- There is a large availability of data, which is reliable
- There is a major need for speed
- There is a major need for cost reduction

The risks in corporate processes are still a bit unclear as well as the lack of data.

We can apply these four principles to our data import process, as the risks are fully discovered in the analysis in chapter 3. There is a large availability of data, which is mostly reliable, and there is a major need for speed and higher efficiency. Using STP we can eliminate certain steps in our workflow, as we can mass accept PMI packages, which could also include checking data against customer data, which is already done by the system, but which is not used, due to inconvenience. This would reduce a large step in the process, as well as all the problems which occur at that step. In addition, if there is an error the task list can be used for notifying the employees of potential or real errors, and the process should still be available for manual accepting. Another part in which STP can be used is the creation of invoices, as a large part of this process is already STP however, there is still the need to manually trigger this process in a separate module, which could be eliminated and eventually be done in batches, which would entirely remove the need for invoice creation. Another part where STP can be applied in the current process, is at the sub process of PMI package deletion, where the packages which are not matched are deleted. In an ideal situation the packages are instantly deleted if they are not matched, as there are no matching procedures after initial matching, and they are therefore useless. Also, here a task list can be used as a place to send errors.

In our current system there is also some small use of STP services, especially at the reception department, which uses the robot to import and match documents, as well as creating tasks. This robot also has a sort of error list in the form of a task list, which is separate from the ERP task list. Here the error documents can be matched manually.

In an ideal situation, an even larger part of the process could use STP services, however, currently there is not the possibility to realize this. In this situation, the employee would put a request for a policy out and from here the process will become, STP until the moment that every piece of data is in, as well as every document including the invoice, belonging with the request. Now the employee only must check the policy against the requested policy and the data, and check the booking and invoice, if this is correct everything can be communicated at once, which reduces the amount of waiting and allows, a two-tasks process instead of a multiple tasks process. To realize this the system needs to be redeveloped to allow STP services to be implemented. In this system it should also be possible to easily adjust bookings and invoices, to keep it to a two-step process.

Another implementation of STP can be found in real-time connections between the ERP system and other systems which are also used by BK. Take for example the certification portal for car security, which is used in the customer adjustment context. If an STP connection for the information between these portals is established, the employees of BK do not have to access the other portal, if the real



time information is available directly in the ERP. There are several of these portals which can be integrated with the ERP for easier use.

Overall, there is a lot of potential for STP to be applied, even in more complex situations. In the current process, there can be small steps which can become more efficient through STP. For the full potential of STP, the current system needs to be reshaped together with the ERP.

4.3 Chain solutions

We now discuss solutions which are already present in the chain but not used at all or not yet used to its full potential. To get an insight in these solutions and the accompanying problems, an interview is done with an employee of the branch organization Adfiz. The interview is available in Appendix D. Other methods which are used are observation and communication approaches with the ERP provider. We will first discuss the possibilities of the current ERP system used. Thereafter we discuss the solutions in the chain, proposed and managed by the branch organizations.

The current ERP provider has some possibilities which can help in solving some problems or at least lessen the impact of these problems. A first feature is the customizability in the raw data. In the current ERP application BK can choose themselves which data labels to show to the employees. And obviously the labels that are not shown will not be checked, this can help reduce the time to check. There are also translation matrices in the application, these matrices determine in which data label the information from the PMI packages is placed. These matrices can be adjusted with the help of the ERP provider.

Then there are also some solutions with interoperability in the ERP application, as work methods can be changed towards more bulk tactics, like working in batches, with for example accepting the PMI packages in batches, thereafter, checking in batches, thereafter, creating the invoices. For most of these steps there are (semi-)bulk options available in the current application.

The ERP application is also developing a new ERP system, to which it will upgrade in relatively short time. With this new development there is also a lot of room for laying new infrastructure and integrating new work methods. It is important to keep the good working features and solve the problems in this new application. The key to this development is communication with the ERP provider and expressing the needs and wishes, not only on this process but also other processes.

In the chain there are many diverse processes at different ICs, therefore the GRS protocol has been introduced by branch organization SIVI, which is responsible for standardization and communication in the chain. In this protocol SIVI describes how documents should be communicated with Aplaza, for a successful integration with insurance brokers. In the protocol is also determined which metadata should be in or send with a certain type of document. Unfortunately, this protocol is not followed strictly by all the ICs. To address this at the ICs, Adfiz and SIVI have created an information and complaint point. They hope to gather data on the type of complaints on documents, and with this data they will address the companies and instruct the ICs where they can improve their document flow. The most common mentioned complaints are:

- Wrong specification of type of document
- Not receiving any documents
- Lack of correct lay-out
- Combining multiple documents in one



Some of these problems can also be recognized at BK. It is therefore encouraged that employees of BK also help filing these complaints, to help provide the data, and bring change at the ICs. As changing the behavior of ICs from only the perspective of BK is hard, due to the difference in size.

An issue with the GRS protocol is that itself is also still lacking some small parts. These parts are applicable for intermediaries which use intermediary finance collection. This means that the intermediary will collect the money from their customers rather than when the IC collects the money directly from the end customer. BK is an intermediary which falls in this category, and therefore also has the steps of creating the bookings and invoices. The GRS protocol still lacks on what information should be in the credit notes, and how this information should be formatted, as there are different inconsistencies amongst ICs, as already mentioned in our company specific problems.

Adfiz is also planning to introduce a certification for the ICs. With this certification the ICs are using the GRS protocol completely as they should, to keep this certificate, Adfiz can check the ICs. The certificate will therefore function as a type of controller and motivator from Adfiz, which represents the insurance brokers, also BK, on the ICs.

4.4 Conclusion improvement methods

To conclude, there are several improvement methods available against the earlier found problems. There are improvements available from best practices in the insurance branch but also other branches like financial branches such as banks and accountants. From these branches we can see that principles of Straight through processing, can help solve many problems focused on waiting. Another aspect is that if further chain integration and optimization of communication, which allows for less errors and also less data filling. Other improvements are available at the ERP application, as there is currently the development of a new ERP application which allows the introduction of several improvement methods, such as updating import matrices and reshaping processes. This also shows the need for the use of APIs for further integration not only in the insurance chain but also connections to other chains like car dealers, and banking for example.

Additionally, the entire process can also be reshaped to the needs of BK, however this will come with issues of integration with other parties in the chain, which will make integration even harder than it currently is. However, if the branch organization spikes such an initiative in reshaping this process at multiple intermediaries, for example shifting more towards a similar process which is more efficient as used at the insurance agents, this change could be beneficial for the entire chain. Additionally, one could look at further integration with for example government portals, damage repair companies and banking companies, so becoming more of a service provider rather than an insurance intermediary. However, in this research we will not focus on reshaping the entire process for the chain, only on the current process at BK and making this process more efficient through chain integration and internal process upgrades.

5 Selecting an improvement method

Now that we are aware of several improvement methods we need to select with which improvement methods we want to work further. For this we first create an overview of all the methods in table 6, in this table we show the methods with the most potential. We also show the owner of the method meaning with whom BK needs to cooperate to implement the solutions, this has an influence on the accessibility of the improvements. We also address with which problems the method can help, this is based on either the principles of the best practices or the effects of the solutions.

Table 6 Overview of improvement methods

ID	Method	Solution/best practice	Method owner	Helps deal with problem(s)
a1	Standardization	Best practice	BK	1, 2, 8, 11, 13, 15, 17
a2	Automation via chatbots and messages	Best practice	IC	8, 16
a3	Relationship building	Best practice	BK	4, 6, 7, 10, 15
a4	Smart contracts	Best practice	IC	1, 2, 3, 4, 17
a5	Postex	Best practice	IC	6, 10
a6	Two-way Aplaza connection / integrated data filling	Best practice / solution	Aplaza, ERP provider, IC	1, 2, 10, 15
a7	Bulk options / STP application	Best practice	ERP provider	1,2, 3, 5, 8, 9, 14, 16, 17
a8	Update translation matrices / ERP data fields	Solution	ERP provider	1, 2, 11, 12, 13, 16
a9	Stimulate GRS protocol	Solution	Adfiz, SIVI	6, 10
a10	Update GRS protocol	Solution	SIVI	6, 8, 10
a11	Certificating documents and flows	Solution	Adfiz, SIVI	9, 10

We now start with selecting an improvement method, but rather than choosing one method, we create a priority list. With this priority list, we can create action plans in the next chapter, in which we can describe the actions BK can undertake to reduce the problems. For this prioritization we use the Analytical Hierarchy Process (AHP).

The analytical hierarchy process is a system commonly used for decision making. It contains three key terms: the goal, the criteria and the alternatives. It was developed by prof. Thomas Saaty in the 1970s. The AHP relies on relative scores between alternatives and criteria. These relative values are displayed in absolute numbers, allowing a calculated approach. The structure of the AHP is also modelled in figure 19, showing the relations between the three key aspects. The AHP uses a numerical scale of 1 to 9 for these absolute values. Where 1 signifies equal importance and 9 represents significantly more important (Henrique et al., 2018; Saaty & Vargas, 1980).

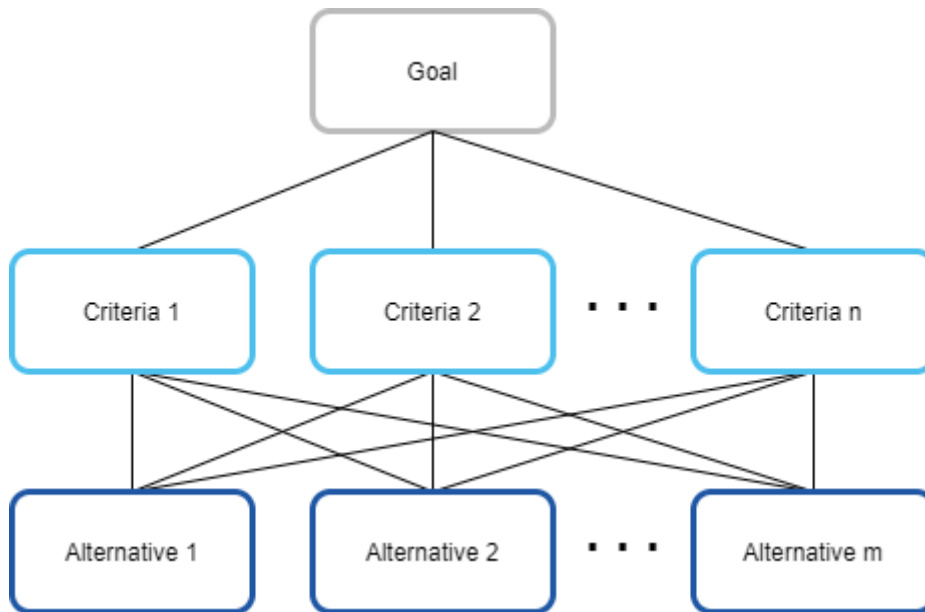


Figure 19 Structure AHP

The goal of the AHP is already determined as dealing with the problems which we found in chapter 3 with the improvement methods found in chapter 4 as efficiently as possible. To execute the AHP there are four steps for a successful execution:

1. Determining the criteria
2. Pairwise comparisons
3. Consistency checks
4. Calculating the results

5.1 Determining the criteria

First is determining the criteria. For choosing a solution we take three criteria into account, these are summarized in table 7. First is the criterion “costs” which represents the costs of implementation and the costs of maintaining the improvement method. A second criterion is implementation, which contains the ease of implementation and the time of implementation. So is the improvement available on short term or more over a long term. The last criterion is the expected efficiency of solving the problems. This criterion measures the impact of the improvement on the found problems.

Table 7 AHP criteria

ID	Criteria
C1	Costs
C2	Implementation
C3	Expected efficiency of solving

5.2 Pairwise comparisons

In the second step we will be comparing the alternatives, with each other on each separate criterion, as well as compare the criteria with each other. We do this using earlier proposed 1 to 9 scale. A full overview of the calculations and the values is available in tables 17 – 20 in Appendix E. The weights of each of the options is determined through normalizing the sum of the rows (Hassan, 2013; Pyzdek, 2003). The pairwise comparison values are based on subjective estimation and analysis.

5.3 Consistency checks

The third step is that of the consistency checks. We do this check through transforming the pairwise comparison matrices into standardized matrices. Thereafter we take the average of each alternative of the standardized matrix. Thereafter we multiply each of these averages with the sum of the columns in the pairwise comparison matrix. We call this the ratio.

$$\text{Ratio} = \sum_1^{11} \text{pairwise comparison (column)} * \frac{\sum_1^{11} \text{standardized matrix (row)}}{11}$$

The standardized matrices and the ratios are available in tables 21 - 24 in Appendix E. We thereafter use these ratios to calculate if the pairwise comparison matrix were filled in consistently. For this we calculate a consistency ratio for each matrix, the matrix is considered consistent if the consistency ratio is below 0,10. For this we first sum the ratios of each standardized matrix, and we then calculate the consistency index with the following formula.

$$\text{Consistency index} = \frac{\sum_1^{11} (\text{Ratio standardized matrix}) - \# \text{ of alternatives/criteria}}{\# \text{ of alternatives/criteria} - 1}$$

The value of “# of alternatives/criteria” is dependent on which matrix is considered. If the matrix compares alternatives this number is 11, if the matrix compares criteria this number is 3. The last step for calculating the consistency ratios can be described with the following formula.

$$\text{Consistency ratio} = \frac{\text{consistency index}}{\text{Random consistency index}}$$

The random consistency index (RCI) is a consistency index predefined by Prof. Saaty, through checking the consistency in a perfect matrix taking all the scale values (1/9,1/8,...,8,9) into account. The RCI is dependent on the number of variables considered. The random consistency index as well as the corresponding consistency ratios are available in table 8 and table 25 in Appendix E (Piantanakulchai, 2003).

