VISUALIZING SERVICE CONTRACT PERFORMANCE AND CUSTOMER BEHAVIOUR

INTERACTIVE DASHBOARDS

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ASSA ABLOY

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Visualising service contract performance and customer behaviour

Interactive Dashboards

Bachelor Thesis Industrial Engineering and Management

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Preface

This bachelor thesis contains the data visualisation of the performance of customers with service contracts and their behaviour and characteristics. This research is done to graduate from the bachelor Industrial Engineering and Management at the University of Twente.

First, I want to thank Indira Parlov and Gerrit Westhof which are the supervisors of the company where this research is done. I also want to thank Ben Koolstra and Johan Hazenberg for giving support with the collection of the data needed in this thesis.

Second, I want to thank the supervisors of the University of Twente. I want to thank Adina Aldea for guiding me through the whole process and the great feedback that was given. I also want to thank Jos van Hillegersberg for assisting my bachelor project and giving insight in service contract performance.

Benjamin Groeneveld, 2019

Management summary

Introduction
ASSA ABLOY entrance systems is a global leader in door opening solutions. The company has several decades of experience in creating automatic entrances. The company delivers automatic entrances to many different industries. Entrances for pedestrians and entrances for industrial use are both created. The company offers different service packages to service automatic entrances. The service packages that the company issues go from bronze to gold++ where bronze has the least service covered and gold++ has the most service covered within the contract.
This research has been conducted for ASSA ABLOY Entrance systems in Ede. The department in Ede covers the pedestrian door solutions. Therefore, this study focused on automatic entrances where pedestrians go through and excludes automatic industrial entrances.
The management team of the company asked to make the relation between the customer service department and the (gold) service contracts clear. To obtain insight in this topic a main research question is made. The main research question is: ‘‘How to gain insight into customer behaviour and the performance of the gold service contracts owned by the customers?’’.

Approach
To gain insight in the performance of service contracts and the behaviour of customers, dashboards are created. The Design Science Research Methodology has been used to solve to core problem. Literature reviews, interviews with managers and directors of the company made the creation of the dashboards possible.
Literature reviews have been done into:

- Performance Measurement
- Data quality, preparation and cleaning
- KPI selection
- BI-Dashboard Design
- Service Packages

The dashboards
In Excel seven dashboards have been created to visualize the performance of the gold customers and their behaviour.

1. The first dashboard is about the financial performance of the gold customers. In this dashboard a gold customer can be selected.
2. The second dashboard is about the reported malfunctions of gold contracts of customers. This dashboard gives the option to select a gold customer.
3. The third dashboard is about the order types and installation types of the reported malfunctions of the gold contracts. This dashboard gives the option to select a gold customer.
4. The fourth dashboard gives a financial comparison of gold customers and other customers. This dashboard gives the option to select all gold customers, all other customers or both the gold customers and other customers.
5. The fifth dashboard gives a comparison of the total amount of reported malfunctions of gold customers and other customers. This dashboard gives the option to select all gold customers, all other customers or both gold customers and other customers.
6. The sixth dashboard gives a comparison of the order types and type of installations that are mostly reported. This dashboard gives the option to select all the different contract types the company offers which are bronze, silver and gold. Also, data of no contract forms can be selected.

7. The seventh dashboard gives a comparison between bronze, silver and gold contracts. The dashboard displays the order types in three different categories in percentages for every contract type.

Conclusions and recommendations
This research gives insight in the behaviour of customers with service contracts and it shows the performance of these customers. The dashboards that have been created make the relation between the customer service department and the service packages visible. The norm of having insight in customer behaviour and characteristics with service contracts is attained with the help of the dashboards. The company can use the dashboards to analyse different gold customers and gold contracts. This can help them to adapt their strategy and take decisions based on the visualisation of data.

To improve the insight in customer behaviour and the performance of service contracts, recommendations are given to improve the dashboards. To increase the insight in gold contracts more only the data about the gold contracts of gold customers should be shown in the future. The data used in the dashboards stems from 2018, real-time data would make the dashboard more usable. Extra KPIs and measures can be added to give more insight in customer behaviour and the performance of service contracts.

Gold customers have a slightly higher margin than other contracts. Gold customers are reporting a higher percentage of their total entrances than other customers of the company. In the future it is possible that margins decrease since customers with gold contracts report more malfunctions. On the other hand, gold customers could have even higher margins in the future, because gold customers have a stronger relationship with the company than other customers which make the process between the two more efficient.

Boundary agreements with gold customers can be set up in new contracts. Acting outside of the boundary will create extra invoices. Customers that stay within the boundary can get a discount on next year’s contract. In this way the behaviour of the customers can be influenced.

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Reader's guide

In this bachelor thesis research has been done to visualize the performance of a customer service department in relation to their customers and products. This report contains eight chapters, below a short introduction is given.

Chapter 1. Introduction
The first chapter explains the problem as received from the company. It also gives an approach to solve the core problem described. Afterwards the research questions to be answered are given to solve the problem. Then the norm and reality are described to show the current and desired situation.

Chapter 2. Current and desired situation
The second chapter shows the current situation within the company. The desired situation shows the goal that is set to accomplish in this research.

Chapter 3. Theoretical framework
The third chapter gives the theory that is needed to solve the core problem. Theory on performance measurement, data quality, data preparation and date cleaning are explained. The third chapter also gives a systematic literature review on the selection of KPIs that can help this research. Theory on dashboard design and service packages are also provided.

Chapter 4. KPIs in the dashboard
The fourth chapter elaborates on the KPIs that were depicted from the systematic literature review and the interviews with managers. Per dashboard the implemented KPIs are explained and the way in how they are calculated is given.

Chapter 5. Dashboard design & development
In the fifth chapter the steps towards the design and development of the dashboard are explained. In this chapter the steps from data gathering to finally designing the dashboard are clarified. In the end of the fifth chapter the limitations of the data are described.

Chapter 6. Demonstration of the dashboards and evaluation
In the sixth chapter the seven dashboards are demonstrated with the help of screenshots. For every dashboard an explanation is given on how the dashboard can be used and what each dashboard visualizes. In the end an evaluation on the dashboards is given.

Chapter 7. Conclusion
In the seventh chapter the answer to the core problem is given together with recommendations to the company. The limitations of the research and recommendations for further research are also provided in the seventh chapter. Finally, contributions to theory and practise are described.

Definitions

Balanced scorecard	A set of measures that gives top managers a fast but comprehensive view of the business (Kaplan & Norton, 1992).
BI	Business intelligence (BI) is about gathering data of a company and/or their customers and process this data into information, that can be used for decision making.
BPMN	The Business Process Modelling Notation (BPMN) is the new standard to model business process flows and web services (Owen & Raj, 2003).
Dashboard	A dashboard is a tool that can visualise the performance of a business by making use of key performance indicators and metrics. A dashboard displays information in form of charts and gauges.
DSRM	Design Science Research Methodology (Peffers et al., 2007).
Installation	Installation is referred to as an automatic entrance.
ISO	International Organization for Standardization
KPI	KPI means Key Performance Indictor, which is a measurable that can value the success of a company on a certain activity.
Margin (%)	Margin (%) is calculated by dividing the total margin and the total sales on a certain product or service.
Margin (€)	Margin (€) is a profit that is made on a certain product or service.
Metrics	A set of numbers that can give information about a process.
MPSM	Managerial Problem-Solving Method, which is a framework to solve managerial problems that contains seven steps (Heerkens et al. ,2017).
Slicer	Makes filtering and selecting data in Excel possible.

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1. Introduction

In chapter one the company where the bachelor project is done for is introduced. The problem faced by the company is explained and the to be used research methodology is elaborated on. In addition, research questions are made to solve the core problem stated in this chapter.

1.1 Introduction to the company

ASSA ABLOY Entrance systems is a global leader in door opening solutions. The company has several decades of experience in producing automatic entrances for both pedestrian and industrial purposes.
The office of ASSA ABLOY entrance systems in Ede has a customer service department that handles all the problems customers encounter with their automatic entrances.

The company offers different kind of service contracts which go from bronze to gold++. Where the bronze contract has the least service covered and the gold++ has the most service covered.
In table 2 an explanation is given on the gold contracts, since that are the contracts that are important for this research.

Figure 1: Service contract types

1.2 Problem statement

The customer service department of ASSA ABLOY entrance systems in Ede is becoming busier and busier. The number of customers calling increases. This increased amount of calling customers to the customer service department make costs higher. To identify whether the situation of more calling customer to receive service is negative or positive, data will be analysed. By making data visible the directors and managers of the company can make decisions based on the visualisation of the data.

The company already analysis data to get insight in how they perform. But the relationship between the customer service department and their service contracts needs more attention. Within the company a lot of data is available. To analyse the data several KPIs will be used to gain insight. The chosen KPIs must give insight in the performance of the service contracts the company offers and the behaviour of customers towards the customer service department. The insights can then be used to adapt the strategy of the company to reduce costs and create better agreements in the service contracts.

1.2.1 PROBLEM SCOPE

The scope of the project will be on customers with pedestrian entrances which are entrances where only people go through, since the sales office of that division is located where the bachelor thesis is executed. There are ten weeks available for this research, therefore a scope is determined.

The focus of this bachelor thesis is on the reporting behaviour of customers about the malfunctions of their automatic entrances and the gold contracts issued. The costs that are made by the company to solve the malfunctions of the customers are only covered in the gold service contracts and not in other contract forms. These other contracts only provide periodic maintenance activities.

A customer with a gold contract pays a fixed amount for the contract per year. The more a customer with a gold contract reports for malfunctions of their installations, the higher the cost will be for the company.

All in all, the focus that has been requested by the management team is on visualising the data about the relation of the reported malfunctions and customers with gold contracts.

1.2.2 THE CORE PROBLEM

A problem cluster is made to identify the core problem. In the problem cluster the causal relations between the problems within the company are shown. In the top of the problem cluster the core problems are shown. It is important to focus on the core problem that is influenceable. All three paths in the problem cluster create higher costs.

The old intake system that logs the incoming calls about the malfunctions of customers, creates higher cost due to the fact that the problem of the customer is not well identified. The new service engineers are not able to solve the problems, therefore a new visit must be planned. The high amount of new service engineers also creates higher costs. The new service engineers often do not have the right skills to solve the problems of customers. The problems of the old intake system and the high amount of new service engineers cannot be solved in this bachelor thesis. The problem of no data visualization is influenceable. Therefore, the core problem that needs to be solved in order to decrease costs is:

There is no data visualization of the behaviours and characteristics of customers with service contracts towards the customer service centre.

By solving this core problem, the management team can get insights to take actions to improve their service contracts to reduce costs and to make the relationship with their customers more profitable.

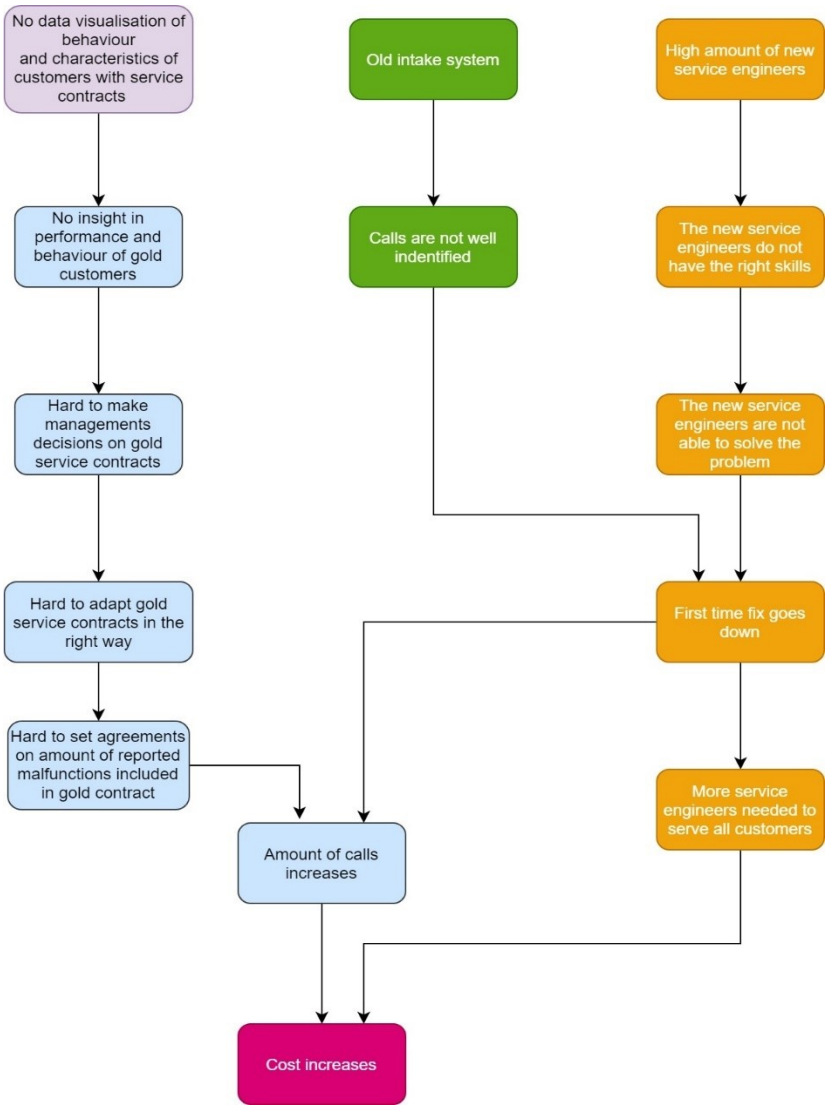

Figure 2: Problem cluster

Table 1: Legend problem cluster

	Problems that are solved when the core problem is solved
	Problems that cannot be influenced
	Problems that cannot be influenced
	Core Problem
	Action problem

1.3 Motivation for the research

The reason for starting the project is that the manager of the customer service department noticed that the incoming reports at the customer service department are rapidly growing. This trend has effects such as longer queues at the customer service department and increased costs.

The behaviour of customers and the turnover that are generated with the different service contracts differ a lot. Expectations of the managers that customers with gold contracts are calling more than other contract forms determines the scope of the project. Now they asked to visualize the data concerning this topic. So, the goal of the research will be to get the relationship between the customer service centre and the service contracts visualised with the help of dashboards. In figure 3 the relation between the customer service centre and the service contracts is shown.

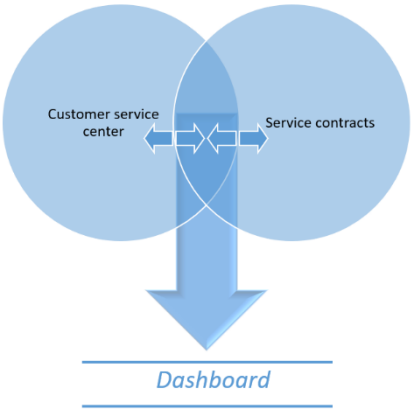

Figure 3: Relation between customer service centre and service contracts

1.4 Problem solving approach

In this section a method to solve the core problem is described. A problem-solving approach is used to have a systematic approach to solve the core problem. In order to find a solution to the core problem a problem-solving approach is chosen and followed.

1.4.1 RESEARCH METHODOLOGY

The research methodology chosen to solve the core problem is design science. Design science includes the following steps (Peffers, Tuunamen, Rothenberger, & Chatterjee, 2007):

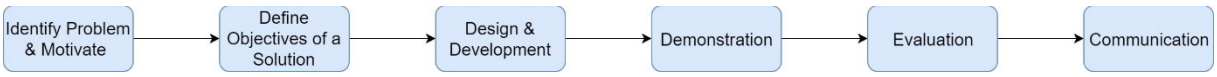

Figure 4: Design Science Research Methodology (Peffers et al., 2007)

The design science research methodology is chosen because, in this project a dashboard will be made. Therefore, the design science research methodology is more appropriate than the managerial problem-solving method (Heerkens et al., 2017), because in this research methodology there is no step such as design and development included. Therefore, it is hard to use the MPSM in this type of project. So, the design science research methodology is better applicable than the MPSM in this study.

Step 1. Identify problem & motivate

In the first step the problem is identified. First, all the problems within the company are summed up. After that, the relationships between these problems are made in a problem cluster. By applying the four rules of thumb described by (Heerkens et al., 2017) to this problem cluster the core problem is identified. In chapter one the first step of the DSRM is followed.

Step 2. Define objectives of a solution
The second step of the DSRM determines the objectives of the dashboards that will be made and the desired situation according to the company is described. In chapter two the current and desired situation of the company is given. Chapter three provides a theoretical framework that provides the information that is necessary for this research.

