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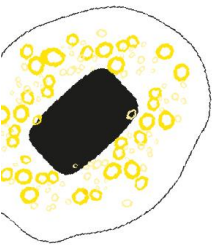

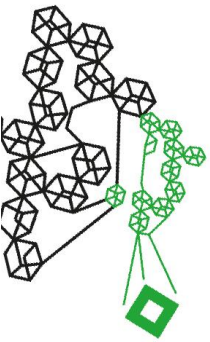

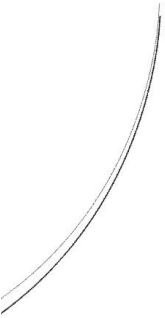

Thesis

Optimization of inspection process for prevention-experts at a.s.r. Nederland

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a.s.r. Nederland

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Preface

Dear reader,

Before you lies the thesis 'Optimization of inspection process for prevention-experts at a.s.r. Nederland'. This thesis has been written in order to finish by bachelor program Industrial Engineering and Management at the University of Twente. The research was conducted at a.s.r. Nederland and officially began back in February 2022, but due to certain setbacks has unfortunately taken until June 2023 to be finished. Working on this research was a challenging task but also a task from which I have learned a lot. I would like to thank everybody who was involved with this research and writing this thesis.

Firstly, I would like to thank the employees at a.s.r. with whom I have worked during this research. The company provided a pleasant working environment, both in Utrecht as online from home. There was always room for questions and discussion with all employees necessary. I would especially like to thank my two company supervisors.

Secondly, I would like to thank my University of Twente supervisors. My first supervisor has been Matthieu van der Heijden, who guided my research process from start to finish. Thank you for helping me trough the process, especially trough the setbacks which occurred. My second supervisor has been Gayane Sedrakyan, who joined later during the research process. Thank you for the new insights when I was stuck later in my research and thank you for taking the time to be second supervisor.

Finally, I would like to thank friends and family for supporting me during this research

Max Gruben

Enschede, June 2023

Management summary

Problem definition

At ASR Nederland, prevention experts conduct inspections at potential customers. This inspection process consists of the experts driven to multiple customers everyday. The planning for these routes is done by the planning staff at the 'schade' department. This is a labour-intensive task and a.s.r. is currently experiencing inefficiency within this process. Inspections fail more often than the company would like to see. This is were this research comes in, to help a.s.r. find out how to improve this process in order to get the level of efficiency up to standard. This results in the research question below.

"How can the inspection process for prevention-experts at a.s.r. Nederland be optimized in order to improve the efficiency?"

Research approach

In order to come up with an answer for the main research question introduced above, a few steps have been taken. First the current situation has been analyses, this has been done by modelling the current business process in order to give insight into how the planning process is currently conducted. There has also been a data-collection effort in order to quantify the actual inefficiency in the current process. Secondly, there has been an extensive literature review in order to find frameworks, best practices and other useful insights which could contribute to this research. Next, the analysis of the current situation and the literature review have been combined to come up with improvement measures for the inspection process. Based upon these measures conclusion have been drawn and recommendations have been made to help a.s.r. improve efficiency and answer the main research question.

Results

From the analysis of the current situation and mainly from the data collection, it became evident that the process is indeed experiencing inefficiencies. Over a four week period of data collection there were irregularities in 28,7% of the appointments. It is concluded that the inspection process is currently inefficient, primarily due to poor communication and handling of last-minute cancellations. Additionally, there is a lack of real-time insight into process performance due to the absence of data collection. The proposed solution to this research problem is two-fold, consisting of a business process redesign and the design of a data-visualisation solution. In order to come up with these solutions, literature has been gathered and based on this the solutions have been drawn up.

Process redesign

Based on findings from the literature, the following improvement measures should be included in the business process redesign.

- The two separate inflows of requests should be automized in order to save unnecessary manual work.
- A new software program should be implemented to also save unnecessary work for the planning staff
- The potential customer should be involved in the appointment making step
- The intermediary should be included in the planning process upfront
- An automatic reminder should be implemented into the new software program

Data visualisation solution

In order to measure the efficiency, the following KPIs should be used:

- Percentage of Failed Inspections (PFI)
- Percentage due to Poor Communication (PPC)
- Percentage due to No-Shows (PNS)
- Percentage due to Moved Inspections (PMI)
- Percentage due to Last-Minute Cancellation (PLC)
- Percentage due to Other Reason (POR)
- Failed Inspections per Intermediary (FIE)
- Failed Inspections per Expert (FIE)
- Number of Kilometres Wasted (NKW)
- Number of Working hours Wasted (NWW)

These should be visualized inside a performance dashboard, for which a design has been proposed. This design has been validated and it can be concluded that the improved version of the performance dashboard at least has a 81% acceptance score.

Recommendations

Based upon the results of this research, the following recommendations are being done.

- Invest in redesigning the planning business process, use the improvement measures identified within this research. This will improve overall process efficiency
- Start the collection of more data, currently no data is being collected at all. This will help give insights into the efficiency of the process significantly.
- Use the proposed KPIs in order to monitor the efficiency based upon the newly gathered data. Which will show more about the efficiency of the process.
- Implement a performance dashboard based upon the proposed design, in order to visualize the KPIs and therefor the efficiency of the planning process. This will enable the management to use the dashboard as a steering wheel and act accordingly to inefficiencies.

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1. Introduction

The research for my bachelor thesis will be conducted at a.s.r. Nederland, within this chapter both the company and the context of the research will be introduced.

1.1. Company introduction: a.s.r. Nederland N.V.

1.1.1. The company

The rich history of a.s.r. begins in the year 1720 with the establishment of 'Stad Rotterdam', back then the company was founded with the goal of offering insurance for merchant ships. However, the foundations for the present-day company were laid in the year 2000, when 'Fortis' and the 'ASR Groep' merged into a.s.r. Nederland.

In present-day a.s.r. is one of the largest insurance companies in the Netherlands and it has a listing on the Amsterdam stock exchange. The company is known for its focus on sustainability and its hands-on approach. The company offers a broad range of financial products ranging from (non-)life insurances to pensions and mortgages.

1.1.2. Inspection process

The head office of a.s.r. is located in Utrecht and their business is divided into various divisions, my research will be done at the non-life division of a.s.r. and more specifically at the prevention team which is a business unit of the 'Varia zakelijk' department. This department is responsible for handling incoming requests for insurance from potential customers and review the necessity to do an inspection, next to that it is also responsible for doing re-inspections at existing customers.