Table 8 Consistency ratio calculation

Criteria	Consistency index	Random consistency index	Consistency ratio
Pairwise considering C1	0.07	1.51	0.05
Pairwise considering C2	0.09	1.51	0.06
Pairwise considering C3	0.06	1.51	0.04
Criteria comparison	0.01	0.58	0.02

As can be seen each of the ratios is below the preferred 0.10 showing that our subjective filling of the comparison matrices is consistent, and that the results are internally validated (Evoledu, 2020; Pyzdek, 2003).

5.4 Calculating the results

We then go on to the fourth and last step of the AHP, which is calculating the results. To do this we take the weights of each of the criteria and multiply this with the value which an alternative scores on this criterion, we call this the conditional weight of an alternative. Each conditional weight of an alternative is then summed for all three criteria, showing the final AHP values for each alternative. The calculation of the conditional weight of an alternative is done with the following formula.



Conditional weight of an alternative

$$= \text{weight of an alternative on a criterion} * \text{weight of a criterion}$$

The weight of an alternative or of a criterion comes from the comparison matrices and are summarized in table 26 in Appendix E.

$$\text{AHP value} = \sum \text{Conditional weight of an alternative}$$

5.5 Conclusion selecting an improvement method

To conclude this chapter, we look at the results from the analytical hierarchy process. The results are available in table 9, with the conditional weights of each alternative and the AHP values, as well as the rank coming with this AHP value. The AHP values are rounded, however, the ranking is determined using unrounded numbers. The notation from tables 6 and 7 are used.

Table 9 Results AHP

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
C1	0.03	0.01	0.03	0	0.03	0.03	0.01	0.07	0.01	0.01	0.01
C2	0.01	0	0.02	0	0.02	0.02	0.01	0.03	0.01	0.01	0
C3	0.06	0.02	0.03	0.02	0.05	0.09	0.12	0.1	0.03	0.03	0.06
AHP value	0.11	0.03	0.09	0.03	0.09	0.14	0.14	0.21	0.05	0.05	0.07
Rank	4	10	5	11	6	2	3	1	9	8	7

As can be seen alternative 8 comes best out of the test, due to high scores on costs and efficiency of solving. Second and third are alternative 6 and 7 respectively, both also scoring high on efficiency of solving but scoring a bit lower on costs. Alternatives 2 and 4 score very low compared to the other alternatives and are therefore considered not suitable in the following action plans. We will use this ranking in creating our action plans and advise for solving the problems in the next chapter.



6 Implementing solutions

In this sixth chapter we discuss the possible action plans that BK can undertake to tackle the problems occurring in the data import process. For these plans we make use of our previously gathered knowledge on the current process and the improvement methods which can help deal with the problems. We discuss three action plans, a plan for the short term, a plan for the long term, and a plan for the chain. The indication of time it takes to execute the improvement methods is based on the research in chapter 4 and on the solution owners described in table 6, as certain problem owners are directly influenced by BK, and some are relatively far away. If there is more influence of BK on the improvement owner, the improvement is easier to implement and often quicker to implement due to shorter connections.

6.1 Short term action plan

For the short-term action plan, we look at the improvements which can be accomplished within a relatively short time plan. In our research we determine 3 months as a relatively short time span, longer than 3 months is considered a long-term solution. In this plan we go in order of priority of the improvement methods.

The first short term improvement method to implement at BK is improvement method a8: Update translation matrices / ERP data fields. This solution is the easiest to implement in the current process at BK, as also shown in the AHP in the previous chapter. The updating of the translation matrices can be done by the ICT department of BK in coordination with the support desk of the ERP provider. First there is a need for an analysis of the current translation matrices and where the errors are thereafter these errors can be resolved by updating these matrices. Additionally, it is good to analyze all the incoming information with the PMI packages as it is possible that some information is sent by the ICs but is not put in the ERP system yet. To implement and start this process there is only a need for coordination with the ERP provider which should be straight forward.

A second part is updating the data fields, this has already been done partly as the data fields for most insurance types are already checked on relevance previously. To execute this improvement, the ICT department can show or not show the data fields in the ERP system, which can reduce time spent on checking empty or not necessary data fields. This process is especially important for the coverage data as, these fields are inconsistent and still need updating. This process is relatively straight forward and is already known by the ICT department, making full use of the customizability of the ERP system. This method can be executed by the ICT department solely, which allows easy implementation. This improvement method helps solve the wrong filling of customer and coverage data by the PMI packages, as well as lessening the differences between employees and especially removing unused data fields.

The second step in this short-term action plan uses the improvement method of standardizing. As discussed in chapter 4 there are multiple parts to this improvement method as you can standardize different aspects in the process. In our short-term plan, we use standardizing procedures as an improvement method for helping deal with the differences between employees, tasks staying in the task list and eliminating extra process steps. Standardizing procedures needs to be done by employees of BK who work in the process, as they have the most insight in unnecessary steps and crucial steps. If a meeting is planned for walking through this process together they can determine an optimal process with the current resources, as well as eliminating any doubts single employees may have. This than also needs to be recorded in a procedure map to explain to eventual new employees.



The third step in our short-term action plan is that of improvement using relationship building and making use of existing relationships. We consider two main relationships, first is that between the ERP provider and BK, as the ERP provider can influence and help shape future and current availabilities for improvement in this process. The ERP provider also plays a large role in solving different problems, using some of the other improvement methods. This relationship is mainly with the ICT department. It is good to have short lines with the ERP provider to get quick responses and limit reaction time, as well as helping improve in the future. A second relationship which can help solve some of our problems is the relationship with the ICs, this relationship also involves the branch organization, who have more influence on the ICs. Using this relationship, we can solve the errors in the PMI packages as well as reducing variance in incoming documents, through more direct notifications, of errors. It can also help in solving the differences between ICs.

A part of this relationship building has already been implemented in solving some current smaller problems from multiples insurance companies. These were issues with regards to wrong data filling of customer data and the poor lay-out of documents with several insurance companies. Whilst the relationship with the ERP provider helps in dealing with the wrong entry of financial data, in the ERP system. With the increase in relationships such smaller issues can more easily be resolved through serious responses by the problem owners.

This is the short-term action plan, in which we deal with the smaller improvements which can have a big impact on the short term. Some of these improvements also help in dealing with the other long-term and short-term improvement methods. An overview of the short-term action plan is available in figure 20.

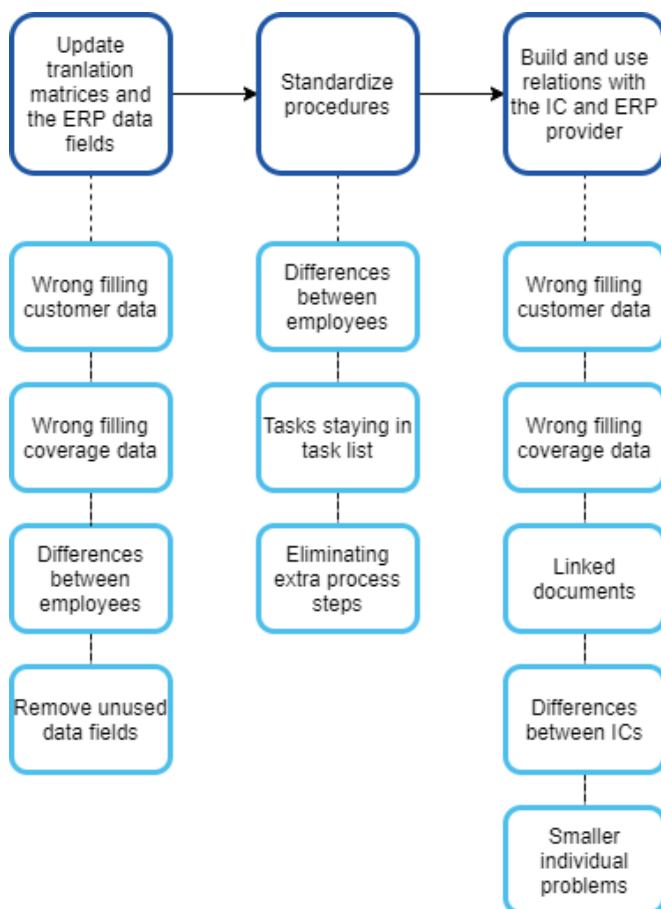


Figure 20 Overview short-term action plan



6.2 Long term action plan

We now go on to discuss the long-term plan which considers improvement methods which will take effect over a longer span of time, which we consider as more than three months. Also, here we start with discussing the improvement methods with the highest priority and work downwards. To be clear, the improvement methods may deliver results over a longer time span however, it is recommended to start using the methods or implementing the solutions as soon as possible for the quickest resolve.

A first step in our long-term plan is that of implementing and experiencing the two-way Aplaza connection. The capabilities for installing this connection are already available in the current version of the ERP, however it is wise to contemplate with the ERP provider for installing this connection. The connection then also needs to be established from the side of the s, as the connection comes from both sides. The connection can be established at the major ICs; however, it is recommended to start with one connection to experiment with it and check the benefits and the cons of the connection. The testing and experimenting allows for a solid connection which can help reduce the times of data filling in the current process as well as help with the consistency if the data. And in turn this helped with the wrong filling of the customer and coverage data. This also helps with the differences between the ICs, as the connection allows direct integration from the ERP. This method is in the current ERP system not up to date, however, in the future ERP system this will be taken into consideration coming from the brainstorm session held with the ERP employees, available In Appendix D.

The second part of this plan is the integration of STP and bulk options in the ERP system. To implement this an interview and brainstorm session are organized together with developers of the ERP provider. Currently the ERP provider is developing a new and upgraded ERP system. The old ERP application is outdated and does not allows for many more useful updates; therefore, the new system is developed using newer programming languages and structures, allowing more customizability but also better performance. The development of this new system creates room for implementation of wishes for the clients of the ERP provider so for example BK. In this interview with the employees who are developing this new application, we expressed our needs and wishes, and proposed methods as described in chapter 4 and 5. The interview questions and brainstorm points are noted in Appendix D. In this interview we also expressed the need for STP options.

Through the development of the new application core components of the application can also be changed and are planned to change. As the current focus of creating invoices for example is on batches, the new application will also feature end-to-end possibilities thereby allowing easier and more efficient invoice creation. Also, the process of gathering the documents by the reception department will become STP as this is automatically done by the ERP itself. Another point which should allow the correct acceptance of PMI packages, is the removal of single coverage data, and allowing multiple coverages per insurance. This system is then the same as that of the ICs and should therefore allow easy transferring of data without any in-between steps. Another solution which is going to be implemented is the phasing out of the ADN PMI store, and integrate the PMI packages with the Aplaza store, this allows easier maintenance as well as less APIs allowing quicker performance. Another workflow that will be considered is the direct STP integration of extranet and ERP system, so if something is filled in the extranet of the ICs, it will directly be accepted in the ERP system. Also standardizing will be considered as various standardizing protocols are kept in place with regards to communication of data and processes. Overall, the application of STP and Bulk options helps deal with problems like wrong filling of both customer and coverage data, linked



insurances and documents, the lack of bulk options the inefficient invoice creation, the not matched PMI packages and the times of data filling.

A third step in the long-term plan is further standardizing communication between the ICs and BK. This means working together with branch organizations to address regular issues in documents and PMI packages. But this also means regularly keeping tabs on the quality of documents and monitoring the situation and making the ICs aware of their mistakes. This should be standardized, for example through a monthly report to the ICs with the errors in the documents, or this monthly report can also be sent to the branch organizations. Another way of standardizing communication is using Postex, however there are major benefits to using Aplaza over Postex, such as direct integration and performance. Therefore, Postex is not considered as a viable option for standardizing communication to and from ICs. We will discuss standardization in communication further in part 6.3. This helps with missing PMI packages as well as complete PMI packages.

A last part in this long-term action plan is the use of relationships over a longer term, also to keep Aplaza and the ADN PMI store up to date. This relationship involves both the ICs and ERP. As already explained, the ERP provider is building a new application. Creating a relationship allows BK to help design and decide on features of the ERP which can be extra helpful in creating a more efficient process. This can also help with making other processes more efficient. This improvement deals with the problem of lack of bulk options and the warnings whilst accepting the PMI packages as well as the inefficient creation of invoices. It is also important to keep updating and adding new APIs to make integration with other applications smoother and allow for future expansion.

Overall, the long-term action plan is focused on creating and upgrading relationships with the ICs and especially the ERP provider. And then using these relationships to implement STP and bulk applications as well as direct connections between parties in the chain. An overview of the long-term action plan is visible in figure 21.