Step 3. Design and development
In the third step the design and development of the dashboard will be executed. In this stage, the data will be gathered and prepared to be able to design the dashboard. Chapter four describes all the KPIs that are chosen to use in the dashboards. In chapter five all the steps taken to design and develop the dashboards are described and explained.

Step 4. Demonstration
In the fourth step the prototype will be demonstrated with the help of screenshots. The demonstration of the prototype will be about what the prototype measures and how it can be used. In chapter six the demonstration of all the dashboards created is provided.

Step 5. Evaluation
In the fifth step the prototype will be evaluated. The feedback and opinions of the company will be described. In chapter six a multi-criteria evaluation on the dashboards by employees of the company is given.

Step 6. Communication
In the last step the product of this research will be communicated with other researchers and the relevant target audience. The evaluation described in step five will help to communicate the research and to describe the limitations. Recommendations for further research are also given.

1.4.2 THE RESEARCH GOAL

The research goal is to get insight in the reporting behaviour of customers with gold contracts. With the help of this insight, managers can have negotiations with customers that have unhealthy reporting behaviours. The management can improve their contracts with the help of the visualised data. Incentives or disincentives can be created to influence the behaviour of the customers with gold contracts.

1.4.3 THE RESEARCH QUESTIONS

Research questions are formulated to solve the core problem. First, the current situation should be made clear, then it is important to look at performance measurement. The data that is gathered needs to be prepared and the preferences and needs of the management team must be detected. Afterwards a literature study on the selection of KPIs will be done, KPIs can then be determined. When the literature reviews are done and KPIs are chosen, the dashboard can be created and the design of the dashboard can be determined. In the end the management team should be able to use the dashboard.

The main research question is:

How to gain insight into customer behaviour and the performance of the gold service contracts owned by the customers?

The insight that is desired to gain is about the reporting behaviour of the customer with gold contracts towards the customer service centre. Also, the financial performance of the customers is necessary to determine whether a customer with a gold contract is profitable or not.

1. **What is the current situation within the company?**

First, the current situation within the company must be clear to be able to know how the company currently acts and handles towards different customers. If the current situation is clear, a more precise way to improve this process is easier. Also, the difference between the norm and reality can then be shown. This first research question will give insight in how the company currently acts. Insight in the current negotiations and decisions making process concerning the service contacts are provided.

This research question can be answered by interviews with the manager of the customer service centre and employees that sell service contracts. By writing down the strategies and the way they currently work, an insight can be obtained to see what the current situation is.

2. **How can performance measurement be used to track the progress of the company?**

Performance measurement keeps track of the progress of the business. The balanced scorecard is used to show different perspectives that can help to choose the right strategy. A link will be made with the KPIs and the different perspectives of the balanced scorecard. In addition, other performance measurement perspectives than the balanced scorecard are given.

To answer this research question, literature on performance measurement will be used. Especially the balanced scorecard will be used to show how KPIs are performing in different perspectives.

3. **How to clean and prepare the data from different datasets?**

To combine different datasets and to make the data as valid as possible several steps must be taken. When the data is prepared, cleaned and made valid, it can be used for the dashboard.

This research question can be answered by al literature study and interviewing the financial manager and the program manager of the company. First a scope must be determined, then the data that is not relevant can be removed.
A literature study on several dimensions of data quality is done to clean and prepare the data. Afterwards the data can be used into the dashboard.

4. **What KPIs should be selected in the dashboards?**

This research question is about the KPIs that must be included in the dashboards according to literature and the management team. The literature review is done to show the available KPIs in literature that can measure the financial performance of service contracts. The literature review looks also at KPIs about the behaviour of customers with service contracts. The already existing KPIs that are in literature should be evaluated to determine the usability of these KPIs in this research.

The interviews with the managers of the company are needed to get insight in what KPIs they need to get the relationship between the service contracts and the customer service department clear.

To answer this research question, a systematic literature review will be done. Based on literature and managers needs a KPI selection can be made. The opinions of the managers should be considered with selecting the KPIs since they have to use the dashboard.

5. How should the design of the dashboard look like according to literature?

In the design and development phase, several aspects of how a dashboard must look like to be able to make the best use of it should be considered. For example, which options to select from and what charts display the data the best.

For this research question a literature review will be done to ensure the usability of the dashboard. To ensure that the data is clearly visible and usable, the dashboard should be clear. The brand style of the company will be kept in mind considering the design of the dashboard.

6. What is the effect of different service packages on customers?

With this research question more insight is gained in what effects different service packages have on the behaviour of customers according to literature. To get a good understanding on what effects service packages have on customers, a better recommendation can be given with the help of the created dashboards.

This research question will be answered by doing a literature study and interviews with employees of ASSA ABLOY. Based on articles from literature an understanding of the effect of service packages can be obtained. This research question will also be answered by interviewing the sales director and an employee of contract sales. The director service sales will be interviewed, to get a better understanding of how different customers behave with different service contracts.

7. How should the dashboard be used?

The dashboard should fit the company. The dashboard should perfectly target the needs of the management team. Also, the program in which the dashboard is made should be available to the employees, it must be in line with the current programs used. The way in how the company should use the dashboard to discover possible improvements in their service contracts and customers is considered in this research question.

This research question will be answered by having interviews with the manager of the customer service department and the service sales director. To be able to analyse the data visualisation in the dashboards in the best way, a clear description must be made.

1.5 Norm and reality

It is needed to determine a norm and reality to see whether the solution provided to the company reached the norm. It is important that the norm and reality can be measured. To be able to measure the norm and reality, indicators are needed. A multi-criteria evaluation will be done in the end to show the difference after the implementation of the solution.

In the current situation there is no data visualisation of the characteristics and behaviours of customers with their contracts. When the data is visualized with the help of KPIs in dashboards, insights in the characteristics and behaviours of customers are generated and can then be used to give recommendations to the management team of the company. The goal of this project is to give the management team insights to be able to act in the best possible way towards customers with service contracts.

Norm: Have insight in customer behaviour and characteristics with service contracts
Reality: No insight in customer behaviour and characteristics with service contracts

2. Current and desired situation

In this chapter the first research question: ‘‘What is the current situation within the company’’ is answered. In section 2.1 the current situation within the company is described and an explanation of the relationship that is researched is given. The desired situation is discussed in section 2.2.

2.1 Current situation

In this research the relation between the service contracts of the company and the logged malfunctions of the installations of customers is made. To understand what the two aspects entail an explanation is given on the gold service contracts and the logged malfunctions of customers. It is important that the two aspects are well explained to understand the relation between the two.

ASSA ABLOY entrance systems offers different types of service contracts to customers. The focus of the bachelor assignment is on gold contracts. Within the type gold contracts three distinctions are made. The three different gold service contracts with their characteristics are shown in table 2. Further on in this thesis, only gold contracts will be referred to. The data used in this research is not divided into Gold, Gold+ and Gold++, but only in gold contracts.

Table 2: Explanation of gold contracts

Gold	Including call out charge and working hours for the execution of periodic maintenance Including call out charge and working hours for malfunctions Including materials for periodic maintenance and malfunctions Excluding call out charge, working hours and materials for external causes of malfunctions
Gold+	Including call out charge and working hours for the execution of periodic maintenance Including call out charge and working hours for malfunctions Including materials for periodic maintenance and malfunctions Including call out charge, working hours and materials for external causes of malfunctions
Gold++	Including call out charge and working hours for the execution of periodic maintenance Including call out charge and working hours for malfunctions Including materials for periodic maintenance and malfunctions Including call out charge, working hours and materials for external causes of malfunctions Including replacement of installations with a budget created by an account manager

ASSA ABLOY entrance systems has a customer service department which handles all the reported malfunctions of the entrances of customers. The malfunctions of the customers are logged into the system at the customer service department. After a malfunction is logged into the system a service engineer will solve the problem of the installation of the customer. Afterwards an invoice will be sent to the customer which depends on the type of contract the customer has. The gold contract only gets an invoice when the cause of the malfunction is an external cause. The gold+ and gold++ contract cover also the costs for external reasons of malfunctions.
To better understand the process from a customer calling for help and have their problem solved in the end, a BPMN model is given in figure 5 to visualize this process.

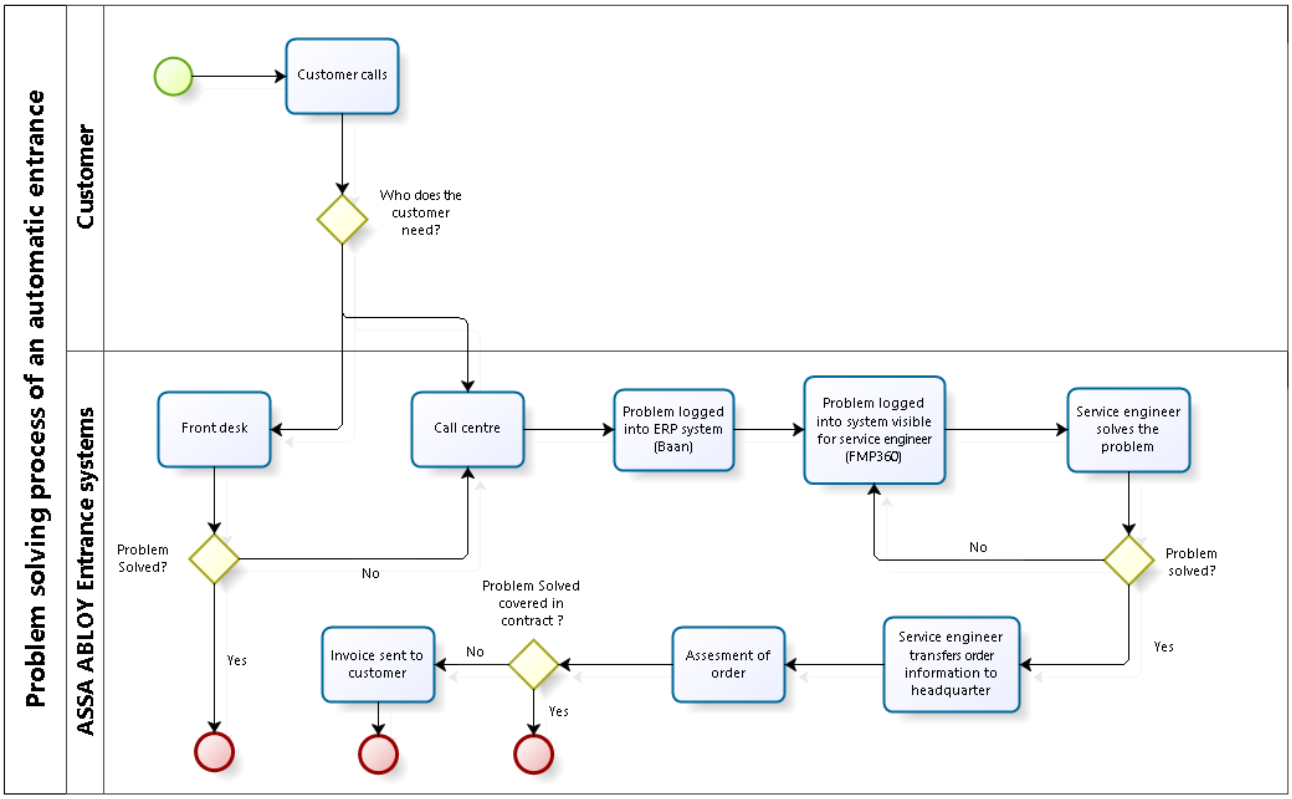

Figure 5: BPMN model of solving a malfunction

To get a better understanding of how contracts are given to customers interviews were arranged with an employee of contract sales and the service specialist. These interviews gave several criteria to determine a contract type of a customer. In table 3 a list of all the criteria is given.

Having a long-term relationship with customers was the first thing the seller of the contracts mentioned. According to the employee from ASSA ABLOY a contract is not beneficial when it is not for the long term. To keep a customer for the long term a good set of adaptive service packages must be chosen for the customer. The service contracts given to automatic entrances of the customers depend on different aspects.

Table 3: Criteria to determine contract type of a customer

Criteria	Explanation
Ratio maintenance costs/ purchase price	when maintenance cost is high and the new price of an entrance is low, entrances tend to be replaced faster.

Criteria	Explanation
Frequency of usage	When the frequency of usage is high, more service is needed to keep the entrance running.
Importance of the installation	An important entrance such as an entrance of a room for surgery, needs a contract that makes sure the entrance is always running.
Mindset of customer	When an advice is given to the customer, the mindset of the customer must also be considered.
Amount of entrances of customer	Customers with a high amount of entrances often get discounts.
Age of entrance(s)	Old entrances (often) do not get all-inclusive contracts which are known as gold contracts.
Type of customer	The amount of risk a customer takes depends the contract type.
Type of entrance	The type of the entrance determines the amount of service needed.
Ratio of Cost of Maintenance/ Price of installation	When the costs to maintain a certain installation exceeds a certain value, the installation often does not get a service contract.

2.2 Desired situation

The ideal situation for the company is that they can predict how much malfunctions a customer will report. Then a perfect adapting contract can be made that optimises the margin on a particular customer. Of course, it is not possible to perfectly identify future customer behaviours and characteristics. Therefore, it is important to learn from the past. A selection of KPIs is made to measure the performance of the contracts and the reporting behaviour of the customers. The created dashboards give insight in the relationship between the reported malfunctions of customers with gold contracts. The insights the dashboards provide is on the type of entrances and the order type of the reports.

The negotiations of future customers must be made easier. The goal in this research is to give more insight into the behaviour of customers with gold contracts to create better negotiations and agreements with future customers.

In the future it is an option to determine a maximum number of malfunctions covered within gold contracts per customer. In future contracts, agreements on the number of malfunctions that customers are allowed to call for can be included in the gold contracts. When customers act outside of the agreement an extra invoice can be sent. For the customers that do not report any malfunctions, some sort of discount can be given. Another possible recommendation can be on the performance of an installations itself. Machines that often break-down must be improved to ensure better performance and less breakdowns. All these possible advices combined must create a right step into the right direction of the improvement of the relationship of the gold service contracts and the reported malfunctions of the installations.

3. Theoretical framework

This chapter answers several research questions. The research questions where literature is needed for to answer them is given in this chapter. This theoretical framework describes all the theory that is necessary to guide the whole research process. First theory on performance measurement is used to allocate the KPIs form literature into different perspectives. Afterwards, theory on data management is provided to be able to prepare and clean the data in this research. Also, theory on the design of a dashboard and the graphs that can help display the data is given. Lastly, theory on service packages is given to get insight in what effect service packages have on customers. Section 3.1 answers research question 2. In Section 3.2 the answer is given to research questions 4. Section 3.3 answers research question 3 and section 3.4 answers research question 5. In Section 3.5 the answer is given to research question 6.

3.1 Theory on performance measurement

The theoretical perspective is performance measurement. Performance measurement is about tracking the performance of an organization. The key elements of this performance measurement is its focus on program results rather than the physical outputs that an agency provides (Hatry & Bryant, 1998).

The balanced scorecard is used to distinguish different perspectives of performance measurement. Within the balance scorecard four different perspective are available. Namely: the financial perspective, internal business perspective, innovation and learning perspective and the customer perspective. The balanced scorecard is like the dials in an airplane cockpit: it gives managers complex information at a glance (Kaplan & Norton, 1992). These four different perspectives will be considered while selecting the KPIs applicable to this research from the articles.

The balanced scorecard gives a balanced representation of financial and operational measures. The financial measures are complemented with customer, internal processes, innovation and improvement activities. It is important that the focus should be on multiple activities and not only on the financial aspects.

The first perspective is about the customers. This perspective is about how to give value to customers. The company should set goals to improve the value for the customer. Evaluation of the customers opinions should be gathered to get an impression of how the customers thinks about the service a company provides. Four types of measures are considered in the customer perspective which are about time, quality, performance and service.

The second perspective elaborates on the internal business. This perspective tells what must be done internally in the business to serve the customers. The focus in the business should be on the processes, decisions and the actions within the organization. Information systems can help to boost improvements and detect problems.

The third perspective concerns innovation and learning. Continuous improvement is needed to grow the value of the company. Revenues and margins can be improved with the help of new products and services. New markets can be tapped into when new or improved products or services are established.

The fourth perspective expresses the financial aspect. Financial performance shows whether the strategy, implementation and execution are performing well or not. Financial measures can help a company to control the quality of the firm. On the other hand, it cannot be assumed that when the operation of a company improves the financial performance also improves.

The balanced scorecard approaches performance measurement with the relationships of the four perspectives. The relationships between these four perspectives is important. For example, financial performance depends on the other three relating perspectives. The decision-making process of managers can be improved by not only focusing on the financial performance but also on the other aspects.