As illustrated in Figure 1. the process of handling incoming requests is divided into four stages, with the first stage being 'Acceptance'. Within this stage the incoming requests are being reviewed and a decision is made if an inspection is necessary. When the decision is made that an inspection is indeed necessary the request is forwarded to the 'Planning' stage in which the inspection will be allocated to one of the prevention-experts and integrated into their time schedule. Thereafter the inspection is carried out by the allocated expert within the 'Inspection' stage, such an inspection will then result in the expert drawing up a report which contains a verdict about how the potential customer is handling certain risks. The drawing-up of such a report and subsequently the final verdict about the potential customer being eligible for insurance or not are contained within the 'Finalisation' stage.

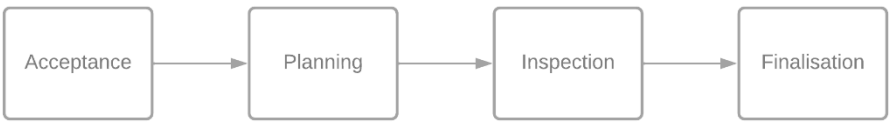


Figure 1. General inspection process

1.1.3. Research motivation

The efficiency of the inspection process described within 1.2. is mainly influenced by the two middle stages, 'planning' and 'Inspection'. Firstly, the planning stage is responsible for making an as efficient as possible time planning for the prevention-experts, this means having minimal unnecessary travel and idle time. From the first conversations with the manager as well as planning and inspection staff it became evident that there is a great deal of discontentment with the efficiency of the current planning strategy. This inefficiency is influenced by multiple factors which makes the problem fairly complex. Next to that, for example the inspection stage entails the actual visits to potential or

existing customers and according to company-experts the prevention staff often experience no-shows from the client side which influence the amount of unnecessary travel time, these no-show's occur in 5 to 10% of all inspections.

Currently the planning department receives inspection requests either via their dedicated software or e-mail, these request are then filtered based on the type of object which needs inspection. These different types are then being put into the corresponding file, from where all the request will be allocated to a specific inspection expert. The planning staff will then look at the allocated expert's agenda and look for the first suitable moment, where the inspection will then be placed. This procedure is currently being handled manually by one of two employees which make up the planning staff.

These factors result in the fact that the company is currently not satisfied with the efficiency of the planning and route construction for their prevention-experts.

Unfortunately, for now, there is not an exact measure of the inefficiency due to a lack of good data but is obvious that it is of real significance. This makes that the goal of this research is to optimize this process in such a way that the company is content with the efficiency.

1.2. The problem

1.2.1. Problem cluster

As mentioned in 1.3. the planning for prevention experts are not efficient and this is influenced by various factors, based on conversations with various experts at the company a list of all these problems has been drawn-up. Subsequently, these problems have been worked out into a problem cluster. A problem cluster is used to map all problems along with their connections (Heerkens & van Winden, 2021). The problem cluster of this research can be seen in Figure 2.

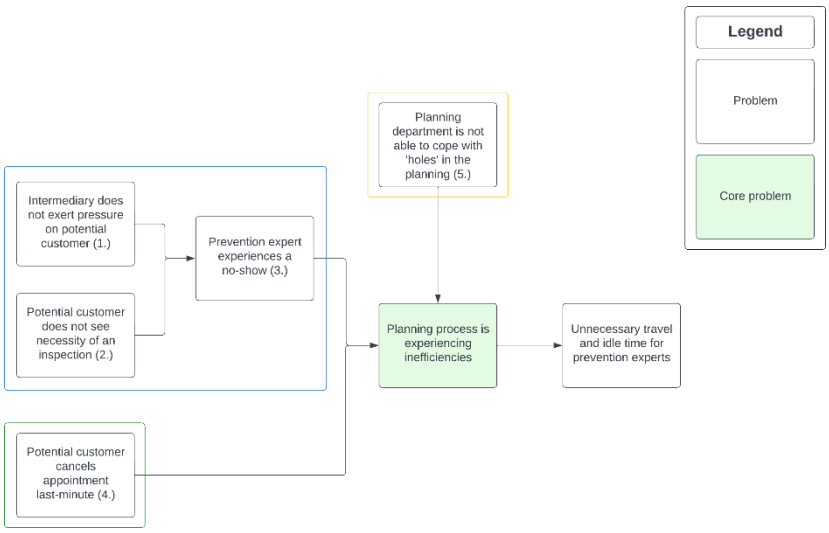


Figure 2. Problem cluster

As illustrated in Figure 2. the problem of inefficient planning is influenced by three main problems, indicated by the coloured boxes. Within this part of the project plan I will discuss each of these problems in more detail.

Firstly, the 'no-show' problem, which is indicated by the blue box is one of the main influences on the efficiency since these occur in 5 to 10% of all appointments. Once the planning has been made and the prevention-expert is executing his daily planning but he encounters a no-show from the client side (*Problem (3.)*), this means that the travel time was unnecessary and a gap in the planning arises. From my talks with company experts I found two main problems which are responsible for these no-show's, one problem on the intermediary side and one on the client side. Whenever a.s.r. does an inspection a third party, or intermediary, is involved. Some of these intermediaries exert pressure on their potential customers to be present at the time of a planned inspection, because they see the value of these inspections. Unfortunately there is also a proportion of intermediaries which doesn't exert this pressure (*Problem (1.)*) which makes that customers do not see the urge of being present, which in term results in a no-show. Next to that a proportion of potential customers do not see the necessity of an inspection (*Problem (2.)*), or even actively counteract the inspection. Which also results in no-show's.

Secondly, the short notice cancelation problem which is indicated by the green box, experts say that often appointments get cancelled with really short notice, on average in about 5% of the cases. This means that for example a planning is already final but last minute an appointment for inspection scheduled on the middle of the day comes through with a cancelation (*Problem (4.)*), this results in a gap in the planning. This gap often results in unnecessary idle times.

Lastly, the coping with 'holes' problem, which is indicated by the yellow box. Once a 'hole' or gap in the planning commences, the planning staff is mostly unable to fill it with another appointment. Which in turn leads to unnecessary idle time for the expert (*Problem (4.)*).

1.2.2. Core problem

According to (Heerkens & van Winden, 2021) core problems are those whose solution will make a real difference. When looking at the problem cluster of my research, one can see that the core problem within the inspection process is defined as 'Planning process is experiencing inefficiencies'. Which result in unnecessary travel and idle time for the prevention experts. Increasing the efficiency of this process will result in less unnecessary travel and idle time, which entail that a potential solution of the core problem will make a real difference.

1.2.3. Research goal

The most ideal outcome of this research would entail a way to improve efficiency for the planning process. My projection is that this will be a difficult process since it has to keep into account many factors. In the ideal situation this research will deliver a way to optimize the planning process which allows the management of the department to lower the amount of inefficiencies.