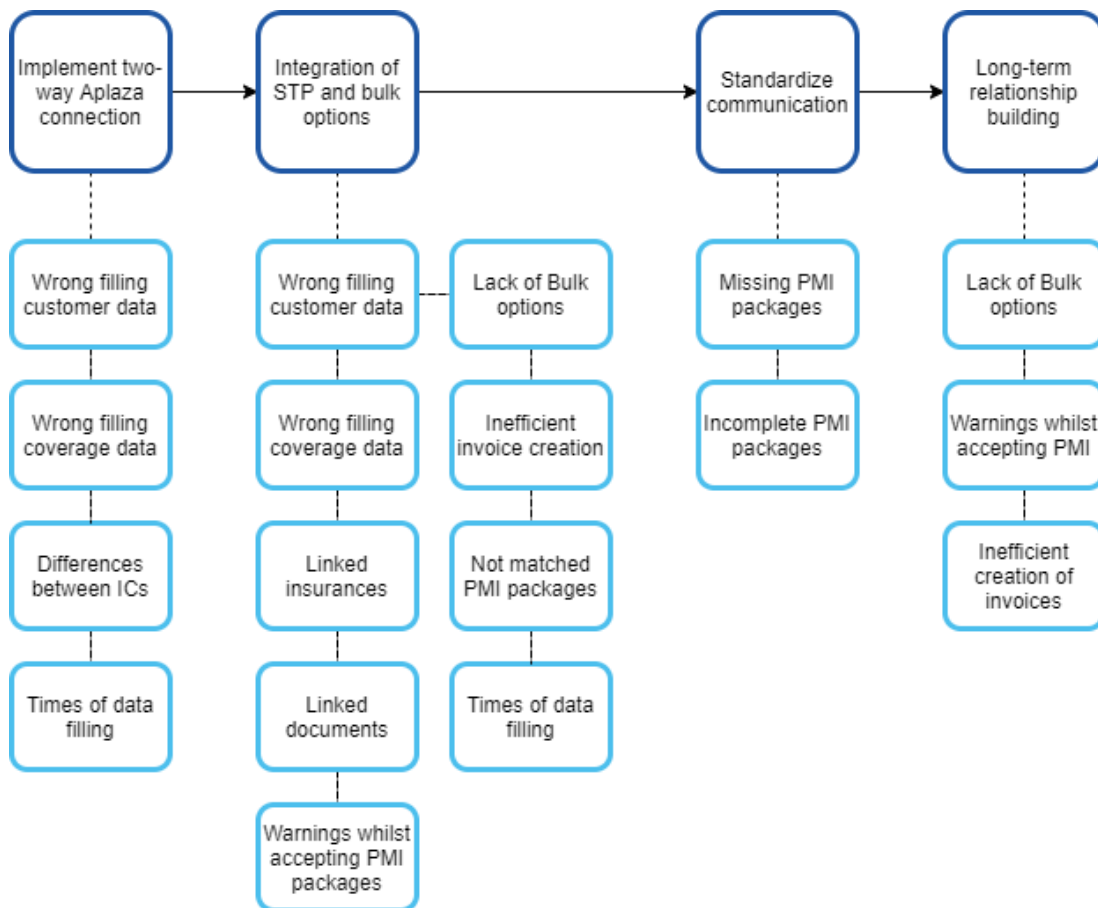


Figure 21 Overview long-term action plan

6.3 Chain action plan

The last implementation plan we discuss is the chain action plan. Here we will discuss what implementations would be preferred in the chain and how BK can help implement these solutions and improvements. This part will not only deliver benefits for BK but benefits for the entire chain, as a smooth working chain is both in the advantage of the ICs as customers have better information availability, as well as benefits for insurance intermediaries, due to less work. Also, in this plan we will work from the highest priority solution or improvement methods. The time-span of this plan is difficult to indicate as there are a lot of parties in the chain which have an influence on the implementation and execution of these improvements. The improvements should be led by the branch organizations as these have the most impact on the ICs and on the intermediaries. However, BK can have an impact on the branch organizations and thereby has an indirect influence on the improvement of the chain.

The steps in this action plan are close together and are linked to each other. However, the first major step is further standardizing communication as already mentioned in the previous plan. As the employee of Adfiz said, there is strength in numbers, if there are a lot of errors that are known at the branch organizations, they can use this as evidence to stimulate improvement. Therefore, it is important that the hotline or complaint point created by SIVI and Adfiz, the branch organizations for intermediaries, is used frequently. This communication should be standardized within the chain, which is currently done through an internet form which can be filled out by intermediaries, but this should also be standardized within the processes of the intermediaries. Therefore, it is recommended that there is one person or department appointed as responsible for sending in these



complaints. This improvement helps deal with the problems of linked documents and inefficient invoice creation.

This brings us to a second step, which needs to come from the branch organizations. This step involves certificating documents and documents flows. This initiative is already initiated by Adfiz; however, it has not reached any significant influence yet. For this certificating of documents, a checklist needs to be created, by intermediaries together with Adfiz. This checklist can then be used to certify documents on characteristics and quality. A certificated document or flow can then be accepted by Aplaza for example, whilst not certificated can be rejected. Another approach can be taken from the perspective of the intermediary, where they choose only to work with ICs who have a certificated document flow. If this certification has become more significant and is checked regularly, let us say each year, it is recommended to choose the ICs which have the certificate as main business partners, for a more structured document stream. This helps with solving the problems of inefficient invoice creation and differences between insurance companies. Certificating documents helps deal with the inefficient creation of invoices and the differences between ICs.

The next two steps in the chain action plan both have to do with the GRS protocol, since they are very close together in the previously executed AHP, we do not state any prioritization regarding these two. The improvement methods considered are stimulating the GRS protocol and updating the GRS protocol. These actions are also both managed by the branch organizations SIVI and Adfiz. As the protocol is lacking some crucial parts of information especially regarding credit notes, the protocol needs to be updated. BK can stimulate this protocol through communicating the needs for this update regarding credit note, in specifying what is good and what is bad about certain credit notes. The protocol should also be updated in the future to keep up with new and upgrading technologies, it is important that this process is monitored closely by the branch organizations and adjusted accordingly. If the branch organizations are lacking it is important that intermediaries like BK, make the organizations aware of this. The other step is stimulating the GRS protocol, as it is currently being used by the major ICs, however the script is not followed as closely as wished for. This process should also be stimulated by the branch organizations. There is no big role in this improvement for BK due to the small influence they have on the ICs. However, it is important to keep the branch organizations aware of the importance, also using the complaint point can help with this. A better protocol and more stimulated protocol deals with the problems of not all documents are received, linked documents and the differences between ICs.

Overall, the influence on the chain of BK is low, however, there can be an indirect influence through the branch organizations which do have a big impact on the chain. It is therefore important to keep the branch organizations aware of significant issues, and make sure that they are trying to improve the process. A complete overview of the chain plan is available in figure 22.

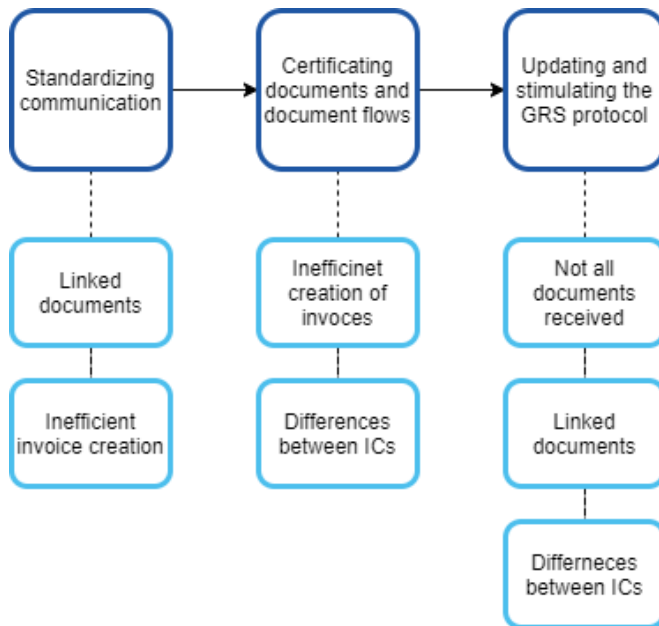


Figure 22 Overview chain action plan

6.4 Evaluation of to-be scenario

In this last part of chapter 6 where we implement our solutions, we discuss some of the solutions which are not implemented. We discuss the problems and how they are solved or not solved. And last we will give a glimpse of an ideal desired process, which can be a goal to strive to.

In our action plans we addressed all the major improvement methods, except for the implementation of Postex, smart contracts and the automation via chatbots. For the first one respectively Aplaza is a better alternative and therefore Postex is not relevant for implementation. For the other two, it is due to their low scores on the AHP, which makes implementation illogical as there are other better options. The other lower options from the AHP are implemented in the chain plan, this means that the chain plan is the least important plan. The other two plans are more important as they entail higher rated solutions, and they are directly implementable by BK themselves without much need for help from for example branch organizations.

The implemented solutions together solve the major causes of the inefficiency at the data import process. As the problems with the wrong filling of customer and coverage data is dealt with in multiple ways, for example relationship building. Whilst another cause such as inefficient invoice creation and differences between employees and ICs, are solved on the short term with standardizing and over the long term with the development of the new ERP application. Overall, each problem we determined earlier is addressed in the previously created action plans.

It is also recommended to be aware of the rapidly increasing danger of cybercrime and the laws that fight against this thread. It is important to only invest in technologies which will also hold in the future. An example of an upcoming law is the digital operational resilience act, which is a law which requires ICT systems and connections to be of a high level. This law is currently in the process of acceptance by the European Commission (Thornton, 2021). Therefore, it is recommended to not blindly follow the action plans, but also keep track of the current changes in threads and legislation.

We now create a to-be workflow as earlier proposed. From this workflow we can determine the significance of solving the problems as well as trace any newly found problems. This workflow is based upon the full execution of the action plans. The to-be workflow is visible in figure 23, and is



enlarged visible in Appendix C. The workflow can be used as a goal to strive to whilst executing the action plans.

In the workflow are green arrows which are numbered, they represent the changes made because of the action plans. Not only did the data import process change but also some of the contexts and some other parts which are not visible. We now discuss the improved parts; we start with the arrows and then the non-visible changes.

The first green arrow shows the changes in the importing part of the data import process. In an optimal situation this is done through STP by the ERP. The unmatched documents should be as few as possible, these still need to be assigned by the reception department manually. However, this is more efficient and therefore should be less work. The second arrow is referring to the change in document flows, as this flow is improved through both the long and short term as well as the chain action plans. Due to this improvement the need to wait for the documents is lower, and the new ERP application also allows the counting of documents eliminating the extra process step of waiting for all the documents to come in.

The third green arrow is the improved step of accepting the PMI. In an ideal situation this is already done automatically without any warnings. Also, as the data is correct or at least more often correct, the next step which is extra data filling is shorter than the current step of adjusting the wrong data and filling extra data. This STP filling of the customer data can be realized through developing the new ERP application. The fourth and fifth green arrows are both process steps which involve checking. As the quality of the data and the documents is higher through the relationship building, standardizing and improved procedures, this checking should take less time, as well as adjusting the errors if the check fails.

The sixth green arrow in figure 23 shows the improvement at the linked insurances. Due to the increased correctness of the coverage data and booking data, as well as the availability of all data and bulk options in the new ERP application, this step is way more efficient than the current step. Bulk options allow for execution of all bookings from one of the linked insurances for all the linked insurances, reducing the time since not all bookings need to be opened and executed separate. The seventh and last arrow refers to the process of invoice creation. Where currently the employee needs to do this manually by leaving the customer data and creating it in a separate module within the ERP, in the new ERP application this can be done directly from the customer data, reducing the time this sub process takes directly.

Now that we have discussed the green arrows, we discuss the improvements which are not visible in figure 23. We first discuss some of the contexts which have improved. In context 1, the customer adjustment context, the data filling has become way easier due to the two-way Aplaza connection. This allows the employees to directly export data from the ERP into the IC portal. Another part of the context that is improved is that of unmatched PMI package deletion, which can be done in bulk in the new ERP application. Lastly another context which has already been mentioned is also improved namely that of the linked data, as this context is completely irrelevant in the new process, as it is directly implemented in the data import process.

A last improvement which is not visible in figure 23, is the improved quality of documents and data. This is due to standardization, improved chain protocols and certification and due to relationship building. The correctness of raw data is higher, allowing employees of BK to use this data also for more purposes in communication. Also, for the customer itself this is an improvement as the level of service is higher.



Overall, in the new improved to-be process the time spent in the data import process and its contexts, by employees is greatly reduced, and the quality of the output has improved. This shows an increase in efficiency over the entire process, allowing the employees to be doing more important work, like actually advising the customer rather than managing data. Especially important is figure 23 which shows an improved process, from the different aspects of the action plans as described above, some examples are the application of STP in gathering documents, the higher quality of data and the implementation of bulk options and reshaping of the ERP application in the invoice creation. To give an indication of time is hard, however, the reception department should be spending less time on the process daily with approximately 0.25 hours a day rather than 0.5 hours a day. Additionally, also time spent by the administrative department is reduced to 1 hour per employee per day, which is a 50% and 33% decrease in time, respectively. 33% on a yearly basis is equal to a reduction of 550 hours.

6.5 Conclusion implementing solutions

To conclude this chapter, there are three action plans which are to be followed by BK to eliminate the majority of the problems in the Data import process. First there is a short-term action plan which focuses on implementing improvement methods which are quick to implement and have a significant effect on the short-term performance in the data import process. Secondly there is the long-term action plan where major improvement methods such as two way data filling and STP options are applied making use of the development of the new ERP application. This plan has a major impact on the performance of the data import process but will take more time to implement. The third action plan fully focuses on chain improvement, together with the branch organizations. The execution of this improvement plan is also not done or regulated by BK but by the branch organizations which they are a member of. From this chain action plan, we can increase the quality of documents and data flows, through certification and protocols.

If all the action plans are implemented an ideal scenario is created, this is also modelled in a to-be workflow model in figure 23. Here the major problems in the process are eliminated or reduced significantly. In this ideal process the time spent on the importing and checking of data is reduced significantly, and additionally less time is spent by the employees on processes which do not really matter, which means more time can be spent on more important processes.