Measures should focus on the four perspectives of the balanced scorecard. Performance measurement traditionally has the focus on the financial perspective according to Kaplan & Norton (1992). The balanced scorecard shows that measures on the three other aspects are important, because there is a relationship between the perspectives. When in one aspect improvements are made, the other perspectives can be positively influenced. To track the performance or progress of a company measures of the four perspectives of the balanced scorecard should be considered.

In addition to the balanced set of measures retrieved from the balanced scorecard from Kaplan & Norton (1992), more essentials of performance measurement are given by Moulin (2004). Measures that are imported to different stakeholders and staff should be considered since they are executing plans within the company. Outcome and process measures should be included. The amount of measures should be cost effective to be able to be valuable. Finally, the measurement system needs to have to focus on continuous improvement (Moulin, 2004).

Alternatives to the perspectives of the balanced scorecard are also discussed. The other perspectives will help to understand where the success of a company can come from. To get an understanding of how performance measurement can help the success of a company, different perspectives are looked at. With the help of several perspectives an insight is obtained in how success is determined.

Another performance measurement perspective is described by Lakhal (2009). The three different perspectives of this framework are quality, competitive advantage and organizational performance. The focus of this framework is on these three perspectives. Many companies have improved the quality of their products and services in order to enhance organizational performance and to be competitive (Lakhal, 2009).

The first perspective is on the quality of the service or product provided by the company. In this research the quality of the service is important. Quality is perceived differently by customers, therefore Lakhal (2009) defines quality of products in different ways. Garvin (1987) describes eight different quality dimensions. The most important two of the eight in this research is serviceability and reliability. Serviceability is important because the capability of the company to deliver a good service is important to the customer. The reliability of the installation of the company is also important, because a reliable product tends to break down less often than an unreliable installation. The combination of these two quality dimensions described by Garvin (1987) are of importance in this research.

The second perspective of Lakhal (2009) is on competitive advantage. Competitive advantage is the extent to which an organization is able to create a defensible position over its competitors (Porter, 1985).
Two models that are described by Lakhal (2009) are the market-based model and the resources of a firm. The market-based model is about cost and differentiation. The second model focuses on the firm's resources and is driven by factors that are internal to the firm (Lakhal, 2009). The reduction of cost and the differentiation of a product or service can give a competitive advantage. The second models show that a competitive advantage can arise from internal factors of a firm.

The third perspective mentioned by Lakhal (2009) is about organizational performance. The balanced scorecard of Kaplan & Norton (1992) shows that it is important for an organization to not only focus on the financial performance of a company. Other research also tells that focusing only on financial measures is not sufficient. The traditional

approach to performance measurement using solely financial performance measure is flawed (Tangen, 2004).

The research of Lakhal (2009) shows the importance of the three perspectives mentioned. According to Lakhal (2009) the quality enhances the other two perspectives. Therefore, a good quality of the installations of a company are of great importance to boost organizational performance and competitive advantage of the company.

Khan, Chaabane, & Dweiri (2019) describes long-term and short-term decisions. Performance measurement is critical to the success of the Supply chain (Khan, Chaabane, & Dweiri, 2019). The success of a company depends on short-term and long-term decisions. Long-term decisions making is strategical and tactical. The strategic level includes decisions that have a long-lasting effect on the firm (Khan et al., 2019). Short-term decisions making is on operation level. These are all the decisions a company has to make on a daily level.

The two perspectives described by Khan et al. (2019) show the importance of focusing on both long-term and short-term decision making. Khan et al. (2019) states that the relationship of the two perspectives allows decision makers to see the impact of their decisions.

All the perspectives explained in this section give different insight in how to measure the success of a company. The solution created in this research should consider the different perspectives to give a balanced overview of the whole company.

In table 4 an overview is given of the source from literature and their perspectives.

Table 4: Overview of perspectives by source from literature

Article	Perspectives
(Kaplan & Norton, 1992)	Financial Internal business Innovation and learning Customer
(Moulin, 2004)	Stakeholders & Staff Outcome & Process measures Cost effectiveness Continuous improvement
(Lakhal, 2009)	Quality Competitive advantage Organizational performance
(Khan, Chaabane, & Dweiri, 2019).	Long-term decisions Short-term decisions

3.2 Theory on KPI selection

In this chapter a summary and discussion of the articles from the systematic literature review is given and the answer to research question 2 is obtained. The answers will give the KPIs that are needed to visualise the data of the company. The selected KPIs will be used into several dashboards to be able to analyse the data of the past.

3.2.1 SELECTING THE KPIS

Four articles have been selected out of the systematic literature review. Out of these articles KPIs are selected that are relevant to solve knowledge question 4. Thereby KPIs are chosen that the management of the customer service department wanted into the dashboard. The KPIs are divided under the perspective of the balanced scorecard of Kaplan & Norton (1992).

To determine the right KPIs to visualise the relation of service contracts and customer behaviour, it is important that different approaches on the kind of relationship with a customer is gained insight in.

An approach described by Akkermans, H., van Oppen, W., Wynstra, F., & Voss, C. (2019) is collaborative service design. According to this article collaboration of buyer and provider is needed. The close collaboration made the two parties both committed. Since problems often must be solved by both parties, the close collaboration is important to optimise the service process. The key performance indicators chosen from Akkermans et al. (2019) mainly focus on the cooperation performance of the two parties. The relationship described concerns the IT business and in this bachelor thesis it concerns a company that provides automatic entrances. Therefore, the applicability of the KPIs out of this article to the company where this research is done should be closely looked at.

Mourtzis, D., Fotia, S., Vlachou, E., & Koutoupes, A. (2018) describes a product service system and gives a framework of how a product service system must look like. Three aspects are involved in the product service system which are the KPI, lean rules and feedback provided by the customers. These three aspects are needed to make a good dashboard of the customer service contracts performance and behaviour according to Mourtzis et al. (2018).

KPIs for maintenance purposes where depicted from the article. Mourtzis et al. (2018) displays the importance of the improvement of a product-service system and not only on issues concerning this system. Also, a clear framework of KPIs for product-service systems is provided, which can be used in the dashboards.

Legnani, E., & Cavalieri, S. (2009) describes an after-sales service system. Satisfaction and, hopefully, loyalty have a significant influence on the company profitability (Legnani, E., & Cavalieri, S. , 2009). A company must work closely together with other parties to provide the service to the customers. Legnani, E., & Cavalieri, S. (2009) gives KPIs to measure the performance of this relationship and the importance of the performance measurement system with their actors by a set of KPIs is explained. Also, the variety of the KPIs which say something about reliability, responsiveness, agility, assets, costs and growths are given by Legnani, E., & Cavalieri, S. (2009). These different types of perspectives are customer, service-network and the company perspective. The relation between all the perspectives of after sales systems with correlated KPIs helps to understand what positive and negative effects indictors have on each other.

Fugini & Siadat (2010) describes that service systems have an influence on the business processes. Five major phases: (1) Identifying KPI, KGI and IT infrastructure parameters; (2) SLA Contract creation; (3) Evaluation and monitoring; (4) Adaptation; (5) Contract Update (Fugini & Siadat, 2010). The third step contains monitoring. By monitoring the execution of the processes of the business, an optimisation of the contract is possible. Fugini & Siadat (2010) gives several KPIs which are shown in table 5.

Akkermans et al. (2019) focuses on the performance of the cooperation between the stakeholders and Legnani, E., & Cavalieri, S. (2009) describes not the cooperation but the relation of the different perspectives and their effects. Mourtzis et al. (2018) gives more additional KPIs that are important for the improvement of the service system, not talking specifically about the relation as is done in the other two articles mentioned above. Fugini & Siadat (2010) provides a framework that has the focus on improving

service contracts. The KPIs given from this article have the goal of monitoring and adapting service contracts to make improvements.

In conclusion, the articles give insight in the relation in service systems and provides KPIs that are relevant to this topic. The combinations of the four articles show the importance of the collaboration of the customer and service provider. Thereby the improvement of a service system is discussed and different perspectives are given. All these aspects give an overview of what KPIs and collaboration issues are important to take into consideration the relation between customer and service supplier.

In table 5 all the KPIs from literature out of section 3.2.1 that can measure the performance of the customer service centre and the different service contracts are shown.

Table 5: KPIs selected from the articles

	Financial perspective	**Internal business perspective**	**Learning and innovation perspective**	**Customer perspective.**
Title and source				
Contracting outsourced services with collaborative key performance indicators (Akkermans et al., 2019)	Cost reduction	Fulness of file systems	First time right Prevention	Customer order changes
				Customer satisfaction
	Revenues	Work pressure	Quality	Customer queries
				Customer calls
A Lean PSS design and evaluation framework supported by KPI monitoring and context sensitivity tools (Mourtzis et al. ,2018).	Corrective maintenance costs	Amount of preventive maintenance activities	Actual maintenance time	
	Percentage of maintenance rework	Maintenance effectiveness		
Exploring the causal relationships of KPIs in after sales service systems (Legnani & Cavalieri, 2009)	Fraction to invest	Assist agility	Quality of investments	New customers
	Return on assist assets			Loyalty
	Revenue	Responsiveness		Recruitment Rate
	Assist operating income	Pending requests		Customer Value

	Financial perspective	**Internal business perspective**	**Learning and innovation perspective**	**Customer perspective.**
	Spare parts costs	Reliability of the firm		Non-monetary costs
	Growth	Agility		Product-service quality perceived
				Planned request rate
				Unplanned request rate
SLA Contract for Cross-Layer Monitoring and Adaptation (Fugini & Siadat, 2010)	Price	Service Level	Reputation	Response Time
	Cost	Availability	Acceptable Downtime	Downtime

3.3 Theory on data quality, preparation and cleaning

The used KPIs from both literature and interviews can be measured accurately when the quality of the data is ensured. Several steps are needed to provide the quality of the data to be able to use it for a dashboard. In this section literature is given to be able to increase data quality.

3.3.1 QUALITY OF THE DATA

When data from one or more sources is loaded into the warehouse, there may be errors (Chaudhuri, S., et al, 2011). The data that is gathered from different sources may contain errors that give a wrong image of the situation within a company. Even when data from one database is acquired, data quality is not assured. The same database: for one use it has poor data quality, and for another it has high data quality (Olson, 2003). As described by Olson (2003) it depends on the situation whether the quality of the data is good or not. Sometimes extra information about the data ensures the quality of the data. Poor data quality can have substantial social and economic impacts (Wang & Strong, 1996).

A conceptual framework about data quality is described by (Wang & Strong, 1996). The framework is a hierarchal framework with four different roots. The four different categories are intrinsic data quality, contextual data quality, representational data quality and accessibility data quality.

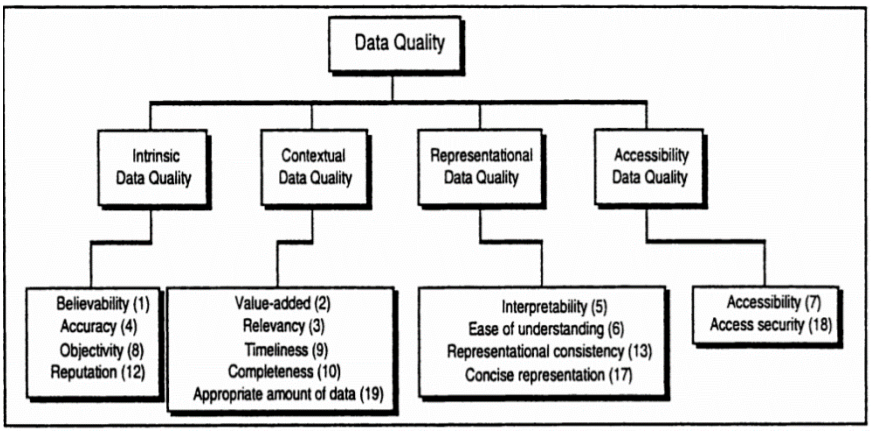

Figure 6: Conceptual framework of data quality (Wang & Strong, 1996)

Intrinsic data quality is about accuracy and objectivity. It is important that the data is interpret in the right way, therefore the objectivity must be guaranteed. The believability and reputation are also important according to (Wang & Strong, 1996). Accuracy and objectivity alone are not sufficient for data to be considered of high quality (Wang & Strong, 1996).

Contextual data quality considers that data must be within the context of the task that has to be executed. The type of task and the data user itself tell whether the data is of high quality or not. Data quality is perceived differently in other situations, therefore it is important to consider the context.

Representational data quality regards the format of the data. The data must be understandable and interpretable. The data can be better understood when it is concise and consistently represented.

Accessibility of data is important for a user. Wang & strong (1996) found that data consumers on computers see accessibility as an important aspect of data quality.

The conceptual framework of (Wang & Strong, 1996) shows four important categories of data quality. The four categories give insight on what high data quality is.

3.3.2 CLEANING AND PREPARATION OF THE DATA

To ensure valid data and high-quality data, cleaning and preparation is needed. The purpose of data cleaning (data scrubbing) is to detect and remove errors and inconsistencies from data in order to improve their quality (Cai, L., & Zhu, Y. 2015).

The data quality standard is composed of five dimensions of data quality - availability, usability, reliability, relevance, and presentation quality (Cai, L., & Zhu, Y. 2015).

First, the *availability* of the data is looked at. The availability of data depends on the accessibility and the authorisation. due to

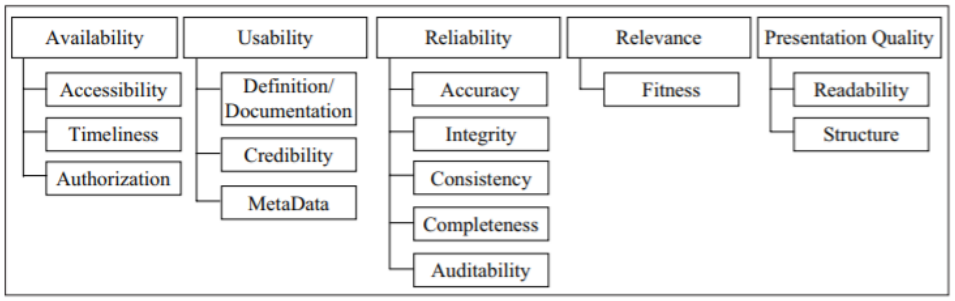

Figure 7: Five dimensions of data quality (Cai, L., & Zhu, Y. 2015)

confidentiality it is possible that data is not available for usage. When a person is not authorized by a company, the data is not accessibly.

Second, the *usability* of the data depends on whether the values in the data are usable or not. The acceptability of the data should be considered. The data that is outside of the acceptability of certain values that has been determined is not usable.

Third, the *reliability* of the data depends on several aspects. Consistency of the data is important to have the same values over a whole data set. Also, the consistency between different data sets is important. The data can then be combined. Data completeness is important to be able to use the data. Missing data decreases the insight in the overall dataset.

Fourth, another dimension of data quality is the *relevance*. Relevant data is about the data fitting the needs of the research. The amount of the data is also important for the relevance.

Lastly, the *presentation quality* is looked at. The data must be understandable and readable. Structured data increases the ability to understand the data.

Sidi et al. (2012) describes two strategies to improve the data quality. The two types are data-driven and process-driven. Data-driven is strategy for improving the quality of data by modifying the data value directly (Sidi et al., 2012). Techniques to improve the data quality described by Sidi et al. (2012) are: acquisition of new data, standardization or normalisation, error localisation and correction. Process-driven is another strategy that redesigns the process which is produced or modified data in order to improve its quality (Sidi et al., 2012). The two main techniques used according to Sidi et al. (2012) are process control and process redesign.

In practice, it has been generally found that data cleaning and preparation takes approximately 80% of the total data engineering effort (Zhang, Zhang & Yanh, 2003). This shows that the cleaning and preparation of the data takes a lot of time. Data that is not well prepared and cleaned creates several issues: (1) disguising useful patterns that are hidden in the data, (2) low performance, and (3) poor-quality outputs (Zhang, Zhang & Yanh, 2003). By cleaning and preparing data, better quality of the data is obtained. It must be possible to prepare quality data from the raw data to enable efficient and quality knowledge discovery from the data given (Zhang, Zhang & Yanh, 2003).

In this section five standards of (Cai, L., & Zhu, Y. 2015) are described about the quality of data. To improve and clean the data, these five dimensions of data quality must be kept in mind. (Sidi et al., 2012) describes two strategies to improve data quality. (Zhang, Zhang & Yanh, 2003) gives several issues that bad quality data creates.

3.4 Theory on BI-dashboard design

To draw the right conclusions from a dashboard not only the right KPIs should be selected, but also a close look must be taken to the design of the dashboard. The chosen KPIs can be visualised by a lot of different charts and graphs. In this section an overview is given on what the design of a dashboard must look like to ensure better interpretations and visibility.

To determine the best design of a dashboard several things must be considered.
First, the management team must be considered. The managers are the one that are going to use the dashboard. The combination of literature and the outcomes of the interview with the manager of the customer services determines the design.
Second, the type of charts and graphs that are available in Excel that match the data and KPIs must be looked at.