1.3. Research approach

1.3.1. Research methodology

In order to conduct the research for this bachelor thesis the Managerial Problem-Solving Method (MPSM) will be used, the MPSM can be used when encountering practical and complex problems were investigating and troubleshooting meet (Heerkens & van Winden, 2021). These problems are more than often typical Industrial Engineering and Management problems. When comparing this to the core problem at hand one can see that this methodology is a good fit, the planning and routes not being efficient is in fact a practical problem. Next to that, the efficiency is being influenced by various factors which make the problem quite complex. These findings make it that the MPSM method is a suitable option to conduct this research. As described in Heerkens & van Winden's book the MPSM is divided into seven stages, these stages can be seen in Table 1.

Phase 1.	Defining the problem
Phase 2.	Formulating the approach
Phase 3.	Analysing the problem
Phase 4.	Formulating (alternative) solutions
Phase 5.	Choosing a solution
Phase 6.	Implementing the solution
Phase 7.	Evaluating the solution

Table 1. MPSM steps

1.3.2. Research questions

- *How is the planning process currently being conducted and what are the points of improvement?*
  In order to answer this research question I will have to research the current way in which the planning department is working, this for example means conducting interviews with the planning experts and putting together a Business Process Model (BPM). Business process modelling enables a common understanding and analysis of a business process (Savén, 2004). Based upon this model I need to identify the points of improvement, in order to do so I will have to quantify the current problems. Since data is not broadly available I will have to find out a way to construct data based upon existing agenda's and measure current inefficiency.

- *What could be learned from literature about the points of improvement?*
  Based on the identified points of improvement there will be a Systematic Literature Review (SLR) to gather relevant literature to improve the efficiency of the process. This literature should be analysed and the most important findings should then be set out. These findings will be the basis for improving the current situation and for the remainder of the thesis.

- *How can Business Process Improvement practices be used to improve the efficiency of the inspection process?*
  Based upon useful literature findings I should research how Business Process Improvement practices can contribute to increasing the efficiency of the inspection process. By answering this research question tangible solutions should be drawn up, which will be based upon the current BPM model, which should be improved.

- *How can a data gathering and visualisation solution help improve the efficiency of the inspection process?*
  As a third potential improvement measure I will research how a data gathering and visualisation solution can help improve the efficiency, mainly because the company is not doing any data gathering in the current situation. By answering this research question I should come up with the best ways of collecting and subsequently visualizing the data in a way that the management can draw clear conclusions based on this.

- *Which conclusions and recommendations are the result of this research?*
  Based upon the implemented and validated model I will have to draw up conclusions and recommendations about the research, this again means interviewing stakeholders and using constructed measures to find out the results of the implementation. This should result in a

clear overview of changes the company can make to its planning and route constructing process in order to make it more efficient.

1.3.3. Scope of the research

In order to conduct proper research it is important to scope it sufficiently, within this part of the project plan the scope of my research will be drawn-up. Certain parts are included and other parts are excluded from the research.

As mentioned before the planning and route constructing process is influenced by many factors, this also means that there are some points which clearly lie outside the scope of this research. For example, no-shows are responsible for a proportion of the inefficiency but finding out the behavioural reasons for a potential customer to have a no-show lie outside of the scope. Secondly, the uncertain inbound stream of inspection requests and the reasons behind this will not be included in this research since it does not lie within the scope. This research will focus on the actual planning and route construction process and the goal is to find a more efficient way to execute this process, based upon the different influences the process has.

2. Current situation

Within this chapter the current planning process will be analysed in detail. This will be done by conducting interviews with planning staff, the process will subsequently be modelled in a BPM model. Next to this, since there is no data available about the efficiency of the process, data will be collected over a period of three weeks. Once the process has been modelled and the collected data has been analysed the points of improvement will be identified. All with all the main purpose of this chapter will be to answer research question 1. '*How is the planning process currently being conducted and what are the points of improvement?*'

2.1. Description of current situation

As mentioned above in order to describe the current process interviews with planning staff were necessary. From these interviews and from observing the process I have gotten a good image of how the planning is currently being drawn up.

Requests for inspection can come in through two different channels. Firstly, they can come in directly within the planning software 'Oodit'. Secondly, requests can also come in through e-mail, these concern requests from outside parties and private individuals. Currently these e-mail requests have to be manually entered into Oodit. This therefore marks the first 'job' which has to be executed by the planning staff. Once inspection requests are inside the Oodit platform the planning staff will divide these requests over their corresponding area folders. This means that the request is sorted based on the postal code of the inspection location. Each area, as said based on a group of postal codes, has a corresponding prevention expert which will carry out the inspection. So the next step taken by the planning staff is looking for an empty spot within the concerning expert's agenda. Once such an empty spot has been found the inspection will be planned for that time and day.

2.2. BPM model

As mentioned in section 1.3.2. the current process will be modelled within a Business Process Model. Business process modelling enables a common understanding and analysis of a business process (Savén, 2004). Below the BPM model of the planning process for inspections can be found in Figure 3.

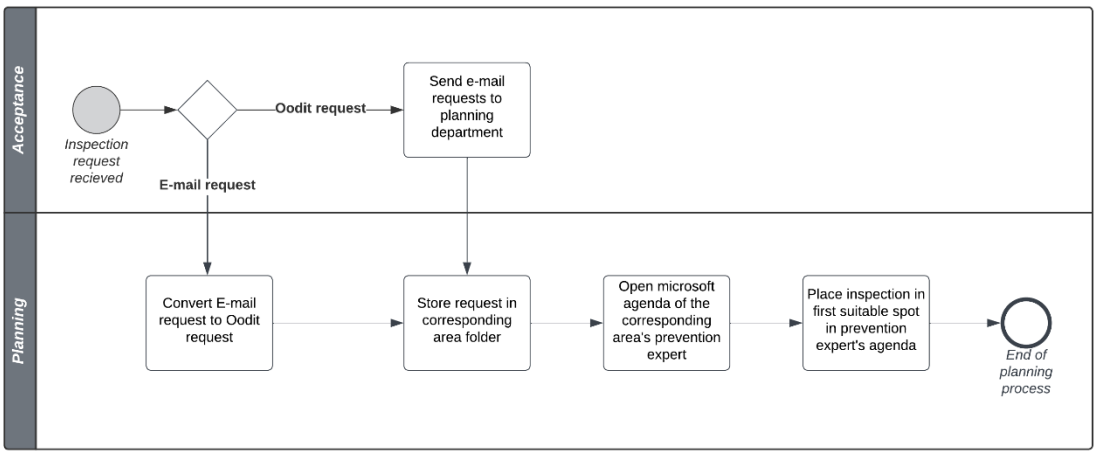


Figure 3. BPMN model of the current situation

2.3. Data collection

In order to analyse the process in a quantitative manner, data about the efficiency of the inspection process is needed. Currently however, the company does not store data about the efficiency of inspections, this means that there is no insight into which inspections have been executed or which inspections encountered irregularities.