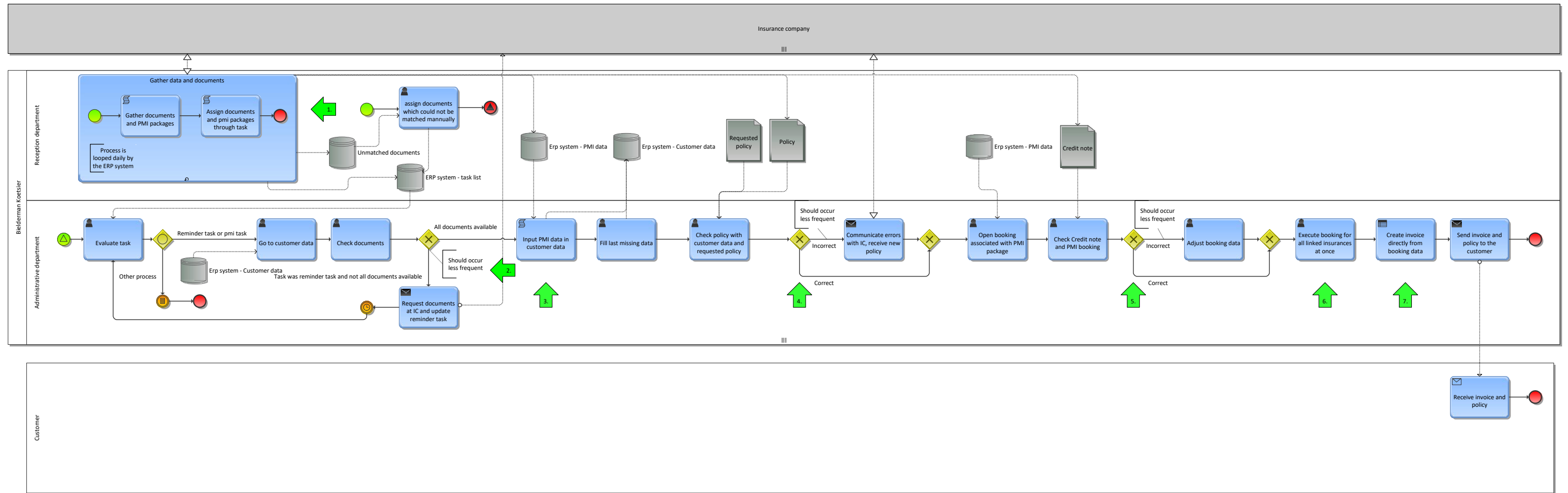


Figure 23 Data import process to-be workflow



7 Conclusion, recommendations and discussion

In this chapter we will summarize and discuss the research done in this thesis. We will start with the conclusion where we will give the answers to the main research questions and the sub research questions. We then discuss the recommendations for BK, for use and implementation in their process. Lastly we discuss the thesis on validity, future research and further reflection.

7.1 Conclusion

In this part we conclude the answers to our sub- and main research questions. We also set up some knowledge questions to help answer the sub research questions, we do not conclude these here, as these have already been discussed in the main body. We conclude each question separately starting with the first sub question and ending with the main research question.

The first sub question SUB1 is described as “What are the causes of the currently inefficient data import process?”. There are 17 causes determined which are all describe din table 4 and 5, the main causes being in document creation, importing raw data and waiting on other processes. To get to the answer to this question we created chapter 3 where we analyzed the current process using workflow models and data flow diagrams. We then used Lean Six Sigma and the Theory of Constraints to determine problems, together with problems that the employees encountered. These problems gave us a representation of the 17 causes of the inefficiency in the data import process.

The second sub-question SUB2 is “Which methods can be used to improve the data import process?”. Overall, we found 11 improvement methods from either straight up solutions or best practices with principles, these improvements are visible in table 6. Some improvement methods which can help in solving the earlier discussed problems are available at the ERP provider, for example integrating a two -way data connection to IC or implementing bulk and STP options. Another part of the improvement methods is available in the chain integration through increasing quality of individual documents and also increasing document flow. Then there are also internal improvement methods such as updating translation matrices, and standardizing procedures. There is also a major need to update and add existing and new APIs for future proof development. To get to this answer in chapter 4 we first searched for best practices from both literature and best practices from the branch. We also discussed the impacts that the concept of straight through processing could have on the current process. Lastly we looked at the available solutions in the chain.

The third sub-question SUB3 is “What method solves the inefficiency at the data import process most efficiently?”. A full ranking of the improvement methods is available in table 9. We also found that two of the 11 improvement methods were not feasible, and that the 3 chain improvement methods scored low due to the hard implementation due to the size of the chain. The highest scoring improvement methods are updating translation matrices in the ERP, integrating a two-way Aplaza connection and lastly the integration of STP and bulk options in the processes and the ERP. For this we used the Analytical Hierarchy Process, a decision tool which makes use of mathematical equations and comparing individual scores to determine the most optimal solution.

From the answers to SUB3 we created action plans to answer SUB4: “How to apply the most efficient solution(s) on the BK data import process?”. We created three action plans, a short-term, a long-term and a chain action plan, where we implemented the improvement methods ranked highest in the two plans related to time spans, and the improvement methods for the chain in the chain action plan. We then created an ideal scenario sketch, which can be used as a goal to strife too, in figure 23. Here we can see that the implementation of improvements id doable but will take some time, it is also up to the company to what extent to implement the action plans.



A last sub-question we stated in the first chapter is SUB5: “What are the recommendations for BK to improve the data import process?”. We have not yet answered this question fully, however, we have gathered all the information to do so. We answer this question in the next part, recommendations as it is not needed for the answer to the main question.

The last part for this conclusion is the answer to the main question: “How can BK improve the data import process?”. We use the answers to the previous questions to get an insight in the current process and its problems, the improvements available and how to implement them. BK can use the action plans created in chapter 6 for implementation of useful solutions to solve the inefficiency of the data import process. Additionally, for future development they can use the models created for explaining the process efficiently as well as use principles from the improvement methods to improve the data import process even further. Overall, after implementing the improvement methods and identifying the problems the time spent in this process can be reduced significantly by 33% up to 50%.

7.2 Recommendations for the company

For the recommendations, the advice is to implement the action plans into the strategy of the company. Especially the short-term plan can drastically increase the efficiency of the data import process, which allows employees to focus on more important work, than data importing. The company should decide on how far to implement each action plan, as the plans first implement the most important improvements and work further down towards less important solutions. This also depends on the costs the company is willing to make to solve the inefficiency of the process.

A very valuable improvement method is that of relationship building, which can also help solve problems in other processes in the company and in the chain. It shows the importance of relationships in the chain and with your software providers, as a lot of problems can be solved together with these parties. It is therefore also recommended to keep on helping in the development of the new ERP application, for the earlier mentioned improvements available in a new application. Also keep working together with ICs and branch organizations to keep improving the quality of the data flows and documents, also providing more service towards the customer.

Some parts of this research may also be helpful in solving other problems in other processes. It can therefore be useful to reuse parts of this research for example the data flow diagrams and the principles from the best practices. Additionally, it is recommended to keep reviewing this and other processes regularly for gradual improvement. Also involve the employees working in the processes in this improvement session as proposed by the Lean methodology.

Lastly it is also important to keep regulative measures and threads into account, when implementing solutions or changing systems and connection in general.

7.3 Contribution to literature

In this research we have focused on the flow of data and documents in the insurance broker processes and the accompanying chain. We provided some examples of the issues on an organizational level and complemented this with issues which are coming from a chain level. This thesis can therefore be used as an example for an analysis of the insurance chain for example executed by the branch organization. This thesis can also be used as a case study for an analysis of an insurance broker in the Dutch market.

The methods used in this research: Lean Six Sigma, TOC, AHP etc. have already been used often in literature and are therefore no significant addition to the body of knowledge. The results of the



research can be useful for literature as no such research on a company level has been established for the Dutch insurance branch.

7.4 Discussion

We now discuss the results of the research. We start with discussing the validity of the research by discussing the methods, the conclusions and the overall validity of our research. We then continue with the interpretation of the results and our conclusion. This is followed by the limitations and lastly by the suggestions for future research.

7.4.1 Validity

We already discussed some small parts of validity in part 1.4.2, where we analyzed some validity on the methods we used. We analyze the methods used per chapter. In chapter 2 our theoretical framework for methodologies, we used a systematic literature review as well as general literature reviews, to gather the information needed for explanation of the methodologies. These methodologies are generally assessed as valid, if the constructs used for executing this review such as exclusion and inclusion criteria as well as search terms are correct (Thompson et al., 2012). In the case of this research the search terms resulted in useful articles for deciding on the methodologies to use in this research later on, which shows that the review resulted in the expected results and is therefore a valid methodology.

In the third chapter we analyzed the current situation, where we first used methodologies to model the current process. For this we used interviews for information gathering and BPMN 2.0 tools for the analyzing of the process. Interviews are a common way of gathering qualitative data which is needed to model the process. Interviews are valid when the questions asked will result in factually correct answers. The questions created for the interviews are based on earlier gathered knowledge and are therefore directly or indirectly based on facts, which leads to the highest chance of getting factually correct answers (Topscriptie English, 2021). The analysis using BPMN 2.0 is also recommended and validated by other literature, however, the use of modelling is subject to quality problems. In our research the notation used in the models is BPMN 2.0 which is the most popular notation and is therefore the most interpretable by a large amount of people. As the BPMN 2.0 notation is used the model is as valid as can be with the available information (Haisjackl et al., 2018).

In the second part of chapter 3 we use data flow diagrams and interviews for data gathering and analyzing. The interviews have already been discussed; therefore, we only check data flow diagrams for validity. For the DFD the Yourdon and Coad notation is used, as it is more suitable to read for managers of processes, for which this research is intended. DFD is also subject to quality problems, however, the rules of the notation are followed and are therefore as valid as possible with the information gathered from the interviews.

The other two methodologies used in chapter 3 where we find the underlying problems of the inefficiency at the data import process are Lean Six Sigma and the Theory of Constraints. As already mentioned in chapter 2 both are suitable for our approach. Both are validated by different authors as methodologies to identify problems for further analysis and solution generation. In our case we only used them for problem identification, and some of the principles for solution generation (Inman et al., 2009; Patel & Patel, 2021).

For finding the improvement methods we used two approaches: best practices and straight up solutions. For best practices we used a literature review, which validity has already been discussed, and benchmarking. Benchmarking is a validated method for finding best practices, however an issue with benchmarking and best practices in general is the point of perception and the influence of bias.



As best practices are perceived differently from different perspectives the validity is questionable, however in our case we looked at best practices from the side of the company. This indicates that we have chosen a solid perspective, which should mean that if the research is carried out again from the same perspectives, the results of the best practices should be roughly the same, making best practices reliable. However, as already disclosed in 1.4.2. the chain and data process technologies are rapidly changing, and with it the best practices change. Additionally, the best practices discussed are far from all the best practices available in literature and in the branch, as researching all these practices simply could not be included in the time available for this research. Therefore, the results from the best practice analysis are not fully validated, but only partly (Malmivaara, 2016).

As mentioned we also analyzed the already available solutions in the chain and branch, in our improvement methods research. Also, here it must be said that there are more already available solutions in the chain available, but also here due to time and information restrictions not all options could be analyzed. However, the first most promising solutions are analyzed and proposed as improvement methods. Therefore, also the research focused on solutions can be partly validated (Malmivaara, 2016).

The analytical hierarchy process is a validated methodology for decision making and prioritization, and therefore fits the available data. Although a key aspect to the validity of AHP is the subjective filling of the comparison matrices. In our case the values of these matrices are validated by the consistency ratio and some indications by employees of BK and through the interview with the branch organization. For full validation, a full analysis should be done on each of the criterion for each of the alternatives (Henrique et al., 2018).

The last methodology to be validated is the construction of the action plans which is based on the previously mentioned AHP. The validation of these plans is done through sparring sessions with the BK supervisor for the short and long-term action plan and with a branch organization employee for the chain action plan. They gave some critical feedback after a small presentation on these action plans, on feasibility and other risks in the plans. This feedback has already been implemented in the action plans.

7.4.2 Use of methodologies

We now discuss the usage of the methodologies in this research as there have been several methods which have been used as described in the previous paragraph. We discuss to what extent the methodologies have been used and the reasons why certain methodologies have been used partly or fully. The first two methodologies to discuss are workflow models and data flow diagrams. These both have been used to a full extent in shaping and getting an insight in the current process but also in a to-be process. As this already indicates, workflow models have been used for both purposes: modelling a current process and modeling an ideal process. The use of workflow modelling and BPMN 2.0 allows for easy insight in processes, also for the managers of BK which do not have technical knowledge. Together with the data flow diagrams the workflow models gave full clear insights in the internal process but also in external data flows, which allowed for a good and strong starting point.

Two other methodologies used are lean six sigma and the theory of constraints which both have been used partially. Both have only been used in the problem identification phase, where they can also be used as full-on improvement methods generation strategies. However due to the nature of both being continuous methodologies only the parts which can be used for single improvements have been implemented in this research, as this research is not continuous by nature. Both methodologies were useful, however lean Six Sigma was more helpful in the identification of



problems as the theory of constraints requires more of a quantitative approach to identify problems whereas there was no real data available in the research which made the use of TOC harder. Lean six sigma also allows for use in qualitative research and was therefore more useful, although also here parts of six sigma are quantitatively oriented and were therefore less useful than aspects from lean.

The use of best practices for improvement method identification was useful as there is a lot of literature available from the insurance branch but also from similar branches like the banking industry. Additionally, the availability of best practices at other intermediaries and ERP providers was easily accessible through the branch organization which allowed for a good use of best practices in combination with benchmarking techniques.

A last key methodology that is used is that of the AHP, which was used to its full extent. The AHP was useful in selecting the improvement methods as there were many discovered methods and the AHP is able to handle this number of methods relatively easy. There is also the need for a multi-criteria selection method. The AHP was chosen over other multi-criteria decision methods as it has a strong focus on the differences between alternatives, rather than a focus on criteria, which was also the goal in this research (Honkala et al., 2007). The AHP led to a prioritization which was expected. Overall, the selection of AHP for the decision methods resulted in a positive comparison.