Third, the way in how the different charts and graphs are set out on the page is important.

3.4.1 CHARTS AND GRAPHS

When a clear need of the management team is determined and the data is ready to use, charts can be made from this prepared data.
A set of charts described by Alexander & Walkenbach (2013) with their purpose is shown in table 6.

Table 6: Chart types (Alexander & Walkenbach, 2013)

Chart Type	**Function/Explanation**
Column Charts	This type of charts shows data points vertically. The height of this point shows the value.
Bar Charts	The advantage of a bar chart is that the labels are often easier to read.
Line Charts	To make continuous data visible, line charts are used to identify a trend over time.
Pie Charts	To show contributions of a whole, pie charts can be used. Pie charts should not be used with a large amount of different data points, otherwise it will be hard to understand.
Scatter Charts	A scatter chart shows data points on both the axes. A scatter charts is helpful to make relationships between two variables visible.
Area Charts	Area charts are basically line charts where the area below has been filled.
Doughnut Charts	A doughnut chart is the same as a pie charts, but there are two differences. A doughnut charts has a hole in the middle and it can show more different data.
Radar Charts	Each category in a radar chart has a separate axis. The value of the data is placed on the axis of the category.
Surface Charts	Surface charts are displayed in 3-D. It can show two or more data series.
Bubble Charts	Bubble charts are almost the same as scatter charts. Bubble charts can tell a little more due to the size of the bubble.
Stock Charts	Stock charts need a minimal of three data series. They are most of the time used in the stock market.

3.4.2 THE LAYOUT OF THE DASHBOARD

It is crucial that the dashboard features (visual and functional) and the contents fit with the dashboard purpose (Vilarinho, Lopes, & Sousa, 2018).
There are several aspects that need to be taken into account when considering the layout of the dashboard.
End users such as executive members can only perform simple filtering and layout changes in most of the cases (Chua et al., 2018). So, it is important to keep the dashboard simple to make sure managers can easily use the dashboards.
Kwapien (2018) defines several design principles.
First, not all the information has to be on the same page, using several dashboards can make the information come across easier.
Second, not too much different colours must be used to enhance the attention.
Third, providing context is important to show whether the data is normal or not. Colours can be added to a value to understand the value better. Also, comparisons values help to understand whether a certain value is normal or not.

3.4.3 USABILITY OF THE DASHBOARD

The ISO standards defined usability as the software's capacity to be understood, learned, used, and to be attractive to the user in specific use conditions (Dyczkowski, Korczak, & Dudycz, 2014). Usability enables the users to easily access BI functionalities and it ensures developers and administrators a high productivity (Golfarelli, 2009). The four basic principles on usability according to the ISO are: ease of learning, ease of use, flexibility and robustness.

Gulati (2016) describes several ways of creating a usable dashboard. First, the consistency is important. Words and actions on a dashboard should mean the same. Second, errors should be prevented. When a user of a dashboard performs an action, the action should not generate an error. Third, a minimalistic design can help to only show the relevant information on a dashboard.

3.5 Theory on service packages

Over the last several decades, leading-edge firms, as well as many business scholars and consultants, have advocated the need for refocusing substantial firm activity or transforming the entire firm orientation from producing output, primarily manufactured goods, to a concern with service(s) (Vargo & Lusch, 2008).

The common justification is that these initiatives are analogous with the shift from a manufacturing to a service economy in developed countries, if not globally (Vargo & Lusch, 2008). The question asked by the article of Vargo & Lusch (2008) is whether this trend is positive or not to a company’s success. First the focus was only on the output of products, whereas now the focus is also on service.

Vargo & Lusch (2008) states that collaborations and partnerships with customers are of importance in business to business marketing. The relationships create strong ties amongst companies. According to (Vargo & Lusch, 2008) when service is seen as a process instead of the perception of output of units, the locus of value creation, then moves from the “producer” to a collaborative process of co-creation between parties (Vargo & Lusch, 2008).

Hadayati, Ginting & Nasution (2018) describes the behaviour of customers choosing a service provider, this article is used to understand what decisions customers make in choosing a certain provider of service. Hadayati et al. (2018) describes the telecommunication business.

Customers have different preferences on what kind of service they want to receive. When the behaviour of customers is known, a better adaption in offering the service can be given. Customers focus on different aspects of service such as the quality of service and the price of the service according to Hadayati et al. (2018). The culture of the customer also depends preferences in what kind of service they want. Applicable criteria given by Hadayati et al. (2018) that give additional insight are satisfaction, price, quality & speed and influence of circumstances. All these criteria have an influence on customer behaviour.

Satisfaction and image of the company are a big factor on the decisions of customers (Hadayati et al., 2018). Also, the quality is important to customers. The price and the extern influences do not have that much influence on the behaviour of the customers according to (Hadayati et al., 2018). Satisfaction is of great importance to have a long-term relationship with customers.

In business markets, suppliers often create customized service packages (CSPs) to avoid difficult pricing decisions or tedious negotiations (Steiner, Eggert, Ulaga, & Backhaus, 2014). The suppliers of complex goods in business markets allow their business customers to choose the service elements they need and want for their specific applications (Steiner et al., 2014). So, the customer voice is of great importance choosing the amount of service a customer wants.

The literature in this section provides an insight of what effect service packages have on customers. The insight obtained help to understand the service contracts of the company better. There is a shift in companies providing services next to their output of products. When this service is seen as a process, relationships and partnerships between businesses are developed. The difficult negotiations and decisions parties have to make are easier with service packages. The behaviour of customers choosing a service provider in the telecommunication business is mostly about the quality of the service. Customizing the service packages to customers target the needs and desires of customers.

All the insights obtained from the literature in this section helps this research to understand the effect and purpose of service packages. With the help of the literature in this section more knowledge is obtained about service packages and their effects on customers. Recommendations and conclusions can be supported by the literature described in this section.

Chapter 4. KPIs in the dashboards

In chapter 4 the KPIs used in the dashboard are explained. This chapter answers research question 4: ‘‘What KPIs should be selected in the dashboards?’’.

4.1 Selected KPIs in the dashboards

To measure the performance of customer service contracts and the behaviour of customers several KPIs have been chosen. Both the literature review and the interviews with the management team of the company provided a selection of KPIs which could be used in the dashboard.

List of requirements of the management team:

- Visualisation of the financial performance of the gold contract
- Visualisation of the relation between gold customers and their reporting behaviour
- Visualisation of the characteristics of the reports made by gold customers
- Visualisation of the amount of reports of a gold customer

In figure 8 the overall KPI selection is given. The KPIs in figure 8 are divided into the following categories: used KPIs in research, KPI not necessary for the research, data not available for this KPI and KPI that gives helpful additional insight. Seven dashboards are developed. In this chapter all the selected KPIs per dashboard are explained and an explanation of the coherence of the KPIs on one dashboard is given.

Financial	Customer	Learning and Growth	Internal Process
Total Sales/ customer	# Entrances/ customer	# malfunctions per Entrance type	# Of gold contract/ total contracts over time
Total Cost/ customer	# Malfunctions/ customer	# malfunctions per order type	# Innovations in the process
Margin/ customer	# Total malfunctions/ # total entrances per customer	# Contracts continued	# First time fix
Fee Sales/ customer	# Malfunctions over time per customer	# Contract cancelled	Time to solve malfunctions
Cost per malfunction/ customer	# visits/ service contract type	# Days materials not available	# Materials wasted
Sales per malfunction/ customer	# visits/ customer	# Unsuccessful visits	
Sales upgrades & modernisation/ customer	# visits/ entrance type	# Customer complaints	
Sales repair/ customer	# visits/ age of entrance	Customer satisfaction	
Sales planned maintenance/ customer	# Malfunctions / customer segment	# Repeated calls/ time	
Cost planned maintenance / customer	Order types/ service contract type	Price of maintenance per year/ price of entrance	
Cost upgrades & modernisation / customer	# Malfunctions / age of Entrance		
Cost repair / customer			

Revenue/ invoices per type of service contract
Revenue/ customer segment name
Revenue/ Location
Total cost customer service department/ time
Revenue/ Age of Entrance
Revenue/ call-out charge

Figure 8: Final KPI selection

	Used KPIs in research
	KPI not necessary for the research
	Data not available for this KPI
	KPI that gives helpful additional insight

Figure 9: Legend KPI selection

4.1.1 DASHBOARD 1 – FINANCIAL PERFORMANCE GOLD CUSTOMERS

The selection of KPIs in dashboard one measure financial aspects. The KPIs that are put together in dashboard one give insight in the financial performance of the gold customers. The management team of the company can see financial numbers of the relation between the gold customers and the cost of their reporting behaviour. With the help of this dashboards the management team can decide whether a gold customer is financially performing well or not.

Total sales, costs, margin (€)
For a general overview of the financial performance of the sales, costs and margins of the gold customers. These KPIs are chosen to tell whether a gold customer is profitable or not. With the total sales and costs, the margin (€) can be calculated.

Margin (%)
The margin (%) chart in the dashboard shows the value of the margin and whether it is below or above the average of the total margins of gold customers. The margin (%) shows whether a customer has a healthy margin or not. The margin (%) is calculated by dividing the total margin and the total sales.

Cost per reported malfunction
The KPI "Cost per Malfunction" compares the average cost per malfunction of all gold customers and the customer that is selected in the dashboard. With this KPI, insight can be gained into whether solving a malfunction of a certain customer cost more or less than average. The cost per malfunction is calculated by the total costs to solve all malfunctions divided by the total the number of malfunctions.

Sales Allocation
The KPI "Sales Allocation" shows a more in-depth overview of where the total sales are coming from. The different categories shown in this KPI are explained below.

Contract Fee sales: The customers with a contract pay a fee per time unit.
E-call: Sales generated by the reported malfunctions that the company receives by e-mail and telephone.

Upgrades & Modernization: The yields from upgrades that are done to existing entrances of customers.
Repair: Sales from a major adjustment or malfunction on an existing entrance.
Planned Maintenance: The yields that are coming from the planned maintenance activities, which are often logically not available because these yields are included in the contract fee paid by customers.

Cost Allocation
The KPI "Cost Allocation" shows a more in-depth overview of where the total cost is allocated to. The different categories shown in this KPI are explained below.

E-call: The cost to solve reported malfunctions that the company receives by e-mail and telephone.
Planned Maintenance: The cost that are coming from the planned maintenance activities.
Upgrades & Modernization: The yields from upgrades that are done to existing entrances of customers.
Repair: Costs from a major adjustment or malfunction on an existing entrance.

4.1.2 DASHBOARD 2 – REPORTED MALFUNCTIONS GOLD CONTRACTS

The KPIs in dashboard two display the reporting behaviour of a customer. The management team of the company can spot which gold customers show above or below average reporting behaviour.

Number of Entrances
The total number of entrances of a specific customer or multiple customers can be displayed. This total number of entrances include only all the entrances with a gold contract.
Number of Reported Malfunctions
The total number of reported malfunctions of entrances reported to the company are measured by this KPI. The reported malfunctions are shown per customer and only stem from entrances with gold contracts.
Malfunctions/ Entrances
Malfunctions/ Entrances measures the number of reported malfunctions of a customer divided by the total amount of entrances. This KPI gives a percentage of how many entrances have been reported relative to the total number of entrances.

4.1.3 DASHBOARD 3 – ENTRANCE MALFUNCTIONS GOLD CONTRACTS

The KPIs in dashboard three visualise the characteristics of the reports done by gold customers. The management team of the company can detect what the reasons of the reports of a customer are. The installations that are mostly reported by a customer are also shown. With this information the company can see what type of installations are reported and what reasons a customer has when reporting a malfunction.

Top Reported Entrances
The top reported entrances display the most reported installations.
Top Order Types
The top reported order types display the reasons of the most reported malfunctions by customers.
Number of Reported Malfunctions over Time
The number of reported malfunctions over time displays the number of reported malfunctions of a customer per month.

4.1.4 DASHBOARD 4 – FINANCIAL COMPARISON GOLD CUSTOMERS & OTHER CUSTOMERS

In dashboard four KPIs are included that are about financial aspects of gold customers and other customers. By putting these KPIs into this dashboard, a comparison can be made. The management team can use this dashboard to detect the financial differences between a gold customer and another customer.

Total Sales, Costs, Margin
The total sales, costs and margin are shown for gold customers and other customers.
Average Margin
The average margin of gold customer and non-gold customers are displayed.
Average Cost per Malfunction
The average cost per malfunction can be displayed for gold customers and other customers.
Sales Allocation
The sales allocations display the way in how the number of the total sales are divided. The five categories given in this KPI are: Contract Fee sales, E-call, Upgrades & Modernization, Repair, Planned Maintenance.
Costs Allocation
The costs allocations display the way in how the number of the total costs are divided. The five categories given in this KPI are: E-call, Planned Maintenance, Upgrades & Modernization and Repair.

4.1.5 DASHBOARD 5 – REPORTED MALFUNCTION COMPARISON GOLD CUSTOMERS & OTHER CUSTOMERS

In dashboard five KPIs about the number of malfunctions are displayed of gold customers and other customers. This comparison is made to show the management team the difference between the reporting behaviour of gold customers and other customers.

Number of Malfunction Comparison
The total amount of malfunctions of gold customers and other customers are displayed.
Number of Entrances Comparison
The total amount of entrances of customers with a gold contract or other customers are displayed.
Malfunction/ Entrances Comparison
The total number of reported malfunctions divided by the total amount of entrances.

4.1.6 DASHBOARD 6 – ENTRANCE MALFUNCTION PER CONTRACT TYPE

The KPIs in dashboard 6 are shown together, because these are the characteristics of the reporting behaviours of the customers. Dashboard six can be used by the company to detect what the top reasons of the reported malfunctions of a contract type are. The installation types that cause the most reports can also be detected per contract type. These KPIs are put together to show the characteristics of the reporting behaviour of a certain contract type.

Top Order Types
The top order types display the reasons of the most reported malfunctions which can be filtered by different contract types.
Top Reported Entrances
The top reported entrances show the entrance types that are reported the most which can be filtered by different contract types.

Number of Reported Entrances over Time
The number of reported entrances over time shows the total amount of reported entrances per month which can be filtered by different contract types.

4.1.7 DASHBOARD 7 – ORDER TYPE PERCENTAGE PER CONTRACT TYPE

The KPIs in dashboard seven gives an overview of what the difference is between the reporting behaviour of the three contract types. This KPI is made for the manager of the customer service centre to see what customers report for. A conclusion can be drawn out of this dashboard whether the gold contracts are reporting for more external reasons. This is an important comparison, because external reasons are covered in some of the gold contracts.

Three Order Type Categories per contract type
In three order type categories the percentages of the total are shown. The KPI shows the reason of reporting by customer in three different categories: Malfunction of Entrance, External Reasons and Solved by telephone.

In this chapter an explanation of the KPIs is given. The coherence of the KPIs on one dashboard is described. Also, a figure with all the selected KPIs is given with a legend to show the details of the KPIs.

In conclusion, with the seven dashboard the company can identify the reporting behaviour of customers with gold contracts and its characteristics. Also, the financial performance of the gold customers is displayed in the dashboards.

Chapter 5. Dashboard design & development

In chapter 5 the design and the development of the dashboard is explained. The development of the prototype contained several steps. A step-by-step plan to create the dashboards is shown in figure 10.

5.1 Step-by-step plan to create interactive dashboards

A step-by-step plan is made in this bachelor thesis to make interactive dashboards. This approach will help creating the visualisation of data in a relatively easy way. Small businesses that have little business intelligence knowledge and do not have the money for expensive programs, can use this information to create a visualisation of their performance. The only thing needed to create the dashboard is a tool to implement the dashboard in. This approach is not only appropriate to the service contract business but can also be used for other type of businesses.

The step-by-step plan consists of 6 steps:

1. Select the KPIs that are necessary
2. Gather the data to measure the KPIs
3. Manage the data to make it usable
4. Choosing the tool to implement the dashboard in
5. Create pivot tables to measure the KPIs
6. Import the created charts from the pivot tables into a dashboard

Figure 10: Step-by-step plan to create interactive dashboards

Step 1. KPI selection
The first step in creating a dashboard is determining what to measure. For every business the KPIs will be different. With the help of literature and by taking into account what the needs of a company are, a set of KPIs can be selected. To make sure a right set of KPIs is chosen, different perspectives should be considered. The four perspective of the balanced score card of (Kaplan & Norton, 1992) can be considered. These four perspectives are the financial perspective, internal business perspective, innovation and learning perspective and the customer perspective.
Also, the three perspectives of (Lakhal, 2009) can be taken into account when KPIs are selected. These three perspectives are quality, competitive advantage and organizational performance.
The perspectives help to not focus on one particular aspect. The perspectives help to choose KPIs evenly to measure all the aspects of a company. With the selection of KPIs also the data the company is able to gather must be taken into account.