This resulted in the need of a manual data-collection effort, which was conducted over a period of three weeks. A longer period is not possible because of the time frame of this research. The process starts on each Friday before a given week with retrieving the schedule of all nine prevention experts and working these out in an excel file. This results in nine separate weekly schedules, one for each expert, an example can be seen in Figure 4. below.

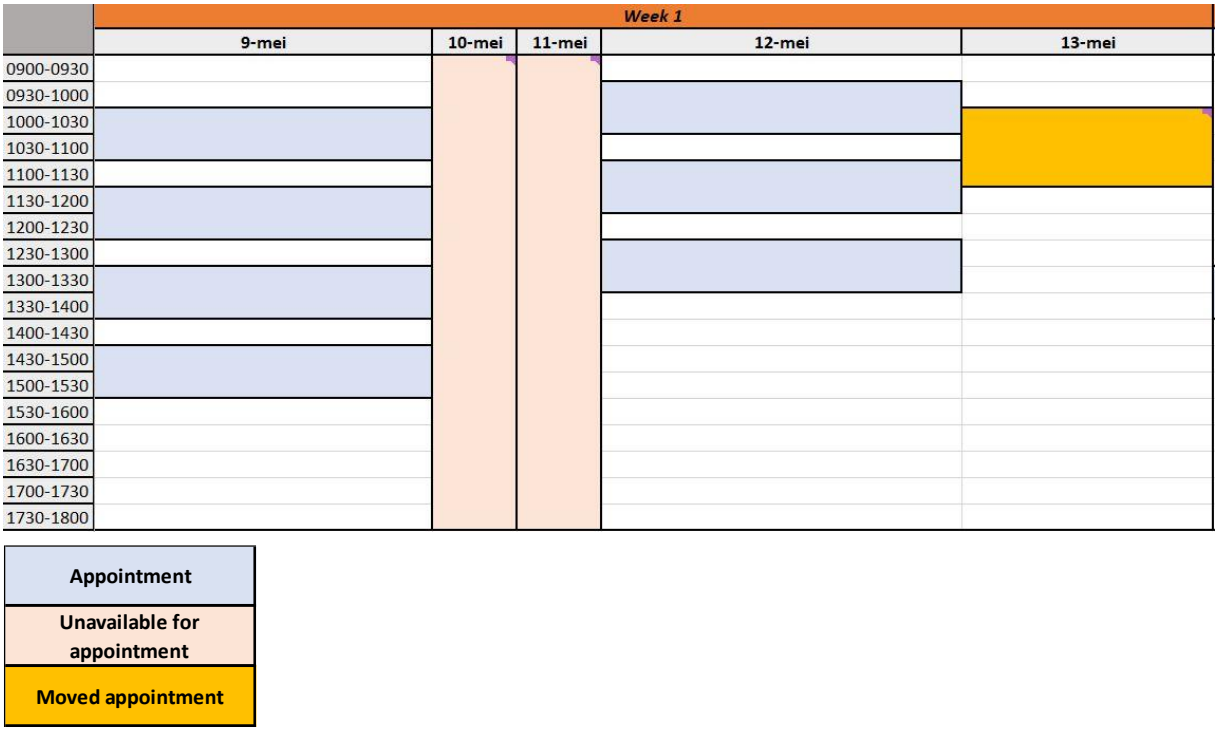


Figure 4. Example of schedule (names removed for privacy reasons)

After these schedules have been worked out, the next step of the process takes place when the week has passed. In order to gain insight into how each inspection has gone, each prevention expert was asked to give a detailed description of all irregularities during the given week. These updates were given by e-mail or by phone call. After all the descriptions have been collected, every irregularity is noted within the schedule like the one in Figure 4. above. Repeating these steps for three consecutive weeks results in the analysis which can be seen in Figure 5. below. As can be seen the total percentage of inspections where irregularities occurred is 28,7%.

P / expert	Week 1				Week 2				Week 3			
	# Inspections	# Good	# irregularity	%	# Inspections	# Good	# irregularity	%	# Inspections	# Good	# irregularity	%
#1	8	7	1	12,5%	10	7	3	30,0%	5	3	2	40,0%
#2	4	3	1	25,0%	3	3	0	0,0%	3	2	1	33,3%
#3	7	5	2	28,6%	3	1	2	66,7%	5	4	1	20,0%
#4	4	4	0	0,0%	6	5	1	16,7%	3	2	1	33,3%
#5	4	4	0	0,0%	4	2	2	50,0%	8	4	4	50,0%
#6	7	4	3	42,9%	5	4	1	20,0%	2	0	2	100,0%
#7	5	4	1	20,0%	5	5	0	0,0%	1	1	0	0,0%
#8	9	6	3	33,3%	2	2	0	0,0%	6	1	5	83,3%
#9	3	3	0	0,0%	4	3	1	25,0%	3	3	0	0,0%
P / Week	51	40	11	21,6%	42	32	10	23,8%	36	20	16	44,4%
Total	129	92	37	28,7%								

Figure 5. Data-analysis

2.4. Data validation

The period over which the data has been collected is merely three weeks, this means that the data set is a sample of the reality. This could mean that the data does not give an accurate image of the efficiency within the inspection process. Within this part of the research, steps are taken to test the data for correctness. In order to do so, the inspection experts will be involved. Selected experts will be asked to participate in an interview. During this interview I will try to track down their experiences in the field, ultimately trying to answer the question 'What percentage of inspections have irregularities and what are the main reasons'. To reach this, the following questions have been drawn up.

'How many inspections do you think you conduct on a weekly basis?'

'How many of those do you feel like have irregularities?'

'What are the three main reasons for these irregularities?'

These questions have been asked to four out of the nine prevention experts, the reason for not asking all experts is the holiday period. The remainder of the experts were unfortunately not reachable within this period. In the table below the results of this validation can be found

	How many inspections?	How many have irregularities?	Main reasons?
Expert #1	10	2	Communication, no-shows
Expert #2	8	2	No-shows, location under construction, communication
Expert #3	9	4	Communication
Expert #4	10	3	Communication

Table 2. Results validation

When analysing these answers the percentages of irregularities are ranging between 20% and 44% with the average coming to 29,9%. This percentage is about one percent higher then the average percentage found in the data collection analysis in 2.3. Next to this, the main reasons given by the experts correspond to most of the reasons found within the data collection. Based on these findings it can be said that the results of the data analysis match with the experiences in reality of the prevention experts.