7.4.3 Interpretation of results

We will now discuss the interpretation of the results and conclusion we have drawn in our research. First up is generalization of the results, as the research has been done at an insurance broker, which is part of a relatively large chain and branch in general, solutions and results can be somewhat used for similar cases in the branch. As other insurance brokers can suffer from the same problems especially if the problems are coming from the chain, therefore the information gathered in this research is generalizable for these organizations. Furthermore, the results are not generalizable for insurance agents as this process is different at these companies. The same goes for any other participant in the insurance chain or any other general organization.

The results show that there are large improvements for efficiency available as expected at the start of the research. In general, the results show that there are improvements available in different processes or parts of processes and in the entire chain. It is important for both BK and the chain to keep on improving these processes to keep maintaining added value for the customers. The methodologies used in this research gave the results as expected, based on the input for the methodologies used. A result which was not expected from the start of this research is the already large amount of readily made solutions for many of the problems which have not yet been integrated. Some of these solutions were also already known by the problem owners, however, have not been implemented due to several reasons.

7.4.4 Limitations

There are also some limitations to the research done in this thesis, which we discuss in this part. A first limitation is the limitation due to time, as this is a bachelor thesis, it means that the research should be conducted in approximately 10 weeks. This means that the validity of certain methodologies may have been lower, as is the case with the best practices research as well as full investigations in the chain. These limitations can be dealt with through further research in these best practices and solutions in future research as the current process is clear now. Another negative impact on this research is the Covid-19 crisis, which meant this study and the interviews were mainly done from home instead of life interviews, this caused the interviews to be very formal and may have reduced the quality of interviews.



The reader should bear in mind that the study is based on an insurance broker which is a smaller party in the chain in comparison to insurance companies and insurance agents. This makes that the potential for change coming for the entire chain from an insurance broker is small, as the big companies largely shape the chain.

7.4.5 Future research

We have now come to the last part of this thesis, where we discuss the future research that is recommended based on the findings in this research. As already mentioned it is good to continuously research the current processes and the problems that occur from these processes. Future research can help with the continuous improvement of these processes including the data import process. Additionally, it is wise to further research the best practices and already available or rapidly developing solutions in the chain, as these have been limited by the available time. A last subject which could be researched further is that of further chain integration in the insurance branch in general, as there is not only room for improvement in the organization but in the entire chain. And if the chain value increases with it comes the value of the individual companies.

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VII. Appendices

Appendix A – knowledge questions

Table 10 Knowledge questions

Knowledge problem	Type of research	Research population	Subjects	Method of data gathering	Method of data processing	Activity plan	Question	Position
which business process modelling tool to select for visualizing the current process?	Descriptive	Methods and tools	Process modeling tools	Systematic literature review	Qualitative comparisons of reasons per tool	Research → literature study → overview tools → choosing best suited language	SUB1	Chapter 2
What data flow modeling language and tools to use for researching the current data flow?	Descriptive	Methods and tools	Data flow modelling languages and tools	Literature study	Qualitative comparison of available languages and programs	Research → literature study → overview tools → choosing best suited tool	SUB1	Chapter 2
What does the current data import process of BK look like?	Descriptive	BK employees, ERP system provider	Administrative department, reception, account manager ERP provider	Communicative approach, context mapping	Visual representation, qualitative	Identify processes → interview for process details	SUB1	Chapter 3
How to detect main problems in data flow processes?	Exploratory	Methods and tools	Problem detection theories	Literature study	Qualitative overview of methods	Literature study → Overview of methods	SUB1	Chapter 2



What are the causes of the problems at the data import process at BK	Explanatory	BK	Stakeholders	Communicative approach, brainstorm	Qualitative and quantitative use of theories defined in previous question	Interviews → Measuring → applying theory → overview causes	SUB1	Chapter 3
What are best practices for data import processes?	Exploratory	Branch companies, literature	Insurance agencies, theories on best practices in data flow	Observation, literature study	Benchmarking, qualitative brainstorm.	Branch analysis → Literature study → benchmarking	SUB2	Chapter 4
To what degree can STP methods be useful?	Evaluative	STP methods	STP methods	Literature study, communicative approach	Qualitative brainstorm	Research STP methods → Check in current process → brainstorm on ways to implement → overview possibilities	SUB2	Chapter 4
What are the already available solutions to problems in the Data import process?	Descriptive	Readily-available solutions	ERP, Communication channels	Communicative approach, internet search	Qualitative brainstorm	Research readily-available solutions → interview branch organization, BK employee → Overview readily-available solutions	SUB2	Chapter 4
Which methods can be used to improve the	Descriptive	Methods	Improvement methods	Communicative approach, observation	Brainstorm, communicative	Gather methods → Overview of methods →	SUB2	Chapter 4



data import process?					approach, Quality review	Analyze methods		
Which improvement method should be prioritized?	Exploratory	Methods previous questions	Improvement methods	Previous questions	Analytical Hierarchy process	Overview of methods → Analytical hierarchy process → ranking	SUB3	Chapter 5
How to apply the most efficient improvement(s) on the BK data import process?	Explanatory	Solutions	Results from previous questions	Brainstorm, literature search	Action plan	Gather most efficient methods → check for usefulness on BK process → Create action plan	SUB4	Chapter 6

Appendix B – Systematic literature review

For the systematic literature review we look at the question: What which business process modelling tool to select for visualizing the current process?. The first step of the systematic literature review (SLR) process is defining the problem, this is done in section 2.1.

Next we define the exclusion and inclusion criteria which are shown in respectively table 11 and 12. The reasons for exclusion or inclusion are shown in the tables.

Table 11 Exclusion criteria

Nr.	Criteria	Reason for exclusion
1	English or Dutch	Researcher cannot understand other languages
2	Open access or institution access	Limited budget for research, so no memberships can be afforded, therefore it should be open access or institution access
3	After 2010	Since the field of BPM tools changes rapidly it is important to have recent information on the newest tools and languages.

Table 12 Inclusion criteria

Nr.	Criteria	Reason for inclusion
1	Article is on tools/languages	The goal of the question is to choose the best fitting language or tools for modelling
2	Article has focus on modelling, not simulation	The answer to the question will be used for modelling, not for simulation.

We also need to decide on which databases to use for our search. In our search we will use two databases: Scopus and Web of Science. These are both multidisciplinary and accept Booleans and therefore contain a lot of information on our subject which is also findable. For finding specific articles Google Scholar is used.

The next step is determining search terms and a strategy, this is done using the search term matrix in table 13, and the search log in table 14. Our search terms will also function as the concepts used for the concept matrix in Table 16.

Table 13 Search terms

Construct	Related terms
"Business process modelling tool"	"Business process modelling", "BPM"
"Select"	"To use", "comparing", "choosing"
"Data import process"	"process"

Table 14 Search log

Search string	Database	Scope	Date	# Of entries
"Business process modelling" OR "Business process modeling"	WOS	Title, Abstract, Keywords	29/3/21	2405 (at least 1 useful)
"Business process modelling" OR "Business process modeling"	Scopus	Title, Abstract, Keywords	29/3/21	4357 (at least 1 useful)

("Business process modelling" OR "Business process modeling") AND select*	Scopus	Title, Abstract, Keywords	29/3/21	315
("Business process modelling" OR "Business process modeling") AND select*	WOS	Title, Abstract, Keywords	29/3/21	159
("Business process modelling tools" OR "Business process modeling tools") AND select* AND data)	Scopus	Title, Abstract, Keywords	29/3/21	4
(("Business process modelling tools" OR "Business process modeling tools") AND select*	Scopus	Title, Abstract, Keywords	29/3/21	13
(("Business process modelling tools" OR "Business process modeling tools") AND select*)	WOS	Title, Abstract, Keywords	29/3/21	5
Total				13
After exclusion criteria				8
After inclusion criteria				6

We combined the 13 and 5 articles from respectively Scopus and Web of Science which resulted in 13 articles without duplicates. Thereafter we assessed the articles using the in- and exclusion criteria determined earlier. This resulted in the 6 articles as shown in table 15. these articles are also assessed using the concept matrix in table 16.

Table 15 Search results

#	Title	Author	Subject	Link
1	An Application of a Multi-Criteria Approach for the Development of a Process Reference Model for Supply Chain Operations	Kechagias, Gayialis, Konstantakopoulos, Papadopoulos	Selecting a tool for BPM, focus on supply chains and IT systems.	https://www.mendeley.com/catalogue/960f78bf-4ee5-360e-9da3-4e2daa4afa07/?utm_source=desktop&utm_medium=1.19.8&utm_campaign=open_catalog&userDocumentId=%7B36eea97c-449f-4466-a915-5b393c3552e3%7D
2	Towards a thorough evaluation framework of software tools suitable for small and medium size enterprises focusing on modelling and simulating business processes	Papademetriou, Karras	Preparation for a selection framework also slight focus on simulation but has interesting views on MSE which is the case at BK, might therefore be useful.	https://www.mendeley.com/catalogue/ea41b0ff-39d2-3ee1-a483-407e1825c915/?utm_source=desktop&utm_medium=1.19.8&utm_campaign=open_catalog&userDocumentId=%7B87423f6e-041a-4e81-be07-439159712373%7D
3	Business process modelling tool selection: A review	Medoh, Telukdarie	Uses AHP to assess different tools on five aspects: functionality, technical requirements,	https://www.mendeley.com/catalogue/b5ca8336-e95f-3708-850e-8aff0d5c59f5/?utm_source=desktop&utm_medium=1.19.8&utm_campaign=open_catalog

			support & maintenance, training and reference sites.	g&userDocumentId=%7B169c2891-fd84-45ff-9148-2b0c7c7a3be7%7D
4	An in-depth comparative analysis of software tools for modelling and simulating business processes	Papademetriou , Karras	Slight focus on simulation, compares general structures of BPM	https://researchportal.port.ac.uk/portal/files/4207178/BMSD_2016_Paper.pdf
5	On the Usability of Business Process Modelling Tools – a Review and Future Research Directions	Shitkova	Literature review on articles focused on the usability of BPM tools	https://dl.gi.de/bitstream/handle/20.500.12116/3041/117.pdf?sequence=1&isAllowed=y
6	Case-based Selection of Business Process Modeling Tools: An Evaluation Criteria Framework	Walterbusch, Grove, Breitschwerdt, Stolze, Teuteberg, Thomas	Literature review focused on the criteria to select BPM tools.	http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.690.5698&rep=rep1&type=pdf

For the concept matrix we used our concepts coming from our question as well as hard examples of tools, as these articles can help in the specific answering of which tool to use, where the other articles are helpful in choosing the best tool.

Table 16 Concept matrix

Articles / concepts	Process modelling tools	Selection / comparison	Data import process / IT	Hard examples of tools
1	X	X	X	X
2	X	X	X	X
3	X	X		X
4	X	X		X
5	X	X		
6	X	X		

The results from the articles are discussed in section 2.1.