Step 2. Data gathering
To be able to measure the chosen KPIs in step 1, data is needed to measure the KPIs. Small businesses often do not have a lot of data available to use, therefore it is of great importance that the company keeps gathering data. It is important to collect data about customers and the products or services a company sells.
It is possible to add extra data when the dashboards are finished.

Step 3. Data management
When the data gathering has been completed, the data must be managed. The data that is gathered should be prepared and cleaned to make it usable and reliable. The data quality standard is composed of five dimensions of data quality - availability, usability, reliability, relevance, and presentation quality (Cai, L., & Zhu, Y. 2015). These five

quality standards described by (Cai, L., & Zhu, Y. 2015) can be used to decrease the amount of errors in the data. After all the data cleaning and preparation, the data can be used for analysis.

Step 4. Choosing the tool to implement the dashboard in
After managing the data, the tool to implement the dashboard in must be chosen. To determine what program can be used several aspects must be considered. First, is there already a program used in the company to visualise data. Second, what is the budget the company has to buy the tool. Third, the tool should be easy to understand to the employees of the company. Fourth, the tool used should be accessible to all the employees that need the data visualisation. By taking these four aspects in mind, a good choice can be made.

Step 5. Pivot tables
When the data is ready to use and the tool has been chosen, pivot tables can be made. A pivot table is a tool that helps to recognize trends in the data. Rows and columns of data can be plotted against each other to get a desired overview of the data. The KPIs chosen in step one can be measured with the help of the pivot tables. When the right data sources are put into the pivot tables, a chart can be made. To keep a clear overview of all the measured KPIs, for every KPI a pivot table can be created and put into a separate sheet. The created charts can later be transferred to the dashboard.

Step 6. Dashboards
In the fifth step the dashboard can be created. The KPIs that are put into one dashboard should have the same purpose. In this way the best overview on a certain topic can be obtained. It is crucial that the dashboard features (visual and functional) and the contents fit with the dashboard purpose (Vilarinho, Lopes, & Sousa, 2018). The design of the dashboard should be kept simple, to make sure the focus is on the KPIs. An option to filter the data in the dashboard is important. Filtering data on several charts at the same time gives a broad overview of the data. A filter can for example show all the data about a certain customer or product.

Conclusion
For small businesses that have little knowledge about business intelligence and that do not have the money to buy expensive BI-tools or hire expensive consultants, the developed approach helps. For a business it is important to continuously improve. Data visualization can help to make better management decisions. The steps described in the approach can be followed to create an interactive dashboard. The goal of this section is to help starting business with analyzing their data with the help of dashboards. The approach shows that little knowledge and money does not necessarily mean that improvements with the help of data is not possible. Especially for starting businesses it is important to take the right direction in the beginning. Creating a dashboard as described in the approach can be a step in the right direction.

5.2 Data gathering

The development of the dashboard started with collecting data. The first data that was received from the company was about all the malfunctions that were reported by customers in 2018. The program manager of the company provided this data. The data set about the reported malfunctions contained several columns with information about the malfunctions. The data that has been received is shown in figure 11. All the data received was flattened out into excel sheets.

Customer
Customer Name
Customer Segment
Customer Segment Name

Date
Report Date
Weekday
Month Reported

Address
Location
Location Name
Location Segment
Location Segment Name

Order
Service Order
Service Order Serie
Logged By
Department
Order Type
Order Type Name
Order Status

Contract
Contract Number
Service Package
Contract Type

Product
Installation
Installation Type
Installation Type Name
Installation Date
Completion Date

Figure 11: Data tables of reported malfunctions

To make the relationship between the gold service contracts and the reported malfunctions visible, more data was needed. After receiving the data about the malfunctions other data had to be gathered. To make a relationship between the reported malfunctions and the gold service contracts the second dataset gathered must be on financial data. Financial data about the gold service contracts were needed to determine the profitability of gold customers. These data were also flattened out in Excel. All the data types shown in figure 11 where shown per customer.

Sales
Sales Amount
Sales Amount E-Call
Sales Amount Installation
Sales Amount Internal Order
Sales Amount No Order Details Present
Sales Amount Planned Maintenance
Sales Amount Repair
Sales Amount Upgrades & Modernization

Cost
Cost Contract Fee Sales
Cost E-Call
Cost Installation
Cost Internal Order
Cost No Order Details Present
Cost Planned Maintenance
Cost Repair
Cost Upgrades & Modernization

Total
Total Sales Amount EUR
Total Cost EUR
Total Local Margin EUR
Total ERP Order Counter

Local Margin
Local Margin Contract Fee Sales
Local Margin E-Call
Local Margin Installation
Local Margin Internal order
Local Margin No order details present
Local Margin Planned Maintenance
Local Margin Repair
Local Margin Upgrades & Modernization

Customer
Customer Name

ERP
ERP Order Counter Contract Fee Sales
ERP Order Counter E-Call
ERP Order Counter Installation
ERP Order Counter Internal order
ERP Order Counter No order details present
ERP Order Counter Planned Maintenance
ERP Order Counter Repair
ERP Order Counter Upgrades & Modernization

Figure 12: Data tables of financial data

After the financial data was received, the amount of entrances per customer was obtained with the help of the financial manager of the company. The data about the number of entrances is important, because then the behaviour of customers can be better understood.

A data model of the gathered data is shown in figure 13. The data model helps to understand the relationships between the data sets received. Also, the compatibility between the different data sets received are made visible by the data model.

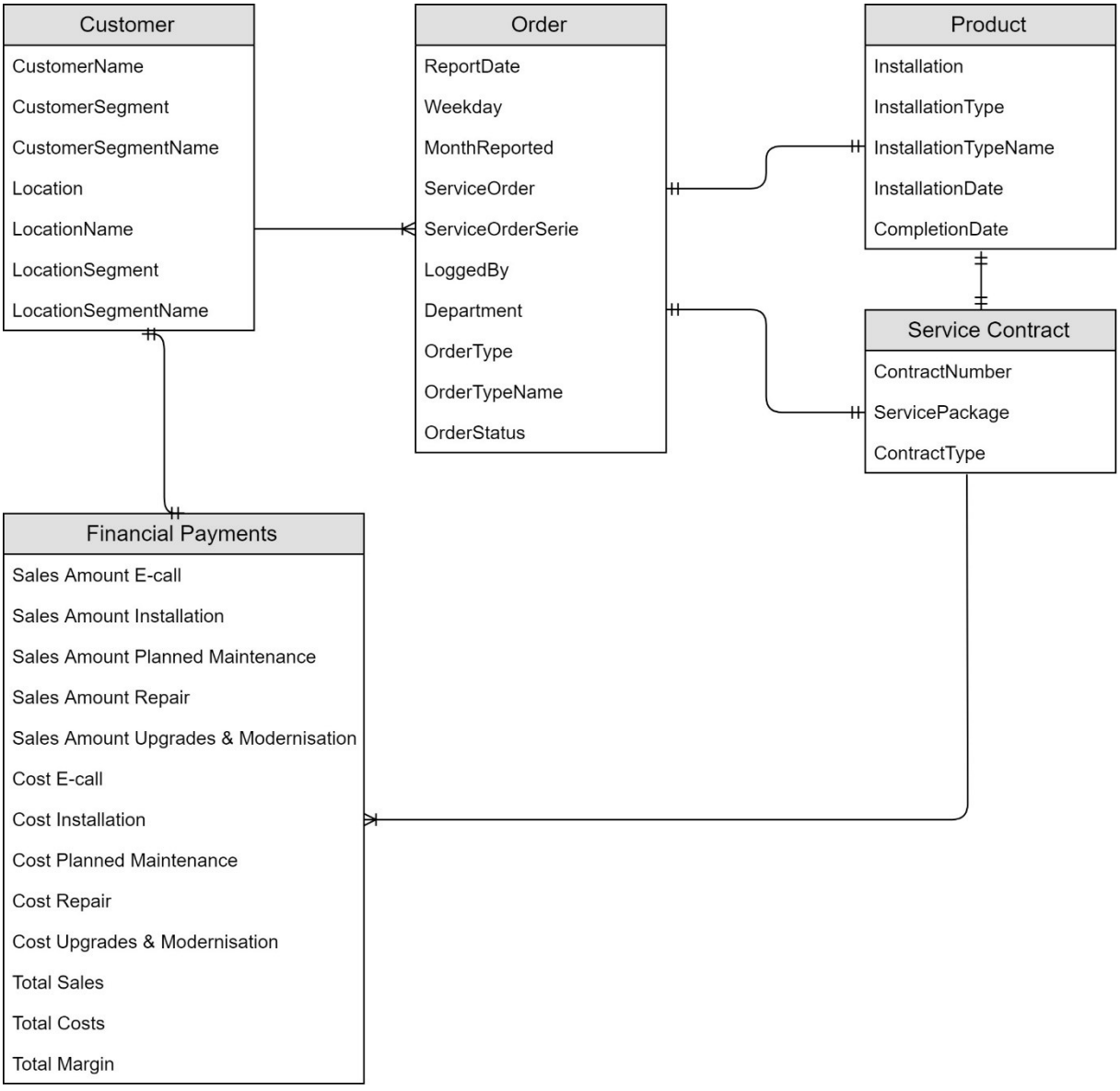

Figure 13: Data model of the received data

Figure	Relationship
	One to many
	One to one

Figure 14: Legend data model

All in all, the data of the reports of malfunction from 2018 was gathered first. Afterwards, the financial data and the amount of entrances per customer in 2018 were gathered to make the relationship between the service contracts and customer behaviour possible.

5.3 Combining the data sets

After gathering all the data that was needed the datasets must be combined. The two different data sets were linkable due to customer names. Also, the number of entrances were given with customer name, this data was also linkable by customer name. In total a basis of three data sheets are used and they are all linked by customer name.

Figure 15: Data transfer

The data of sheet 1 and sheet 3 were transferred to sheet 2 to make relationships. From sheet 1 the number of malfunctions reported per customer were count in sheet 2. Per customer the number of reports from 2018 were count. Next, the number of entrances per customer were put into sheet 2.

In conclusion, the different data received from different departments and different programmes within ASSA ABLOY were put into Excel and afterwards the link was made by using functions in Excel.

5.4 Cleaning and preparation of the data

After combining the different data sources. The data must be prepared and cleaned to be able to use it for a dashboard. The preparation of the data of the reported malfunctions will be explained first.

Within the received datasets in Excel often values are missing, or values are totally out of proportion. Since there were over 267.000 rows of information given at the beginning, checking the data is challenging. Determining the scope of the research already reduced the amount of data that can be used.

Preparation of the data of the reported malfunctions

- First, the data of the reported malfunctions contained a lot of other activities such as planned maintenance activities, upgrades, and checks. Therefore, the data was first filtered on only reported malfunctions.
- Second, the data has been filtered on only data from 2018, since this was the easiest way of combining the data sets.
- Third, there are several departments that make sure planned maintenance activities and other service orders take place. Only the Customer Service department and the external Call Centre that takes over the work outside of the regular 8.00-17.00 working hours were selected to only keep the reported malfunctions data.
- Fourth, in the data set there was a fourth type of contract which was called safety check. All the safety check activities were removed to only have the data of the bronze, silver, gold and no contracts left.

- Fifth, the column "Order Type Name'' contains over one hundred different types of orders. Some of the rows of a reported malfunction contained the order type "Invoice information incorrect'' these rows were deleted from the data table.

- Sixth, customers with no data or rows without customer names were deleted from the data table.

After all the filtering of the data, also data is used to create new data. Several data are added to create a usable set of data. The data was added in the second sheet which is the financial data table.

New data created from existing data

- First, the margin (%) was calculated for every customer. The margin (%) was calculated to get insight in how well a certain customer performs.

- Second, the average margin was calculated. The average margin was calculated to be able to compare the average margin with the margin of one particular customer.

- Third, the number of reported malfunctions per customer where put into the second sheet.

- Fourth, the cost per malfunction of a customer was added by calculating Cost of E-call/ Number of Malfunctions.

- Fifth, the average cost per E-call was calculated to compare this data with the data of one particular customer.

- Sixth, the number of entrances per customer were loaded into the second sheet.

- Seventh, the number of malfunctions were divided by the number of entrances of a customer.

- Lastly, the average number of malfunctions divided by the number of entrances was calculated to compare this to one particular customer.

Since seven different dashboards have been made, the data that has been prepared was filtered again differently to suit a certain dashboard. To understand the data behind the dashboards it is important to pay attention on how the data is loaded into the dashboard.

The first dashboard is about the financial performance of a gold customer. So, the data loaded into this dashboard is only about gold customers. The contracts of a customer are on entrance level. This means that every entrance has a contract. A gold customer is a customer that has a high level of gold contracts according to the company. So, the company refers to a gold customer when it has a high percentage of gold contracts. The data loaded into dashboard 1 is on customer level.
Dashboard 2 and Dashboard 3 only contains data of gold contracts. So, when a customer is selected in this dashboard only the data of their gold contracts will be shown.
Dashboard 4 and 5 are all on customer level. So, in these dashboards there are gold customers and other customers.
Dashboard 6 gives the opportunity to select on bronze, silver, gold or no contract type. The data loaded into dashboard 6 is on contract type level. Dashboard 7 is on contract level.

5.5 Choice for Excel as BI-tool

The dashboard will be made in Excel, because this is the most convenient with the data that is available in this research. The program Excel is accessible for every employee of ASSA ABLOY, therefore all the employees can open the dashboard when needed. Excel is broadly used across the employees of the company, so the dashboard in Excel will be understand more quickly than other programs. Therefore, the dashboards have been made with the help of Excel instead of other BI-tools.

5.6 Pivot tables

With the cleaned, prepared and added data the data was usable to make good use of it. The data of the company was received in Excel. Pivot tables in Excel have been created to plot data against each other. For each chart or graph in the dashboard a pivot table was created, to keep a clear overview of everything that was measured.

5.7 Design of the dashboard

When all the pivot tables were done, the charts and graphs that the pivot tables created could be put into a dashboard. Since the management team of the company will use the dashboard to detect possibilities and get insight in the performance of contracts and customers, the design must be simple to easily navigate through the dashboard.

The charts that were chosen from the pivot tables were chosen according to the data that was put into the chart. The best suiting chart options from table 6 have been selected.

The background colours of the dashboard are the same as the logo of ASSA ABLOY. Because the dashboard gives the option to choose from different gold customers, the name of the customer selected will appear in gold. The title of the dashboard is white which are together with the blue colour of the background the same as the logo of ASSA ABLOY. To show good and bad performance of customers clear red and green colours were used in de margin (%) chart. In charts were several different colours are needed, the ASSA ABLOY brand manual was used to use the colours of their overall theme which are complementary with the logo colours. The chart types used are bar charts, doughnut charts, line charts and pie charts.

5.8 Limitations of the data

Unfortunately, the data used in the dashboards could not all be filtered on contract level. This means that some dashboards where gold customers can be selected, not only show their gold contracts but also their other contract forms. As mentioned before a gold customer is perceived as a customer with a high amount of gold contracts according to ASSA ABLOY. So, a gold customer can have a small amount of other contract forms. The focus of the research is on gold contracts, so the small amount of other contract forms a gold customer has makes it less focused on gold contracts.

Within the financial data sheet, there are zero values. These zero values often mean that there is no data available or that sometimes the number is actually zero. Extreme high and low values have been removed. These values are for example zero values with several numbers behind the decimal point. When these number where used as a denominator, extreme high values were created. Therefore, such extreme high or low values were deleted to ensure a better reliability of the data. Data about the age of installations were not usable, since a lot of the ages of the installations were negative. Which means that for example that the completion date of the entrance was earlier than the installation date, this creates negative values. The age of entrances above 20 years old are also not that reliable, because an average entrance with proper maintenance and average usage has a lifespan of about 15 years according to one of the employees. The

age of the installation is therefore not used since these values were not reliable enough to use.

Some KPIs that were chosen on beforehand could not be measured since this data was not available. Such as the customer satisfaction about the customer service department and the time it takes to solve a malfunction.

All in all, the data has some limitations and values that could not be used. When recommendations and conclusion will be made, the limitations of the data should be kept in mind.

Chapter 6. Demonstration of the dashboards and evaluation

In chapter 6 the prototype will be shown and explained. Chapter six answers the seventh research question: "How should the dashboard be used?".
The options to select different data are shown. The development of the dashboard is shown in chapter 5; the results of this development will be shown in chapter 6. Seven dashboards have been development which will be shown by screenshots and descriptions. The data shown in the dashboard is random data, since the data of the company is confidential.