2.5. Shortcomings and Points of Improvement

Based upon analysis of the gathered data and the validation of this data by interviewing prevention experts, irregularities within the inspection process can be analysed in detail. Because detailed and validated data is used, a percentage in which each of the main problems occur can be given. Which in turn gives a good insight into which aspects could be improved to increase efficiency. The irregularities within the process have been divided into four main types; Poor communication, Last-minute cancelations, No-shows and shifted inspections. These four types will be discussed one by one.

Poor communication (10,85%)

The irregularity within the process which occurs with the highest frequency is missed inspections because of poor communication, in practice these occur in more than ten percent of the cases. The main problem within this communication lies within the dialogue between a.s.r., the intermediate and the potential customer. Either the intermediate does not communicate clearly to the potential customer when a.s.r. is planning to do an inspection or he does not communicate to a.s.r. that the potential customer is not available at the set moment.

Last-minute cancelations (4,65%)

In just under five percent of the inspections a last-minute cancelation occurs, this mains that the inspection is cancelled by the potential customer on the same day the inspection is scheduled. When this is done while the assigned prevention expert is already on route towards the location, the time and distance driven is 'lost'. Another impact of these cancelations is that it creates holes in the schedules, if an inspection which is scheduled in between two other inspections gets cancelled it creates useless time in between. Within this irregularity impending circumstances like sickness are also included.

No-shows (6,20%)

In the case of no-shows the prevention expert shows up at a location to do an inspection but finds that the potential customer is not present at the site. In more than six percent these no-shows occur, which results in inefficient use of time and driven kilometres. When asking potential customers afterwards about the reason for not showing up the general tendency is that the appointment has not been communicated correctly. The potential customer was not aware of a.s.r. visiting to do an inspection, the intermediary did not communicate this to the customer. This makes that this irregularity can in fact be seen under the same category as the 'Poor communication' irregularity.

Moved inspections (6,20%)

This irregularity is different when compared to the three others listed above. The inspections which make up this irregularity have been moved in the schedule either during the same day as the inspection or shortly before. There can be various reasons for the moving of these inspections, firstly it occurs that potential customers last-minute ask for a re-schedule and the inspection still fits in the schedule on a different place, so it is moved. Then for example the inspection is moved forward for an hour to give the potential customer more time. Lastly it also occurs that one of the prevention experts changes the order of the inspections on a certain day because one of them has been cancelled.

2.6. Conclusions

Within this chapter the current situation has been analysed with the goal of answering research question 1. '*How is the planning process currently being conducted and what are the points of improvement?*'. Firstly, the process has been mapped, then data about the efficiency of the process was collected and lastly this data was validated by interviewing prevention experts.

Based on these steps it can be concluded that the inspection process is indeed partly inefficient, the numbers back up the problem statement given by a.s.r. before this research started. This chapter shows that in 28,7% of the cases an appointment experiences irregularities.

Firstly, from the details of the inefficiency it can be seen that poor communication is a cause of a substantial part of the appointments with irregularities. It can therefore be concluded that improving the communication part of the process could potentially greatly improve efficiency. Also, it can be seen that handling last-minute cancellations is another field of improvement for the process. This could for example mean revamping the process in such a way that better communication gets standardized and the process is able to cope with cancellations better. In order to do so, literature has to be gathered about Business Process Improvement in the next chapter. From this literature the best practices can be taken and used to draw up an improved business process which should, when followed properly, decrease appointment irregularities.

Secondly, during the research of the current situation it became evident that there is very little insight into how the inspection process is performing in real-time. This because no data is gathered about the inspections at all. In order to come up with numbers for this research about how many irregularities occur, a data gathering effort had to be conducted. From this it can be concluded that when the management would put in place a data gathering and visualisation solution, it would have insight into the efficiency of the process and can act accordingly. This means that the second part of the research should focus on the implementation of such a solution.

All with all, this means that the research into a possible solution for the inefficiency problem at a.s.r. consists of two main parts. These parts are: improving the business process of the planning department and secondly putting in place a data-gathering and visualisation solution. The combination of these possible solutions should contribute greatly to improving the efficiency of the inspection process.

3. Literature review

Within chapter three literature will be collected about the two proposed main possible solutions to improve the efficiency of the inspection process; optimizing the current process and the data-gathering and visualisation solution. The main purpose of this chapter is therefore answering research question 2. '*What could be learned from literature about the points of improvement?*'

3.1. Business process redesign literature review

When looking back at Chapter 2., the current process has been modelled within a BPM model, which enables a common understanding and analysis of the process (Savén, 2004). Subsequently, based upon the data collection and analysis further on in Chapter 2. It is concluded that the process is currently having a reasonable amount of inefficiency caused by a set of reasons, of which one for example is poor communication. Changing the standard process in a way which will for example improve communication could therefore reasonably improve the efficiency. This means there is a need of literature about 'process redesign'.

According to (Reijers & Mansar, 2005) a business process redesign is commonly seen as a two-fold challenge, a technical challenge and a socio-cultural challenge. Technical due to the difficulty of developing a process design that is a radical improvement of the current design. Socio-cultural due to the severe organizational effects on the involved people. Within this research the process redesign will be focused on the technical challenge, creating the radical improvement mentioned in (Reijers & Mansar, 2005).

Also, according to (Reijers & Mansar, 2005), in order to help the user in choosing the correct best practice when dealing with the implementation of BPR, it is important to define clearly a framework for it. So in order to conduct a business process redesign on the inspection process at a.s.r. a framework should be defined. The idea behind a framework is to help practitioners by identifying the topics that should be considered and how these topics are related (Alter, 1999). In his book, (Alter, 1999) suggests the use of the so-called work-centred analysis framework (WCA). It consists of six linked elements, the internal or external customers of the business process, the products (or services) generated by the business process, the steps in the business process, the participants in the business process, the information the business process uses or creates and finally the technology the business process uses. This WCA framework is visualized below in Figure 6.