Appendix C—Figures

Customer adjustments context

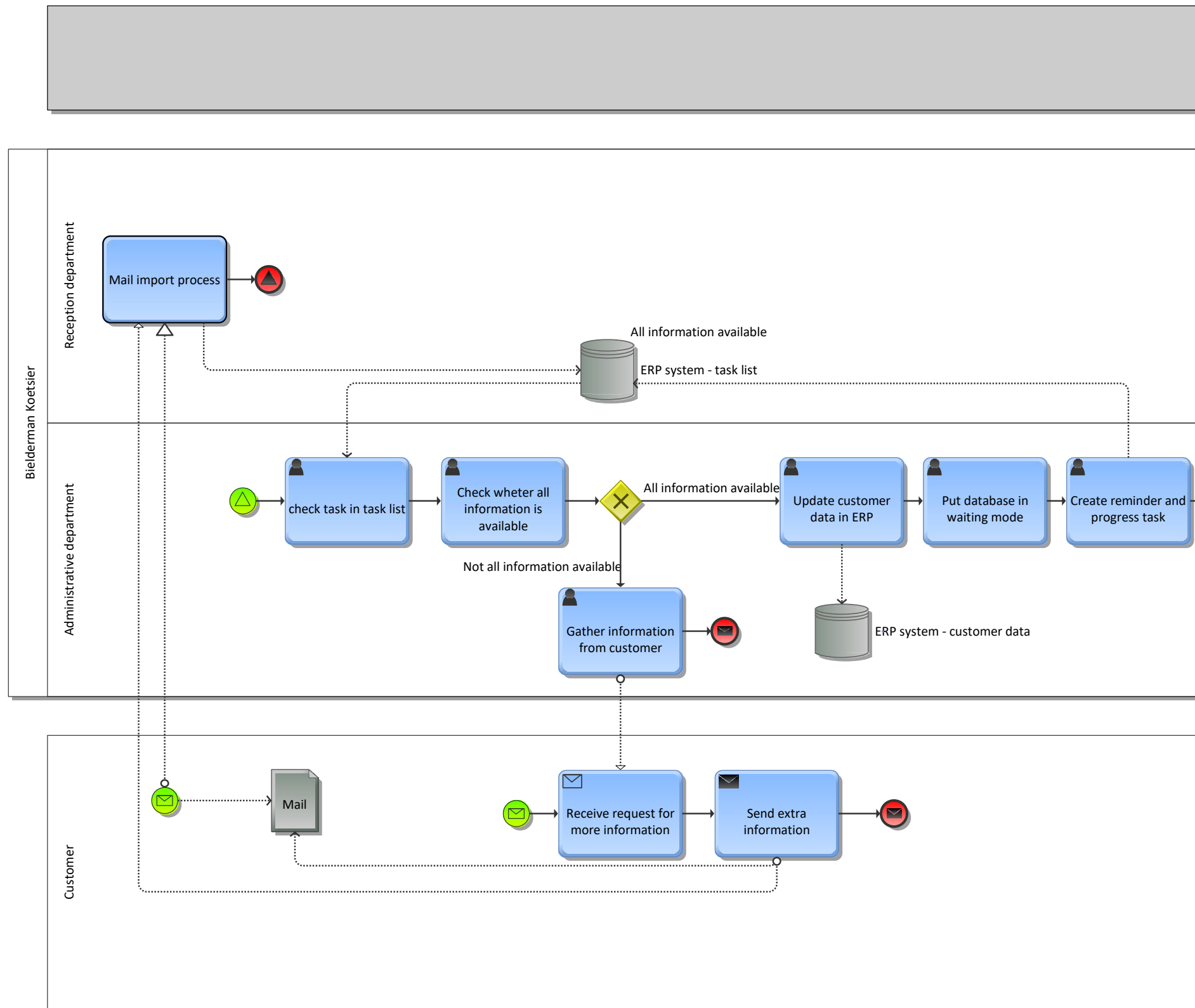


Figure 24 Customer adjustment context workflow part 1

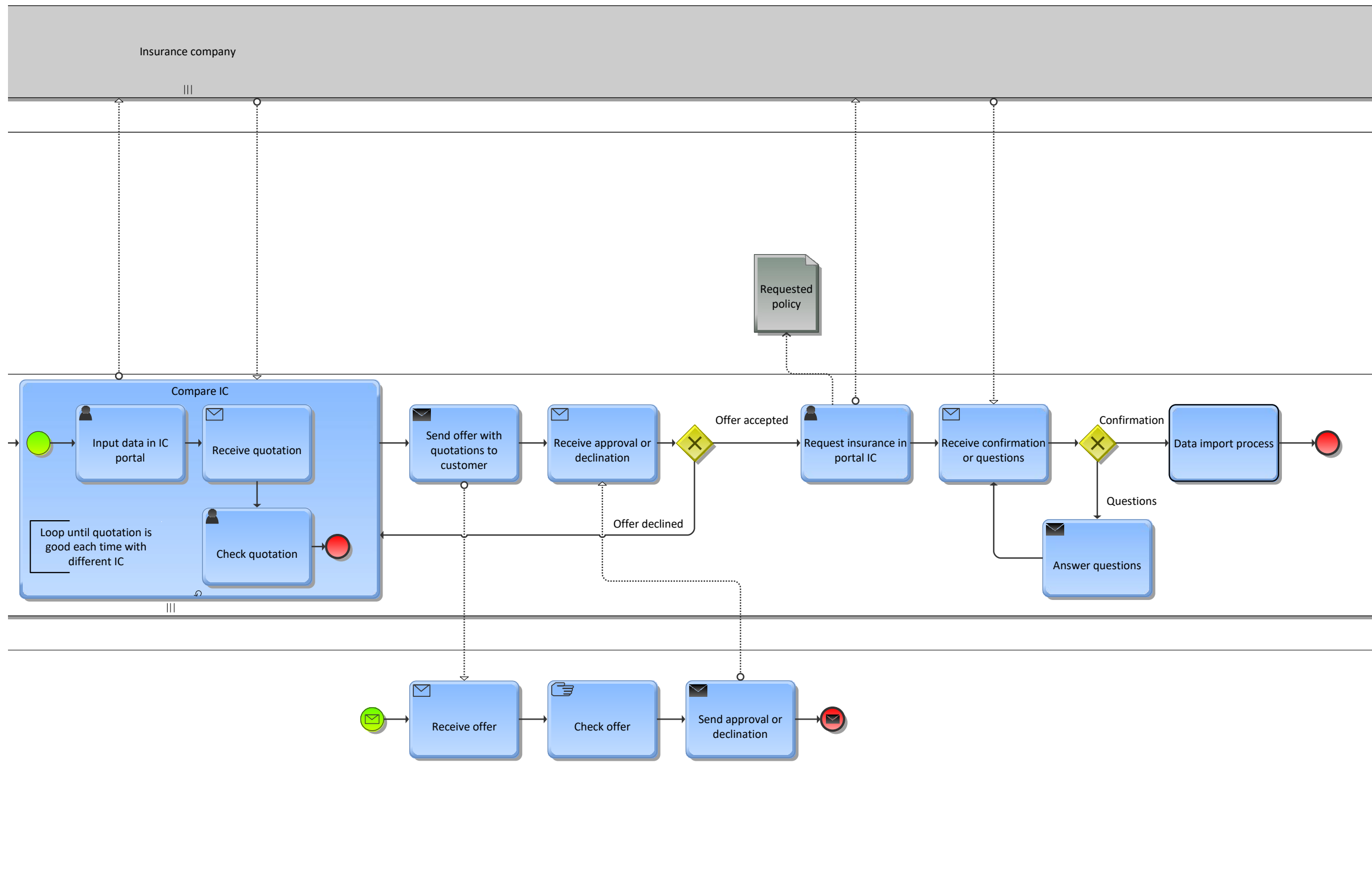


Figure 25 Customer adjustment context workflow part 2

Data import process

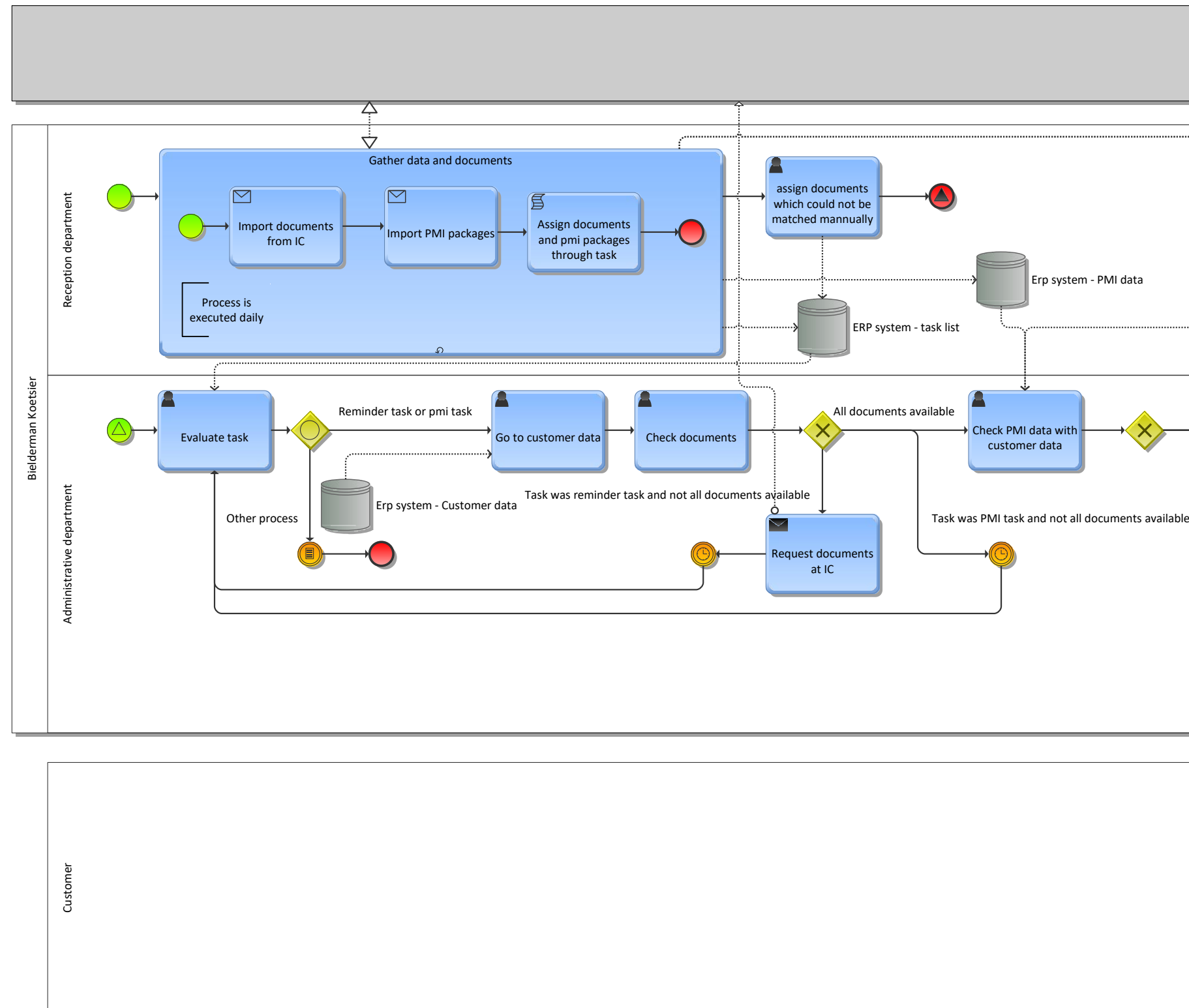


Figure 26 Data import process workflow part 1

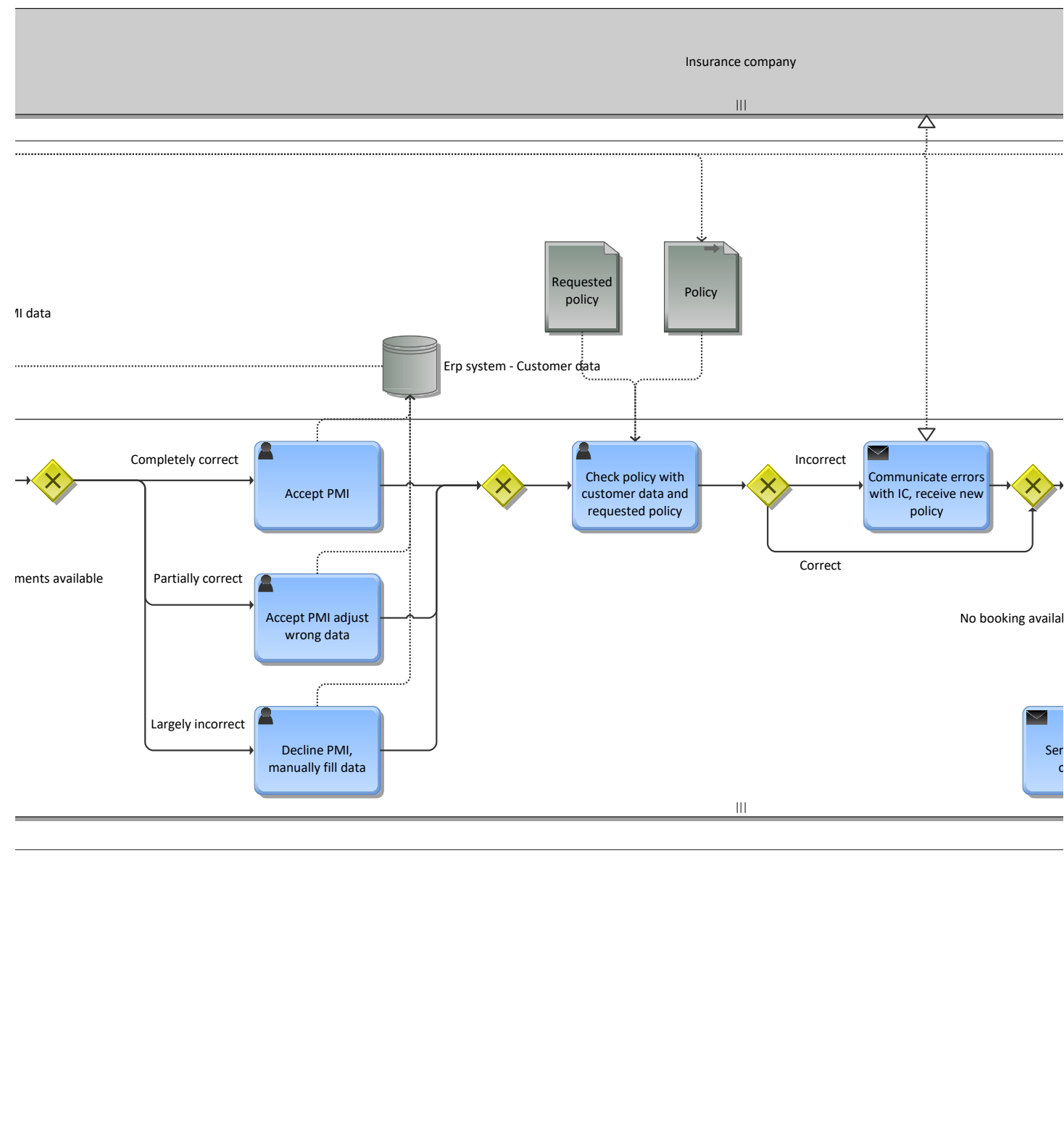


Figure 27 Data import process workflow part 2

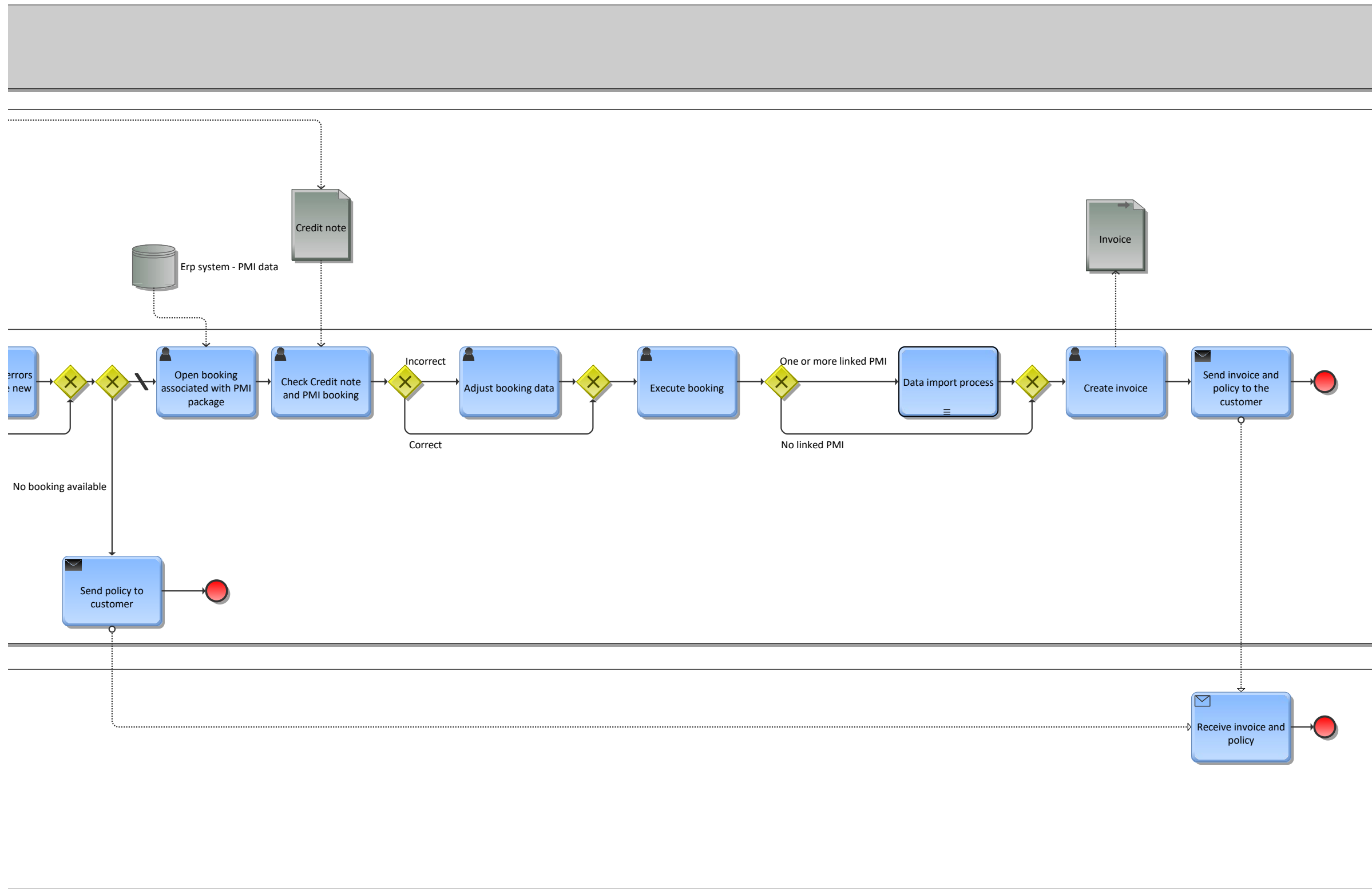


Figure 28 Data import process workflow part 3

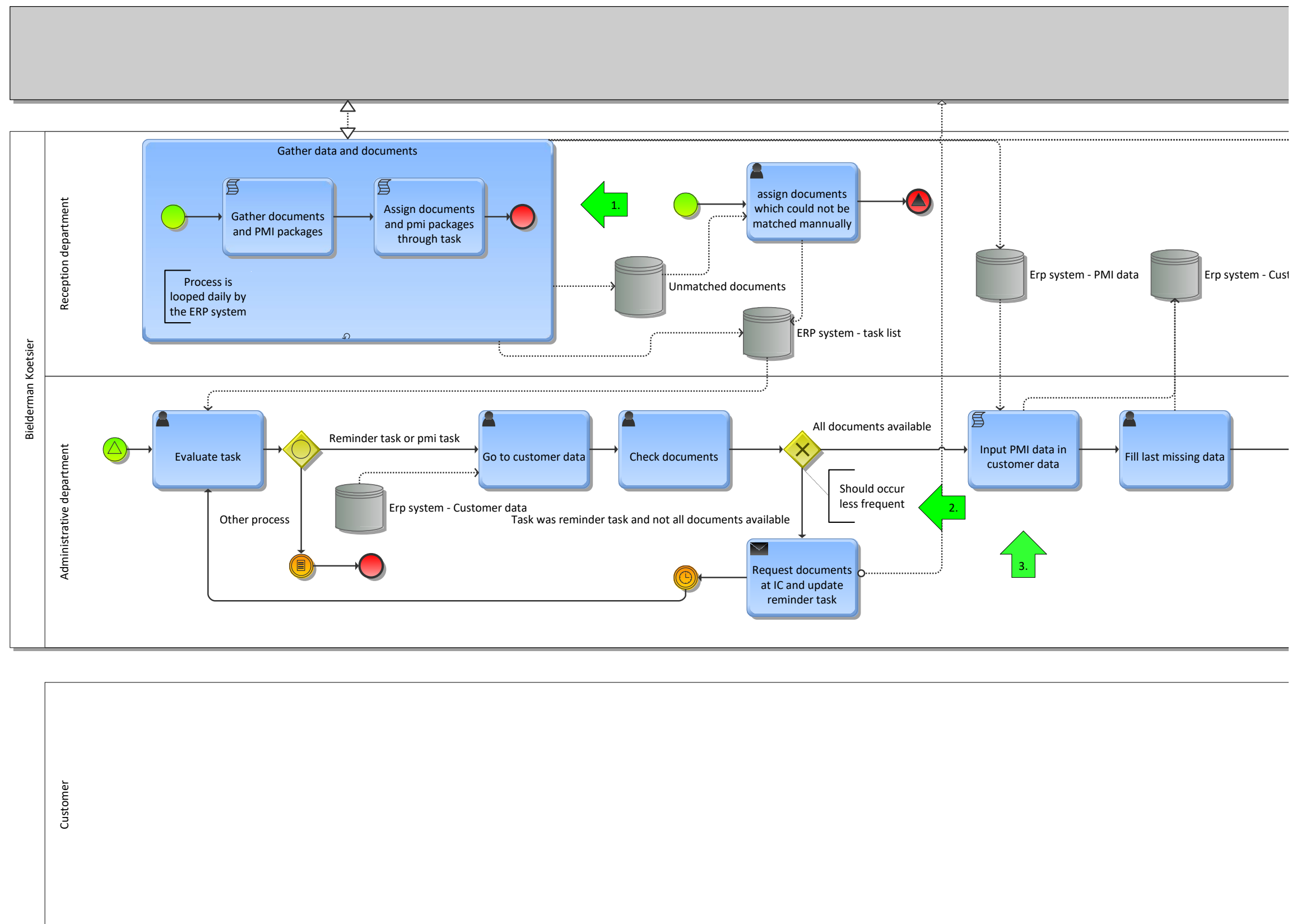


Figure 29 Data import process to-be workflow part 1

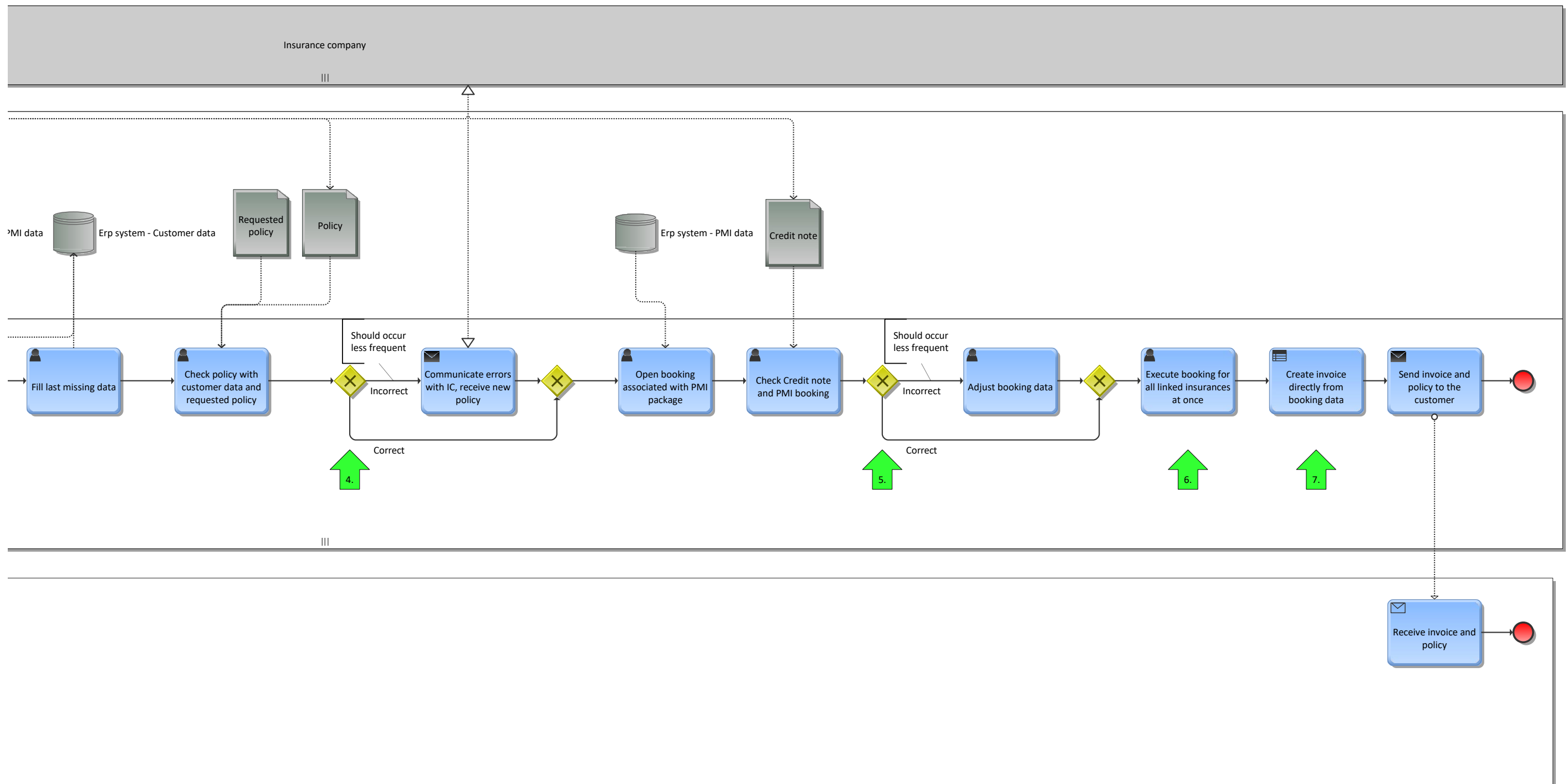


Figure 30 Data import process to-be workflow part 2



Appendix D – Interview questions

All the interviews held for this research have been held with consent from the employees following the form below.

Consent form

Information interviews data import process

In the research the focus will be on analyzing the process of importing and storing data in the ERP system. To gain insights in this process and the problems in this process, interviews are held. These interviews are purely focused on the process, and not on personal matters or qualifications. Therefore, these interviews do not pose any harm or stress. The interviews will be audio recorded if consent is given.

When the interviewee wishes to stop the interview, this is always possible at any time, this can be orally indicated. The information given in the (stopped) interview can be used for the research.

The information given in the interviews will be stored safely in the cloud storage. This information will be stored for the duration of the research, which will end in July. Thereafter the information and recordings will be destroyed. As no personal information is needed for the research this will not be questioned or stored with the data, making the interviews completely anonymous. If wished for the information given can be destroyed earlier through informing the researcher, this can be asked without providing a reason.

Complaints or questions can be directed towards the researcher. If this complaint is rather not directed at the researcher, the BMS ethical committee is available to file a complaint, about the research or researcher for example.

Contact information

Researcher:

Arjan van Laar

a.c.vanlaar@student.utwente.nl

0612805950

BMS ethical committee:

Ethics committee of the faculty of Behavioural, Management and social sciences at the University of Twente.

ethicscommittee-bms@utwente.nl



Consent Form for interviews data import process

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Please tick the appropriate boxes

Yes No

Taking part in the study

I have read and understood the study information dated 18/4/21, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

☐ ☐

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

☐ ☐

I understand that taking part in the study involves storing of the given information preferably via audio recording.

☐ ☐

Use of the information in the study

I understand that information I provide will be used for creating insights in the data import process and detecting problems in this process.

☐ ☐

I understand that personal information collected about me that can identify me, such as [e.g., my name or where I live], will not be shared beyond the study team.

☐ ☐

Consent to be Audio/video Recorded

I agree to be audio/video recorded.

☐ ☐

Signatures

Name of participant

Signature

Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Arjan van Laar

Researcher name

Signature

Date

**Study contact details for further information: Arjan van Laar –
a.c.vanlaar@student.utwente.nl**

Industrial Engineering & Management

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-bms@utwente.nl



Interviews employees BK (translated)

[Information written informed consent]

[Information goal of research and goal of interview]

What is your role in the data import process?

What triggers you to execute the data import process?

What are the exact steps you undertake in this process?

[if applicable discuss the current workflow model]

Are you aware of any differences between you and your coworkers who also execute this process?

Which problems do occur in this process?

- Internal
- External
- Documents
- PMI packages

Do you already have solutions or workarounds for these problems?

- Follow up

Are there other places where PMI packages occur.

- Customer adjustments
- Prolongation
- Termination
- IC adjustments
- Linked insurances

Do you have any wishes regarding this process, so do you have any extra steps or automation requests in this process?

If department = data management



What is the process if documents or PMI packages are not linked?

What problems occur in this process?