6.1 Dashboard 1

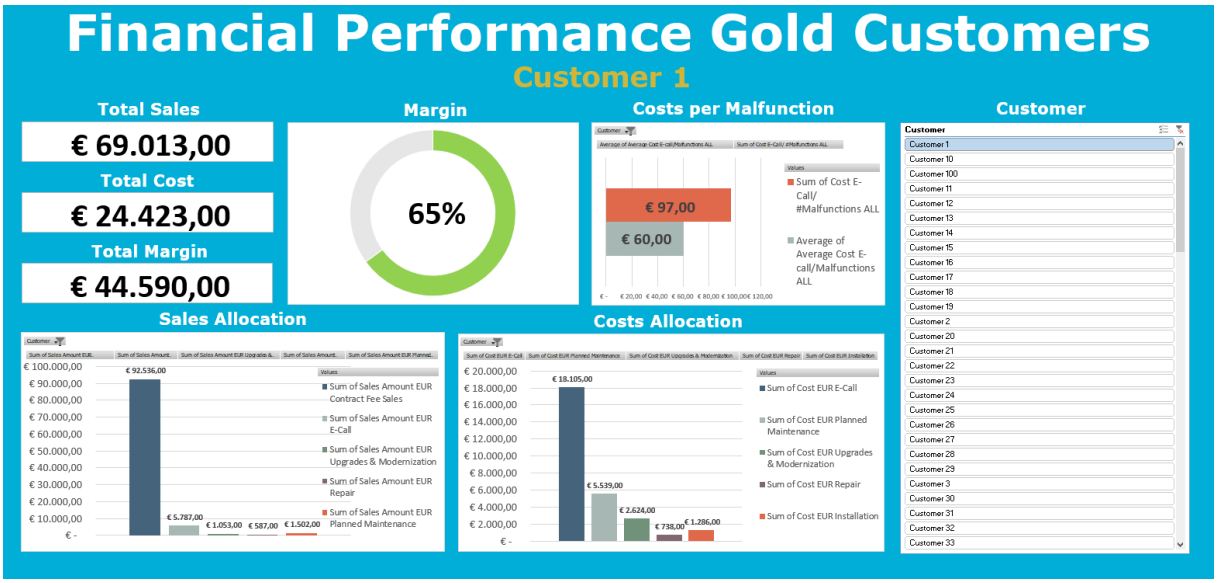

Figure 16: Dashboard 1

Dashboard 1 gives an overview of the performance of gold customers. The slicer "Customer" which can be found on the right-hand side in this dashboard shows all the gold customers. One or more customers can be chosen in this slicer. When a certain customer is selected, all the KPIs in the dashboard display the information of the selected customer.

In the top left corner, the total sales, costs and margin can be found. In the doughnut chart the margin (%) can be found which will turn green when the margin of the selected customer is above average and turns red when the margin of the selected customer is below average. In the "Cost per Malfunction" chart the orange bar shows the average

cost of solving a malfunction for a selected customer. The grey value in the same chart is the average amount of costs to solve a malfunction over all the gold customers. The ‘‘Cost per Malfunction Chart’’ makes a comparison between a selected customer and the average of all gold customers.

In the sales allocation chart the different categories where the sales of the selected customer come from is shown. The different sales categories are explained in section 4.1.1. In the Costs Allocation chart the different categories where all costs come from are shown for a customer that is selected. The different cost categories are also explained in section 4.1.1.

6.2 Dashboard 2

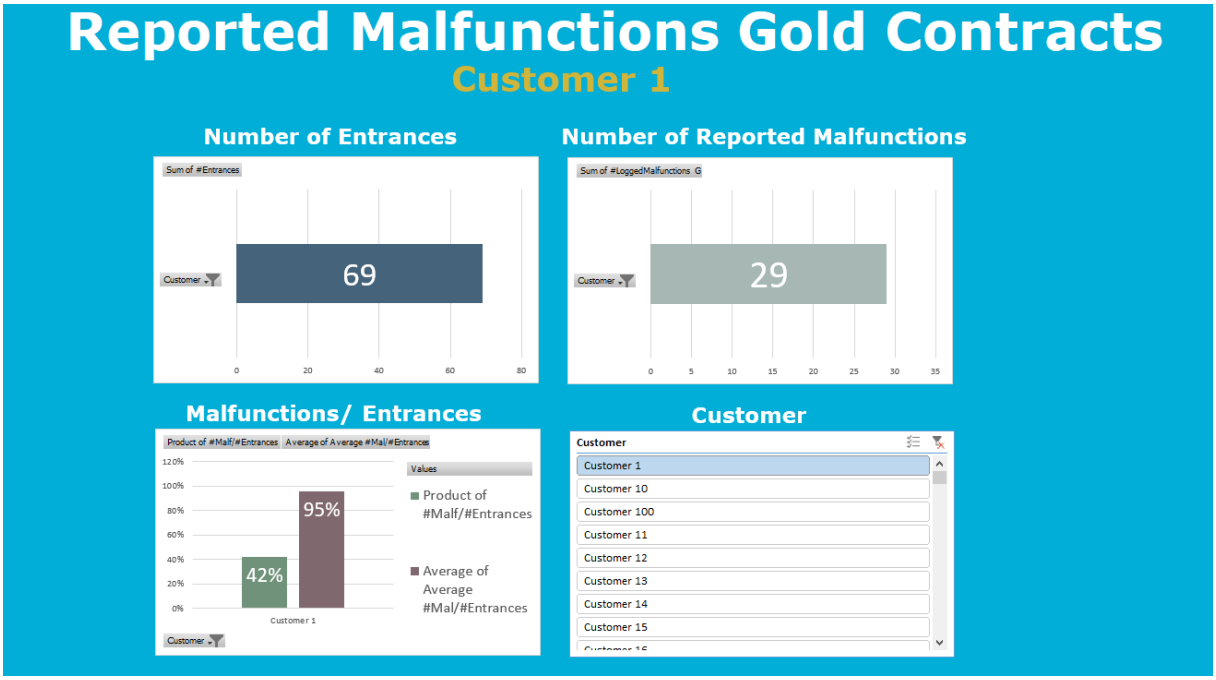

Figure 17: Dashboard 2

Dashboard 2 gives an overview of the reported malfunctions and the number of entrances of the gold contracts of a gold customer. The slicer ‘‘Customer’’ shows all the gold customers that can be selected. In the top left corner, the number entrances with a gold contract of a selected customer are displayed. In the top right corner, the number of reported malfunctions on gold contract entrances are displayed per customer. In the bottom left corner, the average percentage of Malfunctions/ Entrances over all gold customers is shown in a brown colour. The green bar shows the average amount of Malfunctions/ Entrances of the selected customer. There is also the possibility to select multiple customers, the values in the KPIs will be an addition of the customers selected.

6.3 Dashboard 3

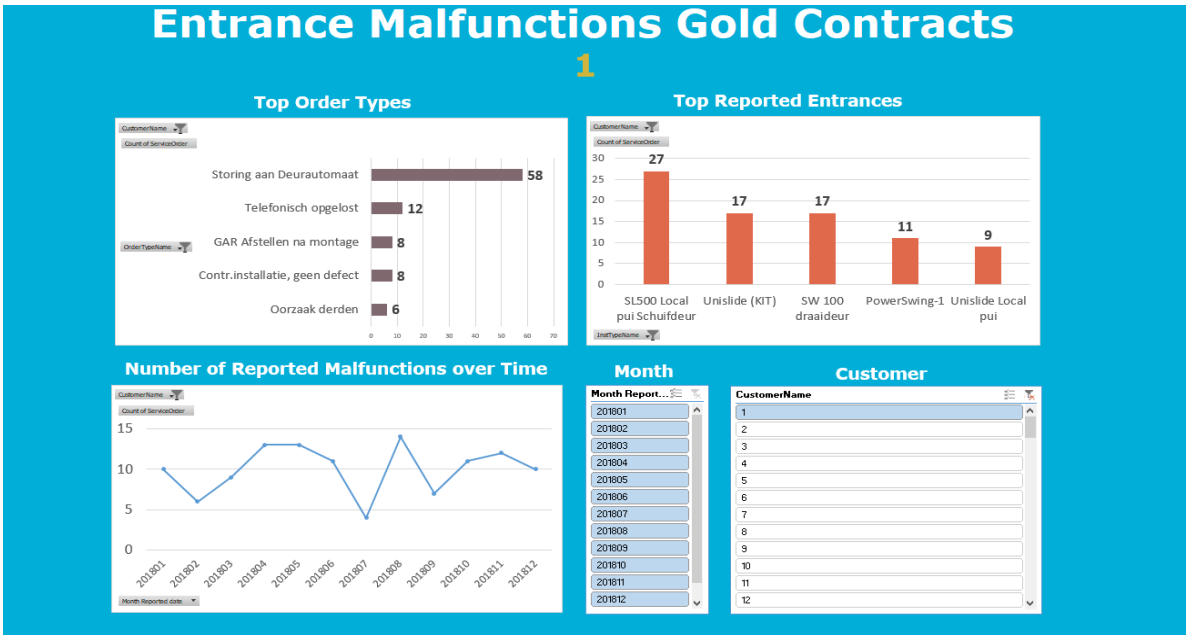

Figure 18: Dashboard 3

Dashboard 3 gives an overview of the order types and the type of entrances that are most reported per customer. In slicer ''Month'' a particular month or months out of 2018 can be chosen. In the slicer ''Customer'' a particular customer or customers can be selected. The KPIs will be automatically updated when a customer is selected. The data shown in this dashboard is on contract level. Only the gold contracts of gold customers are shown in the dashboard.

In the top left corner, the top 5 order types of a selected customer are shown. The order type is the reason behind a reported malfunction. In the top right corner, the type of installations that cause the most reported malfunctions are shown per selected customer. In the bottom left corner, the number of reported malfunctions on gold contracts of a selected gold customer are shown over time.

6.4 Dashboard 4

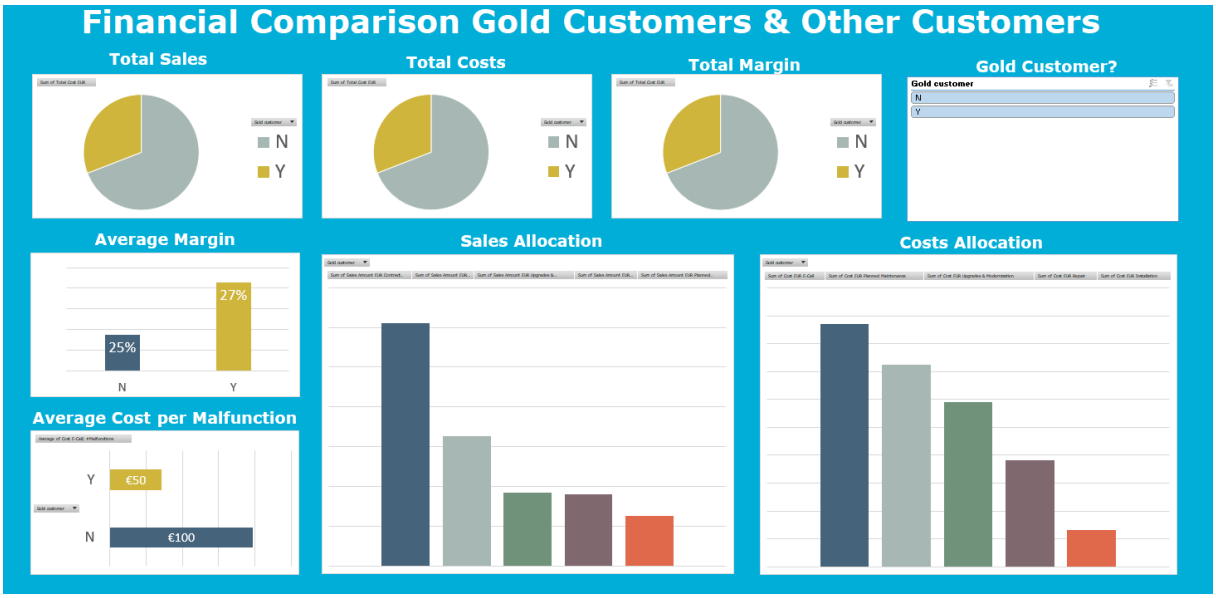

Figure 19: Dashboard 4

Dashboard 4 gives a financial comparison overview of gold customers and other customer. Other customer are customers with a high amount of bronze or silver contracts. In the category ‘‘other customers’’ also customers without a contract are included. The actual numbers in the charts are deleted or randomly filled due to confidentiality rules. Some axes have also been removed in the screenshot of dashboard 4 due to confidentiality rules.

In the slicer ‘‘Gold Customer?’’ the question is asked whether it is a gold customer or not. In the slicer the Y stand for yes and the N for No. So, Y is a gold customer and N stand for other customer. The slicer gives the opportunity to select both Y and N or only Y or N.

In the charts of the total sales, costs and margin the percentages and values are displayed in a pie chart. This pie chart also shows what part of the total amount are gold customer or other customers in financial terms. In the bar chart ‘‘Average Margin’’ the average margin of gold customers and other customers are shown. In the bottom left corner, the average cost per malfunction chart of gold customers and other customers can be found. The bar chart ‘‘Sales Allocation’’ shows where the sales are coming from in different categories. The different sales categories are shown in section 4.1.1. The Costs Allocation of the gold customers and other customers are shown in the bottom right corner. An explanation of the different cost categories is explained in section 4.1.

6.5 Dashboard 5

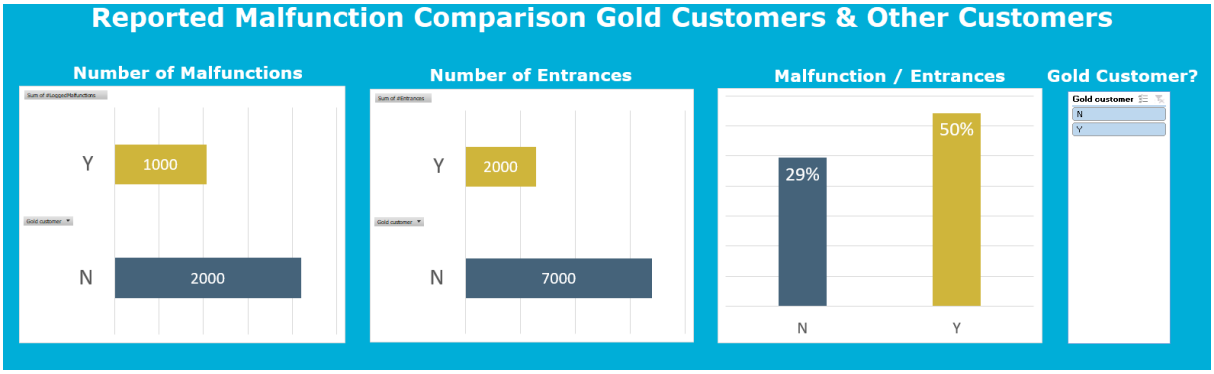

Figure 20: Dashboard 5

Dashboard 5 gives a comparison overview of Gold customer and other customer about the number of malfunctions and entrances. Again, the Y stands for gold customers and the N for other customers. The slicer gives the option to select both Y and N or only Y or N.

The bar chart ‘‘Number of Malfunctions’’ displays the total amount of reported malfunctions per customer type. In the chart ‘‘Number of Entrances’’ the total amount of entrances per customer type are shown. In the chart ‘‘Malfunction/ Entrances’’ a percentage of the total malfunctions divided by the total amount of entrances within a customer category is shown.