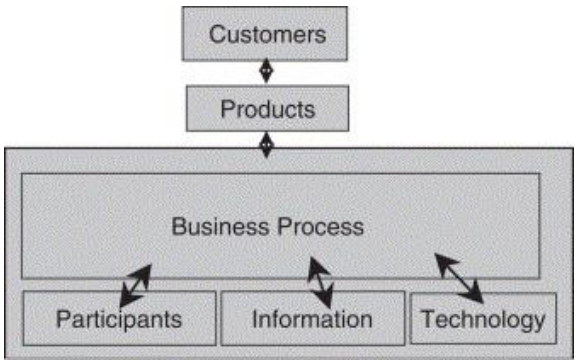


Figure 6. WCA Framework

The WCA framework merely focusses on processes, according to (Grant, 2002) it is a narrow view to only consider processes when depicting BPR; other important aspects of institutions are also organizational structure, people, communication and technology. The danger of adopting too narrow a view is that it misdirects developers to focus exclusively on processes while ignoring a variety of other possible reengineering opportunities that may result from a wider view. However since this is a relatively small process and the organizational impact is out of the scope of this research, a narrow view of this business process remodelling suffices.

All with all this framework seems a good basis for the process redesign at a.s.r. since the business process and its linked internal components are separated from the product and customers. This would reflect the internal planning process at a.s.r. being separated from the products, in this case a service, namely the planning at a potential customers site.

In order to model the inspection process in a scientific and formal way a certain modelling language is needed to do so. According to Chinosi and Trombetta (2012) the state-of-the-art in the field is represented by BPMN (Business Process Model and Notation), the leading standard in the frame of business processes and workflow modelling languages. This method for visualising a business process is focused on being understandable by its users, which means all users, from top to bottom. The method was first launched in 2004 and has seen various updates since, with the most up-to-date being BPMN 2.0.

When looking at the process at a.s.r. it can be seen that there is no need for extremely extensive modelling like BPMN 2.0 adds to the method. The 2.0 version is used for complex modelling scenario's and since the modelling of this process can merely be seen as a descriptive model the standard BPMN suffices. Since BPMN is the state-of-the-art and widely used solution this method will be chosen to be used in the Business Process Redesign. BPMN uses the elements which can be seen in Figure 7. To model a certain process.

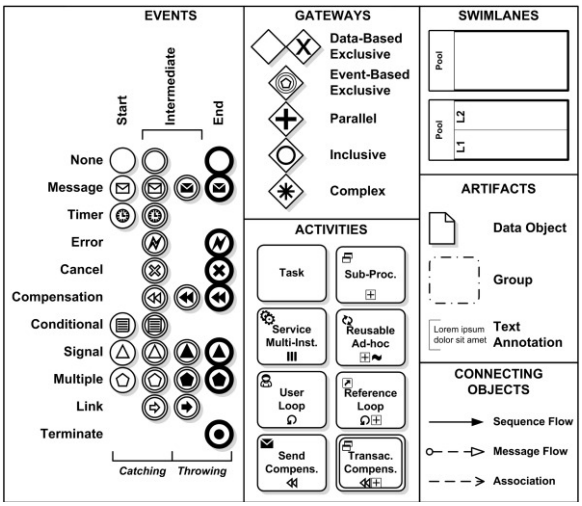


Figure 7. BPMN elements

3.2. Data-gathering and visualisation solution literature review

Since no data is being gathered in the current situation, the first step within this solution would be to put in place a method to start gathering data. This would therefore also mark the first point of literature research. Secondly, from these 'raw data' metrics should be set in place which can tell something about the efficiency of the inspection process. These metrics can be seen as Key Performance Indicators (KPIs). Key Performance Indicators measure the performance of an enterprise relative to its objectives thereby enabling corrective action where there are deviation (Maté, Trujillo, & Mylopoulos, 2017). The last step is the actual visualisation of the data, making it easy for the management to see how the process is going in real time and act accordingly.

3.2.1. Key Performance Indicator selection

Once data has been gathered, KPIs should be drawn up in order to monitor the efficiency of the inspection process. Deriving KPIs is not a simple task, as it must include a deep understanding of the business or operation to be successful, such as, an understanding of the organizational mission and system context. As such, different Performance Measurement Systems (PMS) have been proposed to determine and monitor KPIs. (Meyers & Hester, 2011). Probably the most well-known approach is the Balanced Scorecard as presented by Kaplan & Norton (1996). From the article by Kaplan & Norton (1996) it becomes clear that the balanced scorecard offers the advantage of including more than just financial aspects in its Performance Measurement System. Also, it can be used to align the KPIs with the companies goals and strategy.

Another well-known method to derive KPIs is by using Lean Six Sigma. According to Al-Aomar (2012) Lean Six Sigma key performance indicators (LSS-KPIs) are assessed at the end of the look-ahead period to measure performance and adjust planning and work activities. Also, these KPIs are being tested against a pre-set goal and benchmark, based on this test corrective or improvement actions can be taken.

When comparing these two well-known methods to the situation at a.s.r. there are a few reasons for LSS to be the most suitable method. Firstly, the goal for monitoring the KPIs is not to link them to the company strategy. A.s.r. is a very large company and its strategy is not directly linked to this specific part of its business. Moreover, LSS is used to compare KPIs over time to goals which have been set, which is a good match to the situation at a.s.r. since the goal is to lower irregularities within the inspection process.

From W. Eckerson W, (2009) it is taken that there are two types of KPIs, driver KPIs and outcome KPIs. Driver KPIs can be seen as leading or value drivers, which affect the outcome KPIs. By distinguishing between these two types, the visualisation can become much more clear because the cause-effect can be seen.

When deriving the KPIs, there is a commonly used framework to ensure that these KPIs are actually usable for the management. According to Shahin and Mahbod (2007) it is found that the set of criteria most often used to select KPIs is SMART (Specific, Measurable, Attainable, Realistic and Time-sensitive). These criteria are explained below.

Specific

Indicators cannot be vague or broad, they should be as specific as possible. This could for example mean weights, numbers or times.

Measurable

Indicators should be measurable in order to determine if certain objectives or goals have been achieved. This measurement can either be quantitative or qualitative.

Attainable
Indicators can only be used if they are attainable, meaning they should be accepted by all stakeholders.

Realistic
Indicators should be aiming towards realistic goals, the goal is to find the fine line between unreachable and ambitious goals.

Time-sensitive
Lastly indicators should be measurable against time, this allows stakeholders to look into the state of a certain goal at a certain point in time.

In order to make sure that the chosen KPIs can be used to compare certain values over time, against set goals. The SMART criteria will be used in the process of deriving these KPIs. This will help looking at the KPIs from a LSS point of view.

3.2.2. Data visualisation in a dashboard

When both a data-gathering solution has been set in place and KPIs have been drawn up, the final step is to visualize the data trough a dashboard. According to Eckerson (2010), when deployed properly, a dashboard can transform an underperforming organization into a high-flier. Also, executives use dashboards like a steering wheel to fine-tune corporate strategy as they go along. This is visualised in Figure 8. below.