If department = reception

Do you have any regular problems whilst manually assigning documents which could not be matched?

How often are the documents (not) matched?

If department = after settling

Are there also PMI packages in the after settling process?

Are there problems with incoming documents in this process?

Do you use the core principles of the data import process?

- If yes, how do you use these?



Interview branch organization Adfiz (translated)

[Information written informed consent]

[Information goal of research and goal of interview]

There was a recent webinar about the issues with regards of data usage and transferring, with a special focus on documents, together with other branch organizations.

What type of errors were mentioned a lot during this webinar?

[Talk about problems discovered in our process]

Are you aware of any other chain problems?

- Possibly outside of documents and data
- Individual participants of the chain

Do you also have insight in the ADN PMI package flow?

- If yes, what are the most common problems in this flow.
- [problems from our side]

Do you have solutions for these mentioned problems?

- How can we implement these solutions at individual levels?
- What can we do to help realize these solutions?

Are there best practices which can be applied from for example the insurance agents?

In what way can we further develop straight through processing in the current system?

- What about the abilities of Software providers?



Interview and brainstorm ERP provider (translated)

In this interview and brainstorm session we will talk about the implementation of existing and new solutions in the future and newly developing ERP application.

What is your role in the development of the new ERP system?

What are you currently working on in this development?

[Introduction thesis]

We recognize the following problems at the current ERP system:

- PMI:
 - o Errors in customer data
 - o Errors in coverage data
 - o Lot of warning sin accepting PMI
 - o Translation matrices are not known and not correct
- Documents:
 - o Wrong specification of documents
 - o Invoice creation

We also have some questions with regards to the new ERP application:

- What is the process of development towards the new application?
- What could be the new process steps in the data import process?
- How will the recognition and assigned to the correct insurance?
- Are you going to implement bulk options at:
 - o PMI deletion process?
 - o Task creation when all documents are in and not earlier?
 - o Assigning documents?
- Are you going to implement STP at:
 - o Gathering documents?
 - o Two-way Aplaza connection?
 - o Invoice creation?
- Are there any ERP plans for the possibilities to split linked documents easily?
- Which standardize protocols are you going to follow?

- [Other processes not related to data import process]

Appendix E – Analytical Hierarchy Process

Overview

Of alternatives: 11

Of criteria: 3

Random consistency index n = 11: 1.51 (Piantanakulchai, 2003)

Random consistency index n = 3: 0.58 (Piantanakulchai, 2003)

Pairwise comparison matrices

Table 17 Comparison matrix considering criteria 1(C1)

C1	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11		Sum	Weight
a1	1.00	3.00	0.50	8.00	2.00	1.00	3.00	0.20	3.00	3.00	3.00		27.70	0.12
a2	0.33	1.00	0.17	3.00	0.25	0.20	0.50	0.11	0.50	0.50	0.50		7.06	0.03
a3	2.00	6.00	1.00	9.00	0.50	2.00	4.00	0.25	2.00	2.00	2.00		30.75	0.14
a4	0.13	0.33	0.11	1.00	0.00	0.25	0.33	0.11	0.33	0.33	0.33		3.26	0.01
a5	0.50	4.00	2.00	5.00	1.00	0.50	3.00	0.25	2.00	2.00	2.00		22.25	0.10
a6	1.00	5.00	0.50	4.00	2.00	1.00	4.00	0.20	3.00	3.00	3.00		26.70	0.12
a7	0.33	2.00	0.25	3.00	0.33	0.25	1.00	0.14	1.00	1.00	1.00		10.31	0.05
a8	5.00	9.00	4.00	9.00	4.00	5.00	7.00	1.00	7.00	7.00	7.00		65.00	0.29
a9	0.33	2.00	0.50	3.00	0.50	0.33	1.00	0.14	1.00	0.50	1.00		10.31	0.05
a10	0.33	2.00	0.50	3.00	0.50	0.33	1.00	0.14	2.00	1.00	2.00		12.81	0.06
a11	0.33	2.00	0.50	3.00	0.50	0.33	1.00	0.14	1.00	0.50	1.00		10.31	0.05
Sum	11.29	36.33	10.03	51.00	11.58	11.20	25.83	2.69	22.83	20.83	22.83		226.46	1.00



Table 18 Comparison matrix considering criteria 2(C2)

C2	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11		Sum	Weight
a1	1.00	5.00	0.33	7.00	0.33	0.33	2.00	0.20	3.00	2.00	5.00		26.20	0.10
a2	0.20	1.00	0.13	2.00	0.14	0.14	0.33	0.11	0.33	0.33	0.50		5.22	0.02
a3	3.00	8.00	1.00	9.00	3.00	2.00	5.00	0.33	5.00	4.00	7.00		47.33	0.18
a4	0.14	0.50	0.11	1.00	0.14	0.13	0.33	0.11	0.50	0.50	0.33		3.80	0.01
a5	3.00	7.00	0.33	7.00	1.00	1.00	3.00	0.20	2.00	2.00	3.00		29.53	0.12
a6	3.00	7.00	0.50	8.00	1.00	1.00	3.00	0.20	2.00	3.00	3.00		31.70	0.12
a7	0.50	3.00	0.20	3.00	0.33	0.33	1.00	0.14	0.50	1.00	1.00		11.01	0.04
a8	5.00	9.00	3.00	9.00	5.00	5.00	7.00	1.00	7.00	8.00	8.00		67.00	0.26
a9	0.33	3.00	0.20	2.00	0.50	0.50	2.00	0.14	1.00	2.00	3.00		14.68	0.06
a10	0.50	3.00	0.25	2.00	0.50	0.33	1.00	0.13	0.50	1.00	2.00		11.21	0.04
a11	0.20	2.00	0.14	3.00	0.33	0.33	1.00	0.13	0.33	0.50	1.00		8.97	0.03
Sum	16.88	48.50	6.20	53.00	12.29	11.10	25.67	2.69	22.17	24.33	33.83		256.65	1.00

Table 19 Comparison matrix considering criteria 2(C2)

C3	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11		Sum	Weight
a1	1.00	3.00	3.00	5.00	2.00	0.33	0.33	0.50	2.00	1.00	0.50		18.67	0.10
a2	0.33	1.00	0.33	2.00	0.33	0.20	0.17	0.20	0.50	0.33	0.25		5.65	0.03
a3	0.33	3.00	1.00	2.00	0.50	0.33	0.25	0.25	1.00	1.00	0.50		10.17	0.06
a4	0.20	0.50	0.50	1.00	0.50	0.33	0.25	0.25	1.00	1.00	1.00		6.53	0.04
a5	0.50	2.00	2.00	2.00	1.00	0.50	0.50	0.33	2.00	2.00	1.00		13.83	0.08
a6	3.00	5.00	3.00	3.00	2.00	1.00	0.50	1.00	3.00	3.00	2.00		26.50	0.15
a7	3.00	6.00	4.00	4.00	2.00	2.00	1.00	2.00	4.00	4.00	3.00		35.00	0.19
a8	2.00	5.00	4.00	4.00	3.00	1.00	0.50	1.00	3.00	3.00	2.00		28.50	0.16
a9	0.50	2.00	1.00	1.00	0.50	0.33	0.25	0.33	1.00	1.00	0.50		8.42	0.05
a10	1.00	3.00	1.00	1.00	0.50	0.33	0.25	0.33	1.00	1.00	0.50		9.92	0.06
a11	2.00	4.00	2.00	1.00	1.00	0.50	0.33	0.50	2.00	2.00	1.00		16.33	0.09
Sum	13.87	34.50	21.83	26.00	13.33	6.87	4.33	6.70	20.50	19.33	12.25		179.52	1.00



Table 20 Comparison matrix criteria

	C1	C2	C3		Sum	Weight
C1	1.00	2.00	0.33		3.33	0.25
C2	0.50	1.00	0.25		1.75	0.13
C3	3.00	4.00	1.00		8.00	0.61
Sum	4.50	7.00	1.58		13.08	1.00

Standardized matrices

Table 21 Standardized matrix considering criteria 1(C1)

C1	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11		Average	Ratio
a1	0.09	0.08	0.05	0.16	0.17	0.09	0.12	0.07	0.13	0.14	0.13		0.11	1.27
a2	0.03	0.03	0.02	0.06	0.02	0.02	0.02	0.04	0.02	0.02	0.02		0.03	0.99
a3	0.18	0.17	0.10	0.18	0.04	0.18	0.15	0.09	0.09	0.10	0.09		0.12	1.24
a4	0.01	0.01	0.01	0.02	0.00	0.02	0.01	0.04	0.01	0.02	0.01		0.02	0.80
a5	0.04	0.11	0.20	0.10	0.09	0.04	0.12	0.09	0.09	0.10	0.09		0.10	1.12
a6	0.09	0.14	0.05	0.08	0.17	0.09	0.15	0.07	0.13	0.14	0.13		0.11	1.28
a7	0.03	0.06	0.02	0.06	0.03	0.02	0.04	0.05	0.04	0.05	0.04		0.04	1.05
a8	0.44	0.25	0.40	0.18	0.35	0.45	0.27	0.37	0.31	0.34	0.31		0.33	0.89
a9	0.03	0.06	0.05	0.06	0.04	0.03	0.04	0.05	0.04	0.02	0.04		0.04	0.97
a10	0.03	0.06	0.05	0.06	0.04	0.03	0.04	0.05	0.09	0.05	0.09		0.05	1.10
a11	0.03	0.06	0.05	0.06	0.04	0.03	0.04	0.05	0.04	0.02	0.04		0.04	0.97

Table 22 Standardized matrix considering criteria 2(C2)

C2	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11		Average	Ratio
a1	0.06	0.10	0.05	0.13	0.03	0.03	0.08	0.07	0.14	0.08	0.15		0.08	1.42
a2	0.01	0.02	0.02	0.04	0.01	0.01	0.01	0.04	0.02	0.01	0.01		0.02	0.94
a3	0.18	0.16	0.16	0.17	0.24	0.18	0.19	0.12	0.23	0.16	0.21		0.18	1.13
a4	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.04	0.02	0.02	0.01		0.02	0.89
a5	0.18	0.14	0.05	0.13	0.08	0.09	0.12	0.07	0.09	0.08	0.09		0.10	1.26
a6	0.18	0.14	0.08	0.15	0.08	0.09	0.12	0.07	0.09	0.12	0.09		0.11	1.23
a7	0.03	0.06	0.03	0.06	0.03	0.03	0.04	0.05	0.02	0.04	0.03		0.04	0.99
a8	0.30	0.19	0.48	0.17	0.41	0.45	0.27	0.37	0.32	0.33	0.24		0.32	0.86
a9	0.02	0.06	0.03	0.04	0.04	0.05	0.08	0.05	0.05	0.08	0.09		0.05	1.18
a10	0.03	0.06	0.04	0.04	0.04	0.03	0.04	0.05	0.02	0.04	0.06		0.04	0.99
a11	0.01	0.04	0.02	0.06	0.03	0.03	0.04	0.05	0.02	0.02	0.03		0.03	1.05



Table 23 Standardized matrix considering criteria 3(C3)

C3	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11		Average	Ratio
a1	0.07	0.09	0.14	0.19	0.15	0.05	0.08	0.07	0.10	0.05	0.04		0.09	1.30
a2	0.02	0.03	0.02	0.08	0.03	0.03	0.04	0.03	0.02	0.02	0.02		0.03	1.03
a3	0.02	0.09	0.05	0.08	0.04	0.05	0.06	0.04	0.05	0.05	0.04		0.05	1.10
a4	0.01	0.01	0.02	0.04	0.04	0.05	0.06	0.04	0.05	0.05	0.08		0.04	1.07
a5	0.04	0.06	0.09	0.08	0.08	0.07	0.12	0.05	0.10	0.10	0.08		0.08	1.04
a6	0.22	0.14	0.14	0.12	0.15	0.15	0.12	0.15	0.15	0.16	0.16		0.15	1.02
a7	0.22	0.17	0.18	0.15	0.15	0.29	0.23	0.30	0.20	0.21	0.24		0.21	0.92
a8	0.14	0.14	0.18	0.15	0.23	0.15	0.12	0.15	0.15	0.16	0.16		0.16	1.05
a9	0.04	0.06	0.05	0.04	0.04	0.05	0.06	0.05	0.05	0.05	0.04		0.05	0.96
a10	0.07	0.09	0.05	0.04	0.04	0.05	0.06	0.05	0.05	0.05	0.04		0.05	1.02
a11	0.14	0.12	0.09	0.04	0.08	0.07	0.08	0.07	0.10	0.10	0.08		0.09	1.08

Table 24 Standardized matrix criteria

	C1	C2	C3		Average	Ratio
C1	0.22	0.29	0.21		0.24	1.08
C2	0.11	0.14	0.16		0.14	0.96
C3	0.67	0.57	0.63		0.62	0.99

Table 25 Consistency ratios

Criteria	Sum of ratios	Consistency index	Consistency ratio
Pairwise considering C1	11.69	0.07	0.05
Pairwise considering C2	11.94	0.09	0.06
Pairwise considering C3	11.60	0.06	0.04
Criteria comparison	3.03	0.01	0.02

Results

Table 26 Weights of alternatives and criteria coming from comparison matrices

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11		Criteria
C1	0.12	0.03	0.14	0.01	0.1	0.12	0.05	0.29	0.05	0.06	0.05		0.25
C2	0.1	0.02	0.18	0.01	0.12	0.12	0.04	0.26	0.06	0.04	0.03		0.13
C3	0.10	0.03	0.06	0.04	0.08	0.15	0.19	0.16	0.05	0.06	0.09		0.61

An overview of the results of the AHP are available in chapter 5, together with an explanation of the formulas used to calculate the values in these tables.