6.6 Dashboard 6

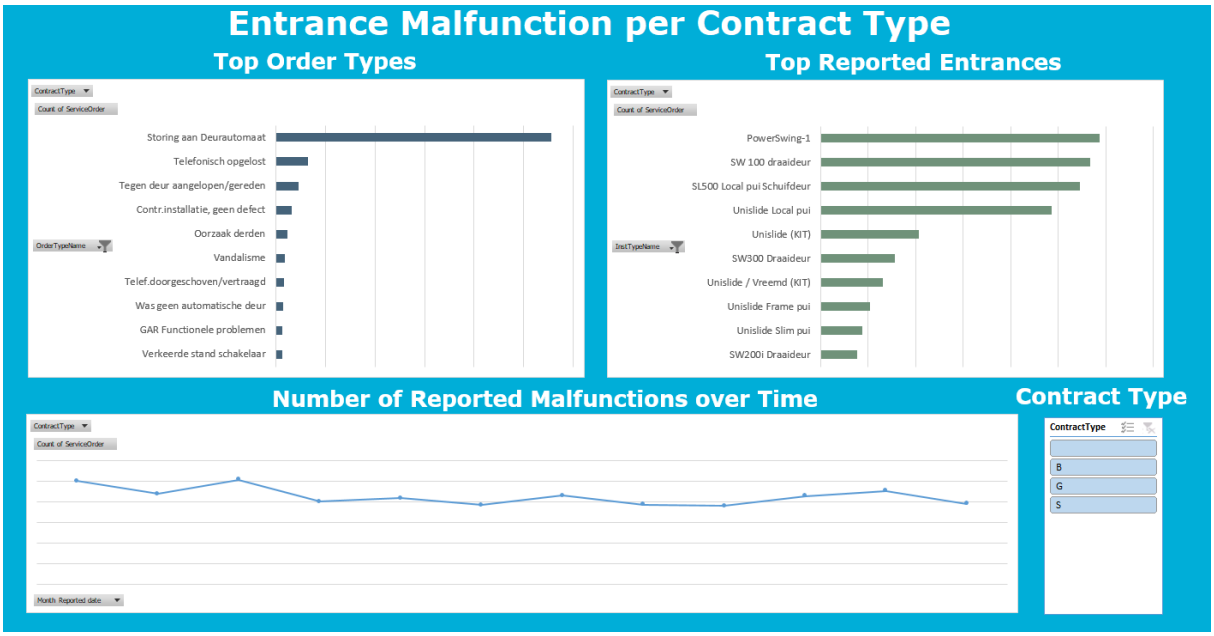

Figure 21: Dashboard 6

Dashboard 6 gives an overview of the top reason of reported malfunctions and the entrance types that caused the most reported malfunctions. In the slicer ‘‘Contract Type’’ 4 options can be selected. Blank stands for no contract type, B stands for Bronze contracts, S stands for Silver contract and G for Gold contracts. In the slicer one or multiple contract types can be selected.

In the top left border, the most common reasons of a reported malfunctions are displayed. In the top right corner, the most reported entrance types are shown. In the bottom chart the number of malfunctions over time per contract type can be selected. Number are not shown in dashboard 6 due to confidentiality rules.

6.7 Dashboard 7

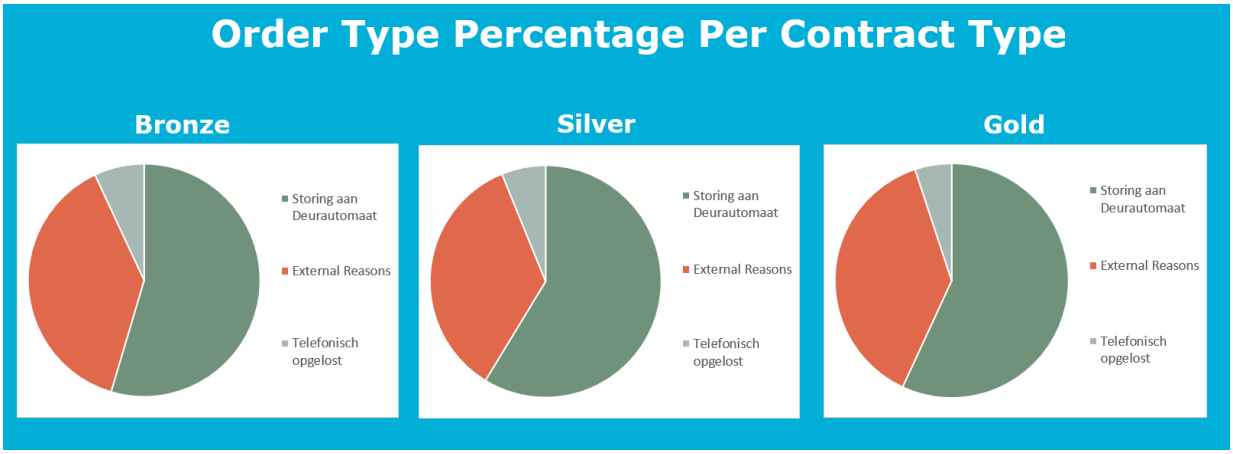

Figure 22: Dashboard 7

In dashboard 7 three categories of the reason of reporting is shown. The three categories are: Malfunction of Entrance (green), External Reasons (orange) and Solved by telephone (grey). On the left-hand side, the chart for all bronze contracts is shown. The middle chart displays the silver contracts and the chart on the right shows the information of the gold contracts. The percentages in the charts have been deleted due to confidentiality rules. The charts shown in dashboard 7 give insight in what the percentages are per contract type per order type.

6.8 Evaluation and conclusion

To discuss whether the developed dashboards create an improvement over the previous situation of ASSA ABLOY, a multi-criteria evaluation is done. The managers and directors of the company can give their opinions and thoughts about the created prototype. This multi-criteria evaluation consists of several indictors that can measure in what way the insights have increased with the prototype created. Also, their opinions on the design of the dashboards are taken into account. The article of (Dyczkowski et al., 2014) provides a multi criteria evaluation. This multi-criteria evaluation of (Dyczkowski et al., 2014) is used to evaluate the opinions on the created prototype in this bachelor thesis. The categories of the evaluation in table 7 and 8 are based on the framework BI Scorecard. The framework BI scorecard can be found in Appendix C.

There was no data visualisation at the start of the research on the topic researched. Therefore, the multi criteria-evaluation is assessed in the two categories "without dashboards" and "with dashboards". This evaluation is made to see what has changed in in the insight of the employees in the research topic.

In table 7 the requirements and the average scores according to managers and employees of ASSA ABLOY are displayed. The scores are going from one to five. Five is the best score and one is the worst score.

Table 7: Multi-criteria evaluation about insight in research topic

requirements insight research topic	Score without dashboards	Score with dashboards
Insight in KPIs	2,5	4
Insight in comparison values	2	4
Insight in exception values	2	3
Insight in top ranking values	3	4,5
Insight in reporting behaviour of customers	1,5	4
Insight in financial performance of customers	3	4
Insight in characteristics of customers	2	3
Overall insight in research topic	2	4,5
Average value	**2,25**	**3,875**

In table 8 an evaluation on the design, layout and usability is given. Since there was no such a dashboard to compare the prototype developed in this bachelor thesis with, the opinions of the directors and managers are measured on a scale from one to five. Where five is the best value and one is the worst value.

Table 8: Multi-criteria evaluation design and usability

Dashboard design, layout and usability requirements	Score
Visual appeal	4
Usage of colours	4
Combination of metrics on one dashboard	4,5
Interactivity	4
Ability to resize objects independently	3
Charts used	4
Usability of the slicer (select options)	4,5
Go from one dashboard to another	3,5
Print the dashboard	4
Overall ease of use	4,5
Average value	**4**

Conclusion

The multi-criteria evaluation is filled out by the two supervisors of ASSA ABLOY. In appendix D the filled-out forms of each supervisor are given. In table 7 and 8 the average of the two supervisors is shown.

In table 7 several indicators are shown to measure the insight of the supervisors of ASSA ABOY in the researched topic. The table shows the insight obtained by the supervisors with the help of the dashboard and without the dashboards. The average score of all the indicators without the dashboards was 2,25 out of 5. The average score of all the indicators with the dashboards is 3,875 out of 5.

Insight in KPIs
The insight in the KPIs that can measure the behavior of customers and the financial performance of the service packages went from 2,5 to 4. This means that the employees of the company have a lot more insight in what available KPIs there are to measure the research topic.

Insight in comparison values
The dashboard shows several charts where values are compared. Without the dashboard the score was 2 and with the dashboard the score was 4. This means that the employees of the company have a better visualization of the values that are compared with

averages. With the dashboard the value of one customer can be compared with the average of all customers.

Insight in exception values
Values that are above or below a certain level are exception values. The score without the dashboard was 2 and with the dashboards the score is 3. This means that there is a small improvement made on this indicator.

Insight in top ranking values
The top reasons for reporting and the automatic entrances that are reported the most are the top-ranking values. The score rated without the dashboard was 3 and the score with the dashboard went to 4,5. This means that there is made an improvement on this indicator. The employees of the company have an overview of what the reasons is behind malfunctions and what entrances are reported.

Insight in reporting behavior of customers
The insight in the reporting behavior of customer is measured with this indicator. The score without the dashboard was 1,5 and the score with the dashboard is 4. There is a big increase in the insight on this topic. According to the employees of the company a big increase in insight in this topic is obtained with the help of the dashboards.

Insight in financial performance of customers
The insight in the financial performance of the gold customers was without the dashboard scored a 3. With the dashboards the score of 4 was given. This means that the company already had a good insight in the financial performance of the customers with service contracts. With the help of the dashboard there was a small increase in insight.

Insight in characteristics of customers
The characteristics of customers are about the reporting behavior, reasons of the reporting, amount of reports and their margins. This is indicator is about an overall view of the customers. The score of this went from a 2 to a score of 3. This means that a slight increase in the characteristics is gained.

Overall insight in research topic
The insight in the overall research topic that has been requested by the company went from a 2 to a 4,5. This increase in score is significant, which means that the employees gained a lot more insight with the help of the dashboards.

The average value of all the indictors provided in table 7 went from 2,25 to 3,875. The increase in score means that based on all the indictors valued by the employees of ASSA ABLOY, the insight in the research topic increased significantly. With the gained insight better management decision can be made.

In table 8 several indictors that measure the design, layout and usability of the dashboard according to the supervisors of ASSA ABLOY are given. The table shows the opinion of the supervisors of the company on the dashboards. The average scores that the two supervisors gave on the indictors in the table is 4 out of 5.

Visual appeal
The visual appeal of the dashboards was scored with 4 out of 5. The employees liked the design that matches the logo and colors of the ASSA ABLOY theme.

Usage of colours
The usage of colours was rated 4,5 out of 5. The employees liked the fact that the theme of ASSA ABLOY came back in the dashboard. The little details such as the name of gold customers displayed in gold were also adored.

Combination of metrics on one dashboard
The score that was given to the combination of metrics on one dashboard is 4,5. The usability of one dashboard is greater when metrics with relations are shown on one dashboard. The score of 4,5 is high, which means that the employees think that the metrics work out well together.

Interactivity
The score to the indicator interactivity was scored with 4. The interaction with the user and the dashboard was scored high. This means that the employees think the dashboard can show what they want them to show.

Ability to resize objects independently
Sometimes it is needed to increase or decrease the size of objects on the dashboard. The indictor was scored 3 out of 5. Which means that there is some room for improvement on this indicator.

Charts used
The chart used to display the data of the company is scored with 4 out of 5. This means that the employees like the chart that are used to show the data.

Usability of the slicer (select options)
The slicer in the dashboards makes selecting different data possible. The score that was given to this indicator was 4,5. The employees could easily select the data they wanted.

Go from one dashboard to another
It is important to navigate through all the different dashboards with ease. The score given on this indictor was 3,5. The sheet name and the order of the sheets where the dashboards are made in are of importance considering this indicator.

Print the dashboard
Sometimes it is needed to print the dashboard for meetings. When the dashboard is printed the dashboard should clearly visualize all the values in it. The employees rated this indicator 4 out of 5. This means that the numbers, text and charts are still visible when it is printed.

Overall ease of use
The overall ease of use was rated with a 4,5. The overall opinion on the usability of the dashboard is scored very high. The employees can easily go through all the options and can interpret the data visualized by the dashboards.

All in all, table 7 showed that the score about the insight in the research topic went from 2,25 to 3,785. After the implementation of the dashboards the two supervisors have obtained a lot more insight in the requested research topic. The norm of having insight into customer behaviour and characteristics with service contracts is therefore reached. Table 8 shows that the average value of the design, layout and usability of the dashboards was scored a 4 out of 5. The score of 4 tells that the employees think the dashboard is usable and has a beautiful design.

Chapter 7. Conclusion

In chapter seven a conclusion is given. An answer to the core problem and the main research question is given in section 7.1. Recommendations to the company are given in section 7.2. In section 7.3 the limitations of the research are discussed. In section 7.4 contributions to theory are described. Section 7.5 describes contributions to practise.

7.1 Discussion

In this research the answer to the core problem: ‘‘There is no data visualization of the behaviours and characteristics of customers with service contracts towards the customer service centre.’’ is the goal. The main research question: ‘‘How to gain insight into customer behaviour and the performance of the gold service contracts owned by the customers?’’ is made to solve the stated core problem. Seven research questions where made to solve this main research question. To answer the seven research questions literature studies have been done and interviews with employees were held.

The answer to the main research question: ‘‘How to gain insight into customer behaviour and the performance of the gold service contracts owned by the customers?’’ are seven dashboards with several selected KPIs both from literature and interviews with employees of the company.

A discussion on the seven research questions is given below.

1. What is the current situation within the company?

Currently, the contracts within ASSA ABLOY are given to customers with several criteria. There are three type of gold contracts developed in the company to adapt to customer needs and desires. The reported malfunctions of customers with contracts are logged at the customer service center. Afterward a service engineers solves the problem and it is determined whether the problem will be invoiced to the customer or not.

2. How can performance measurement be used to track the progress of the company?

Performance measurement helps to track the progress of the company. Different perspectives on performance measurement help to focus on several aspects of a company. The different perspectives used in the thesis helped to not only focus on the financial aspects of the service contracts, but also the focus on customers and their behavior is made.

3. How to clean and prepare the data from different datasets?

The data that has been received in this research, was cleaned and prepared. Five data quality dimensions were kept in mind with the cleaning and preparation of the data. The technique used is was a data driven process. The errors were localized, corrected and new data was added.

4. What KPIs should be selected in the dashboards?

The selected KPIs used in this research measure the relation between the customer service department and the service contracts. The KPIs used are divided under the four perspectives of the balanced scorecard.

5. How should the design of the dashboard look like according to literature?

The design of the dashboard was kept simple to increase the understandability and usability. The charts are chosen that adapts the best to the data that was available.

6. What is the effect of different service packages on customers?

Service packages can create strong ties with customers. The quality and service are important to customers choosing a service package. Difficult decision and negotiations can be easier with service packages that cover a lot of service.

7. How should the dashboard be used?
A description of how the dashboard can be used is presented in chapter six. All the seven dashboards have a different purpose, all the KPIs on one dashboard are coherent. The slicers in the dashboard make it possible to select different customers.

With the help of the seven research questions, the main research question and the core problem seven dashboards have been created. The seven dashboards give insight in the reporting behaviour of gold customers and the dashboards show the financial performance of these customers. Also, a comparison between gold customers and other customers is provided within the dashboards.

7.2 Recommendations

In this section, recommendations to improve the dashboard in the future are given. Also, recommendations are given to ASSA ABLOY Entrance systems to improve their service contracts with the help of the dashboards created.

7.2.1 RECOMMENDATIONS TO IMPROVE THE DASHBOARDS

To increase the insight in only the issued gold contracts. The dashboard should only contain gold contracts. Now a gold customer is referred to as a customer with a high percentage of gold contracts on their entrances. The gold customers in dashboard 1, 4 and 5 contain not only gold contracts but also other contract types. To draw better and more accurate conclusions the data of the gold customers should be filtered only on their gold contracts. So, the dashboards should all be made on contract level.

The dashboard created contains data from 2018. To gain more insight in the performance of contracts and customer behaviour over time, the data that is loaded into the dashboard should be made real-time. The different data databases should be linked and afterwards the data must automatically be loaded into the dashboards.

To measure even more performance or behaviours, extra KPIs can be added to the dashboard. Unfortunately, the data of the ages of entrances were not reliable. Therefore, this data was not used. When the data of the ages of entrances is made reliable and valid, a KPI on the age of entrances can be added. Other data such as the amount of entrances per entrance types, can give more insight in what percentage of a certain entrance type breaks down often. To get even more insight in the malfunction behaviour of gold customers, the average number of reported malfunctions of a customer can be compared to the segment average. When a customer is compared to their own segment, it gives more insight in whether their behaviour is normal compared to other customers in the same segment.

7.2.2 RECOMMENDATIONS BASED ON THE DASHBOARDS

The comparison dashboards show that gold customers have a higher percentage of number of malfunctions divided by the total amount of entrances than other customers. On the other hand, the gold customers show a slightly higher average margin than the average margin of other customers.

The future of the gold contract
The recommendation out of this data is that continuing with issuing gold contracts will probably not created negative margin trends.
The data used is from 2018, so this recommendation is based on data from a certain timeframe and not over all the years that contracts were issued. The trend of issuing more gold contracts in the future, based on the data set of 2018, will probably not generate negative margin trends. There is a chance that the company will get busier with handling gold customers in the future at the call centre, when the total percentage of

gold contracts increase in the future. Also, service engineers will be busier serving gold contract customers.

On the other hand, the invoicing process is much easier. Gold customer do not receive as much invoices as other customers, which create a lot less hassle. Customers with gold contracts pay a fee per time unit, which is a much easier process. The relation between a gold customer and the company is a lot easier to handle due to this easier process.