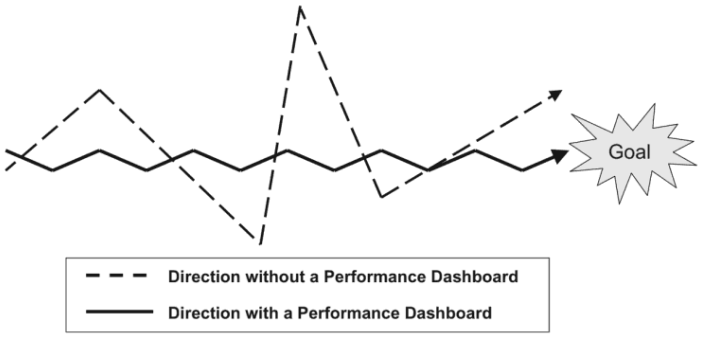


Figure 8. Performance dashboards enables executives to chart a steady course. (Eckerson, 2010)

The reason so many organizations are implementing performance dashboards is a practical one: They offer a panoply of benefits to everyone in an organization, from executives to managers to staff (Eckerson, 2010). These are the most important benefits when looking at the situation at a.s.r.;

- ***Refine strategy:*** *Using the dashboard as a steering wheel, see Figure 8.*
- ***Increase visibility:*** *The dashboard gives insight into daily operations and performance.*
- ***Increase coordination:*** *Insight into performance gives encouragement to act accordingly when performance is low.*

According to Bugwandeen and Ungerer (2019) there unfortunately is no generic template for dashboards, as the development of successful dashboard can be a detailed and complex task. However, there are best-practice guidelines for developing performance dashboards. Based on the research by Bugwandeen and Ungerer (2019) it is evident that the design of a dashboard has five

relevant common aspects: content, data analysis, visual effects, functionality and platforms. These five aspects will be set out in detail below.

Dashboard content

The dashboard should display the KPIs, which are aligned with strategic objectives, in order to allow for effective decision-making. Also, the information which is being showed should be timely, relevant, accurate and actionable.

Dashboard data analysis

Further insight should be given by making use of analytical tools such as heat maps or drill downs, however these tools should be kept manageable by the users of the dashboard. This view is also shared by Eckerson (2010).

Dashboard visual effects

From Bugwandeen and Ungerer (2019) it becomes clear that dashboards should be visually attractive and elements should be arranged correctly. There is also broad consensus about dashboards being one well-designed screen which enables users to gain useful information at a glance. Eckerson (2010) suggests that dashboards should contain tabs and filters to manage information. And lastly, colour coding is often used in dashboards, where red indicates poor performance, amber is borderline, and green is good (Bititci, 2015).

Dashboard functionality

According to Bugwandeen and Ungerer (2019) it is debatable if it is beneficial to allow for much customisation in a dashboard. This is something which should be assessed during the design phase of the dashboard. This can be seen as putting to much buttons and/or sliders in place on a dashboard, which could cause the overall dashboard being not easy to work with.

Dashboard platforms

In order to facilitate the dashboard, an underlying software architecture which allows the correct information to be available at the correct time should be put in place (Rasmussen et al., 2009). From Bugwandeen and Ungerer (2019) it is clear that this software should be supported by the organisations IT policies and expertise. Also it is suggested that Microsoft Excel can be seen as an option to create a dashboard, but it is rather simple. A dedicated software package can potentially be more suitable.

While designing the dashboard, choices have to be made about how the data will be visualised, for example which graphs will be chosen to showcase certain KPIs. In order to present data effectively, Evergreen and Emery (2018) have created a 'chart choosing sheet' which can be used to link the right graphs to certain data types. For example, when looking for the right graphs to showcase changes of certain KPIs over time, the sheet recommends the charts which can be seen below in Figure 9. In Sedrakyan et al. (2019) this view is shared, in order to visualize a trend over time either a column or line visualisation is recommended as a general rule of thumb.

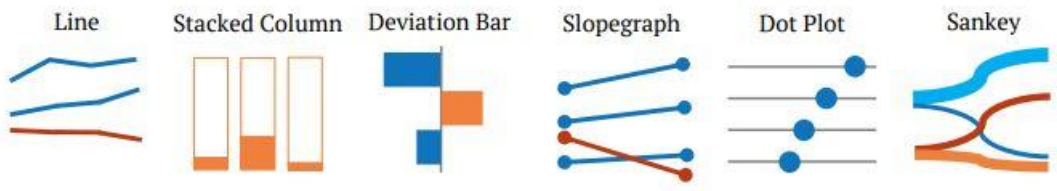


Figure 9. Recommended charts by Evergreen and Emery (2018)

3.3. Conclusions

Firstly, based upon the literature review about business process redesign a few conclusions can be drawn. In order to redesign the planning process at a.s.r. the WCA framework should be used, this framework will help by making the redesign orderly. The different aspect of this framework will cover all 'stakeholders' inside the process in order to ensure a smooth redesign. The BPMN modelling language should be used in order to formally model the business process.

Based upon the literature review about the data gathering and visualisation solution a few conclusions can be drawn. In order to derive the right KPIs the two main methods which are described in 3.3.1. have been considered. For the situation at a.s.r. the Lean Six Sigma (LSS) method has been found more fitting, since the KPIs should be compared over-time to certain pre-set goals. The management at a.s.r. should set goals for the amount of irregularities within the inspection process and the KPIs should give insights into the performance of these goals. Also, to help the KPIs fit this LSS method the SMART criteria will be used in order for them to be usable for the management. Lastly, it should be identified which KPIs are driver KPIs and which are outcome KPIs in order to identify cause-effect relations in the measures. When looking at the visualisation of the data, it is obvious that a performance dashboard should be used. This dashboard should have three main goals, namely: refine strategy, increase visibility and increase coordination. For the design of this dashboard there is no generic template but the best practices described in this literature review will help steer this design. Also, when choosing the right visualisation practices for this dashboard, the LSS method should be kept in mind. Which means that the charts which best describe change over time should be used in order to enable to compare the values to goals and past values.

4. Business process redesign

Chapter 4. will work out the business process redesign for the inspection process. Ultimately trying to answer the research question: '*How can Business Process Improvement practices be used to improve the efficiency of the inspection process?'.* This will be done by first reviewing the current situation against a selected framework and after this drawing up the process redesign measures. The result will be a model of the proposed new process.