It is also possible that gold customers create an even higher margin in the future. Margins of gold customers are largely affected by planned maintenance cost. It is possible that 2018 was an expensive year in terms of maintenance activities. When entrances are modified and upgraded often in 2018, this can result in less costs in the next upcoming years.

The increased costs for the call centre and the service engineers must be kept in mind when the amount of gold contracts increases over time. But the easier process and better use of materials balance the costs. When the trend is set to issue more gold contracts in the future, the trend will probably generate positive margin trends. Due to the fact that the relation between a gold customer and the company is a lot better adapted to each other than other customers.

With this recommendation it is important to keep in mind that a gold customer has a high percentage of gold contracts. So, the slightly higher margin could also be affected by the other contract types a gold customer has.

Reported malfunction prevention
To prevent gold customers to report malfunctions with external reasons such as malfunctions due to moral hazard, boundary agreements can be set. The most reported reason of gold customers is ‘‘Malfunction of Entrance’’, which is more than fifty percent of the total.
Unless the order type ‘‘Malfunction of Entrance’’ is the most reported reason by the gold customers, something must be done to decrease the amount of reports.

The gold customers report a higher percentage of their entrances. Therefore, gold customers should be more careful and pay more attention to their entrances. The company should encourage the gold customers to be more careful and discourage a behaviour resulting in more external reason reports.

Also, the entrance types per customer that cause the most malfunctions could be looked at. On these entrance types a more frequent periodic maintenance activity can be executed, or better inspections are needed on these installations.

Currently a customer with a gold++ contract can report infinite. Customers with gold and gold+ can receive extra invoices, but often they report malfunctions that are covered by their contract. Boundaries can be set into the gold contracts based on the total average reported malfunctions. Customers can get an extra invoice when they report more than average, customers get a discount when they report less than average. In this way the behaviour of customers can be influenced.

7.3 Limitations

There are several limitations in this research. The influences that could not be controlled in this research are mentioned in this section. Al the limitation factors explained influence the research that has been done.

First, for this research different Excel files with data of the company have been used. The datasets as received contained errors, which are mostly cleaned. There is still the possibility that the data still contains errors. Thereby in some cases the datasets contain

no values at all. The data as received from the company is enormous. Not all data can be used in the timeframe of ten weeks to give insight in the performance of the customer service department.

Second, the time available for this bachelor thesis is limited to ten weeks. Therefore, a focus on the gold customers is made. The company provides more different service contracts which could not be specifically researched within the ten weeks. Therefore, the two groups of gold customers and other customers is made.

Third, the data that is gathered is from 2018. So, there is a specific timeframe where the data stems from. Findings will only concern this timeframe, so it cannot conclude findings outside of these time boundaries.

Fourth, human error should also be considered. There is the possibility that mistakes have been made along the way.

In conclusion, it is the time, the limited amount of time, human error, data errors and size of the data that form the limitations of this research.

7.4 Contributions to theory

The lack of insight in the relation between service contracts and customer behaviour with contracts shows the importance of this research.

Scholars doing research about service contracts will be able to better understand the effect of different service packages. The research shows the behaviour that is raised by customers with different service packages. The findings of this study can help to confirm the results of other scholars. Scholars can elaborate on the insights obtained from this study.

The data that is used in this bachelor thesis stemmed form 2018. This has to be taken into account considering the insight obtained. The main insight gained from the research of the relation between the service contracts and the behaviour of customer are given below.

- Customers that are allowed to report malfunctions of their products without consequences show a higher report percentage than other customers.
- Customers with all service covered in a service package have a better relationship with the company.
- Customers with all service covered in a service package tend to create higher margins.
- Service packages that offer all service create more pressure on customer service and service engineers
- Service packages that offer all service create less pressure on the financial department.

Another contribution to theory is the approach that has been developed to make the dashboards in this research. This step-by-step plan can help scholars in creating measurement tools. With the help of this approach a structured plan is provided in order to gain insight in data. The approach is presented in section 5.1.

7.5 Contribution to practice

In this section KPIs that can be generally used by organisations to measure service contracts are given. Assessing service contracts depends on the service that is given and on the product that is serviced. In this bachelor thesis the reporting of customers to the customer service department is researched. KPIs obtained from this bachelor thesis that can be generally used to obtain insight in the financial performance of service contracts

and customer behaviour are listed in table 9. The approach developed in 5.1 can also be followed by organisations to make an interactive dashboard.

Table 9: KPIs for assessing service contracts

Financial	Customer	Learning and Growth	Internal Process
Total Sales/ customer	# visits/ service contract type	# Contracts continued	# Innovations in the process
Total Cost/ customer	# visits/ customer	# Contract cancelled	# First time fix
Margin/ customer	Customer satisfaction		Time to solve malfunctions
Fee Sales/ customer	# Customer complaints		# Materials wasted
Total cost customer service department/ time			#Repeated calls/ time
Revenue/ invoices per type of service contract			# Unsuccessful visits
Revenue/ customer segment name			
Revenue/ Location			

All in all, the study provided both contributions to theory and practice. Findings of this study contribute to the theory and help scholars to understand the relation between service contracts and customer services. Another contribution to the theory is the approach developed to create interactive dashboards. Organizations can use the KPIs for measuring their service contracts. Also, the approach to create interactive dashboards can help organizations in creating data visualizations.

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Appendices

Appendix A - Systematic literature review

The service contracts that the company offers to their customers is a very big part of their turnover. It is important to find the right KPIs to measure the performance of these service contracts. To answer research question 4 a systemic literature will be executed. Several steps must be taken to select the right literature systematically. The article of Webster & Watson (2002) is used to determine the steps that are needed to do a systematic literature review. The following steps were taken to find the articles relevant to the research.

1. First the following will be looked at: key words, inclusion and exclusion, search strings, title and abstract of article.
   Key words: Dashboard, KPI, Service, Contract, Key performance indicator
   Inclusion and exclusion: in appendix 1 this part will be shown
   Search strings: KPI and Service, KPI and contract, dashboard and Service, dashboard and contract
   Title and abstract of article: the titles and abstract relevant to the knowledge question
2. The second step is to look at the references of the articles that can be used to answer the knowledge question.
3. A concept-matrix will be made to give an overview and summary of the articles based on the concepts.
4. The final literature list will be given.
5. A concept-matrix is given with the KPIs out of the articles.

Search strings

It is important that the correlation between the KPIs and the service contracts is made, therefore pairs of two words are chosen. The following combinations will be used:

Table 10: Search strings

Search	Dashboard	KPI	Service	Contract	Search String
1.		■	■		KPI & Service
2.		■		■	KPI & Contract
3.	■		■		Dashboard & Service
4.	■			■	Dashboard & Contract

Inclusion and exclusion criteria

In order to get the relevant articles, inclusion and exclusion criteria are set up to filter the articles. Inclusion criteria are criteria that must be available in the article to be part of the study and exclusion criteria are criteria that disqualify the article of being usable in the project.

Table 11: Inclusion criteria

Inclusion criteria	Reason
KPI, Key performance indicator, service, contract, dashboard, performance	These key words must be available in the article in order to be usable for the research.

Table 12: Exclusion criteria

Exclusion criteria	Reason
- Engineering electrical electronic - Computer science artificial intelligence - Civil Engineering - Construction Building technology - Healthcare sciences services - Health policy services - Education scientific disciplines - Medicine general internal	These subjects are not relevant to the to be answered knowledge question.

Search Results

In table 13 and 14 the strings that are used and the number of articles found are shown. Articles that will be usable in the research can be selected from this searching results.

Table 13: Search results Scopus

Scopus	Number of articles found
KPI & Service	91
KPI & Contract	3
Dashboard & Service	143
Dashboard & Contract	1
Sub Total	**238**
Number of duplicates	-5
Sub Total	**233**

Table 14: Search results Web of Science

Web of science	Number of articles found
KPI & Service	47
KPI & Contract	3
Dashboard & Service	120
Dashboard & Contract	3
Sub Total	**173**
Number of duplicates	-72
Sub Total	**101**

Total Scopus and Web of Science	**334**
Number of duplicates	16
Subtotal	**318**
Exclusion criteria	-309
Subtotal	**9**
Remove from list after reading full text	-5
End Total	**4**

Literature list

In table 15 the chosen literature list is given with the title, name of the author and publisher.

Table 15: Literature list

Author (year)	Title	Publisher
Akkermans, H; Van Oppen, W; Wynstra, F; Voss, C (2019)	Contracting outsourced services with collaborative key performance indicators	WILEY, 111 RIVER ST, HOBOKEN 07030-5774, NJ USA
Mourtzis, D; Fotia, S; Vlachou, E; Koutoupes, A (2017)	A Lean PSS design and evaluation framework supported by KPI monitoring and context sensitivity tools	SPRINGER LONDON LTD, 236 GRAYS INN RD, 6TH FLOOR, LONDON WC1X 8HL, ENGLAND
Legnani, E. Cavalieri, S. (2009)	Exploring the causal relationships of KPIs in after sales service systems	CELS - Research Center on Logistics and After-Sales Service, Department of Industrial Engineering, University of Bergamo, Viale Marconi, 5, 24044 Dalmine, Italy
(Fugini & Siadat, 2010)	SLA Contract for Cross-Layer Monitoring and Adaptation	American Society of Civil Engineers (ASCE)

Covered perspectives

In table 16 an overview of what perspective of the balanced scorecard are covered by the selected articles is given.

Table 16: Covered perspectives by articles

Article	Financial perspective	Internal business perspective	Learning and Growth perspective	Customer perspective
Akkermans, H; Van Oppen, W; Wynstra, F; Voss, C (2019)				
Mourtzis, D; Fotia, S; Vlachou, E; Koutoupes, A (2017)				
Legnani, E. Cavalieri, S. (2009)				
(Fugini & Siadat, 2010)				

Appendix B - Interviews with employees

In table 17 an overview of the interviews that were held with ASSA ABLOY employees is given.

Table 17: Interviews with ASSA ABLOY employees

Function of Employee	Interview about
Director Service Sales	Relation service contracts and customer service department
Manager Customer Services	KPIs implemented in the dashboard Relationship with gold customers Behaviour of customers
Program Manager BI	Data on reported malfunctions
Contract Sales	Contract negotiation
Financial Manager	Financial data of service contracts
Sales Director	Issuing of service contracts Contract pricing
Service Specialist	Criteria to determine contract type of a customer
HR advisor	Confidentiality of the data

Appendix C - Evaluation framework BI scorecard

BI Scorecard®
(BI Scorecard Evaluation Frameworks)
(see [13], [14])

1. Information delivery and business intelligence reach
2. Business query and reporting
3. Production reporting
4. OLAP support
5. Dashboard capabilities
    - 5.1. Dashboard layout
    - 5.2. Dashboard design
    - 5.3. Presentation
    - 5.4. Alerting
    - 5.5. Analysis
    - 5.6. KPIs/metrics
    - 5.7. Dashboard interactivity
    - 5.8. Delivery
    - 5.9. Architecture
    - 5.10. Other
6. Delivery and Exploration
7. Spreadsheet Integration

Figure 23: Framework BI scorecard (Dyczkowski et al., 2014)

Appendix D - Evaluation on the dashboards

Job title at the company: Manager Customer Services

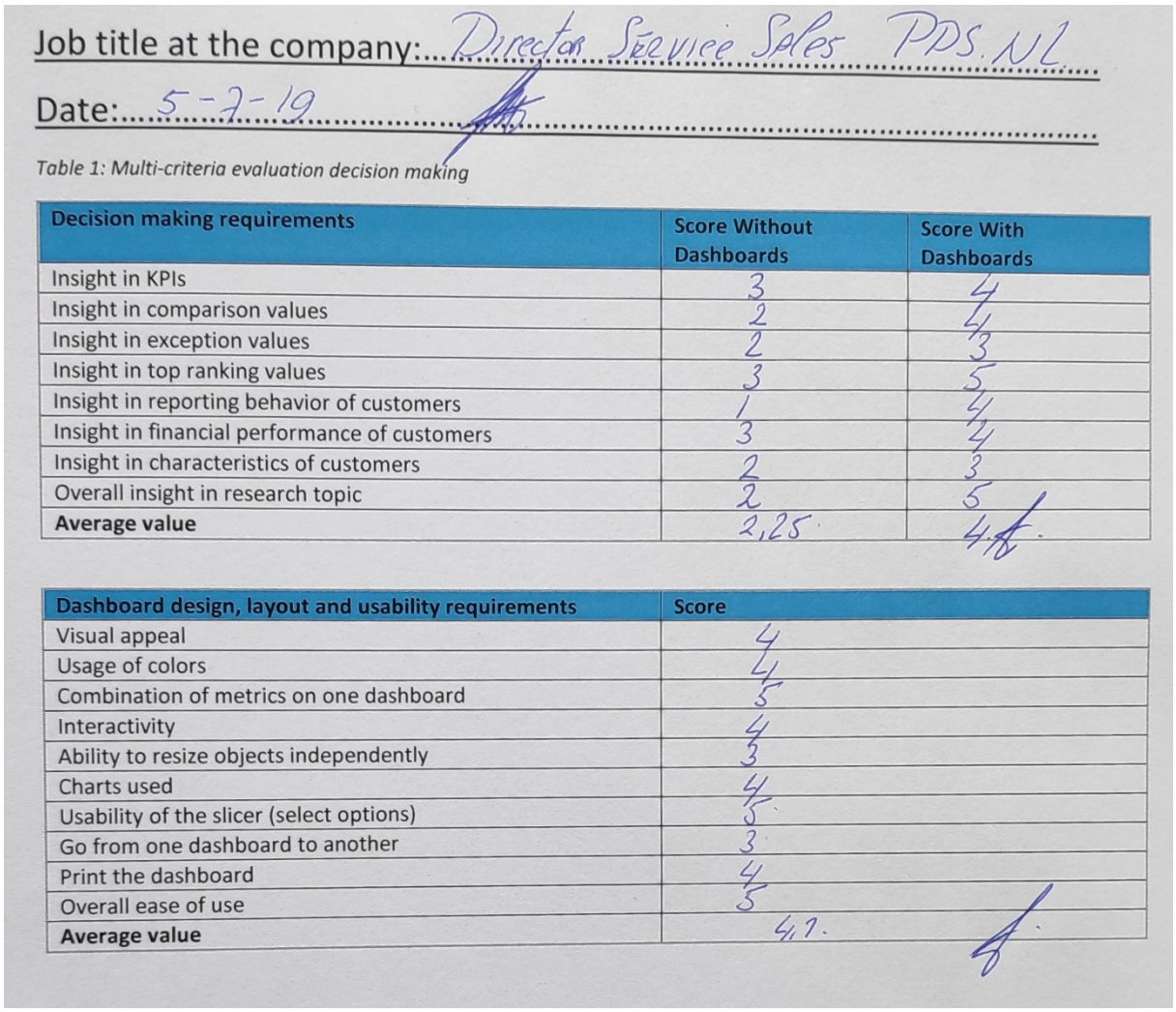
Date: 5-7-2019

Table 1: Multi-criteria evaluation decision making

Decision making requirements	Score Without Dashboards	Score With Dashboards
Insight in KPIs	2	4
Insight in comparison values	2	4
Insight in exception values	2	3
Insight in top ranking values	3	4
Insight in reporting behavior of customers	2	4
Insight in financial performance of customers	3	4
Insight in characteristics of customers	2	3
Overall insight in research topic	2	4
Average value	2,25	3,75

Dashboard design, layout and usability requirements	Score
Visual appeal	4
Usage of colors	4
Combination of metrics on one dashboard	4
Interactivity	4
Ability to resize objects independently	3
Charts used	4
Usability of the slicer (select options)	4
Go from one dashboard to another	4
Print the dashboard	4
Overall ease of use	4
Average value	3,9

Figure 24: Evaluation Manager Customer Services



Job title at the company: Director Service Sales PDS NL

Date: 5-2-19

Table 1: Multi-criteria evaluation decision making

Decision making requirements	Score Without Dashboards	Score With Dashboards
Insight in KPIs	3	4
Insight in comparison values	2	4
Insight in exception values	2	3
Insight in top ranking values	3	5
Insight in reporting behavior of customers	1	4
Insight in financial performance of customers	3	4
Insight in characteristics of customers	2	3
Overall insight in research topic	2	5
Average value	2,25	4,4

Dashboard design, layout and usability requirements	Score
Visual appeal	4
Usage of colors	4
Combination of metrics on one dashboard	5
Interactivity	4
Ability to resize objects independently	3
Charts used	4
Usability of the slicer (select options)	5
Go from one dashboard to another	3
Print the dashboard	4
Overall ease of use	5
Average value	4,1

Figure 25: Evaluation Director Service Sales