4.1. Framework and current situation

As described in the literature review about business process redesign in order to conduct a redesign, first a framework should be in place. The framework chosen for this redesign is the Work-Centred Analysis framework (WCA) and can be found in Chapter 3. This framework is a good basis for the process redesign at a.s.r. since the business process and its linked internal components are separated from the product and customers. This would reflect the internal planning process at a.s.r. being separated from the products, in this case a service, namely the planning at a potential customers site. The WCA framework will make sure that not only the process itself but also all 'stakeholders' are included in the redesign. However one important component which is missing from this framework is the 'intermediary' component. The intermediary is not a internal participant since it is not included in the actual planning process but only given details once an appointment has already been scheduled. This change makes the framework look like it does in Figure 10. below

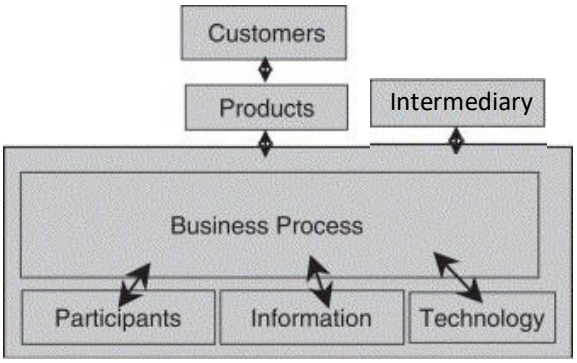


Figure 10. Changed WCA framework

Now, the current situation should be reviewed against the WCA framework, meaning that all stakeholders should be linked to one of the components of the framework. The result of this can be seen in Table 3 below.

WCA Component	Current situation
Customers	Potential customers which require an inspection
Intermediary	*Not included in current planning process*
Products	In this case a service, namely doing an inspection at a potential customers site
Business process	Complete current planning process as shown in Figure 4.
Participants	Management, planning staff, prevention experts
Information	All data about customers, data from prevention experts agendas
Technology	Oodit and Microsoft agenda

Table 3. WCA components

4.2. Process redesign measures

Now that the planning process has been set-out in terms of WCA components, each component will be reviewed for improvement measures. These measures will be based upon analysis of the current situation and discussion with employees which are part of this process. This review of components is listed below, starting with the business process component.

Business process

In order to gain insights into the business process, a BPMN model of the current situation has been created. BPMN is the industry standard and state-of-the-art method of formally modelling business processes, which ensures a clear overview of the current situation. The model is illustrated below in Figure 11.

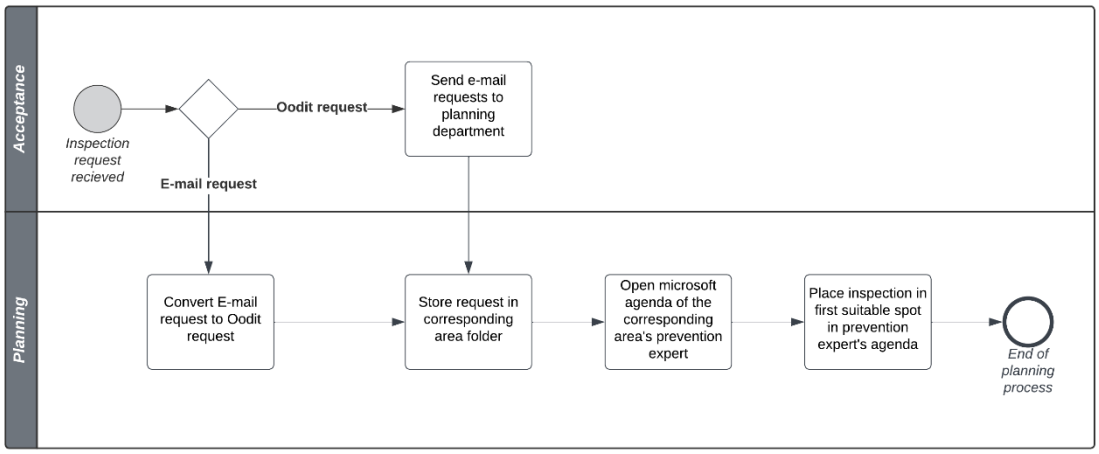


Figure 11. BPMN model of the current situation (repeated)

The first thing which stands out about the current process is the fact that inspection requests come in through two different channels, either through e-mail or through the software called Oodit. When discussing this with planning staff it became evident that requests which come in through e-mail have to be manually copied into Oodit by entering all the information in the system manually. This is a labour-intensive task and is taking up unnecessary time of the planning staff. This makes that the first improvement measure is to automate the loading of e-mail requests into the software program, resulting in less unnecessary work for planning staff and making the process more efficient this way. In order to do this, a.s.r. should implement IT solution within their e-mail which retrieves the data from the e-mail requests and sends it to Oodit. Since all e-mail requests come in the same layout, this should be a fairly easy process.

The second thing which stands out is that there are two different platforms in use to create the planning and therefore the routes. Oodit is used to get the inspection requests and store them, while Microsoft agenda is used to create the actual planning. This was also discussed with the planning staff and what this mean in reality is that the two programs have to be opened on the same screen simultaneously in order to create the planning. Once a spot has been found for a certain inspection request, the information of this request has to be manually entered into the corresponding agenda. This makes that the second improvement measure is to implement a dedicated software program which can combine both these programs in order to decrease the amount of unnecessary work. This has also been discussed with management and it became evident that such a program has been researched some time ago but the perfect match had not been found yet. Since this is an obvious point of improvement, and previous efforts for finding such software have not been successful. A.s.r. should look into developing such a software program in-house.

Also, what stands out, is the fact that appointments just get placed in the first suitable agenda spot of an expert. This is done without consulting the potential customer upfront. This seems like an huge window of opportunity, by first consulting the customer about a possible appointment, the chance of it being successful can increase significantly. This could be done in multiple manners, either by calling the potential customer and discuss an appointment on the call or by giving potential customers a number of options in order for them to choose.

Participants

The participants component entails all the involved employees within the planning process, which is; the management, the planning staff and the prevention experts themselves. The improvement measure within this component will mainly focus on the cooperation between the planning staff and the prevention experts. From discussion with both these groups it has become evident that there is uncertainty about who is responsible for reminding the potential customer about their inspection appointment. In some cases the expert calls the customer themselves but most of the experts count on planning staff to do so. In reality however, there are almost no reminders being sent out. In order to improve this communication towards the customer and also make the cooperation between the planning staff and prevention experts smoother, guidelines should be set in place about who sends out the reminder. When discussing this with all involved parties it became evident that the most useful guideline would be to make this task a responsibility for the planning staff since these are always in an office and have insight into all agendas. The management, however, did place a sidenote to this by stating that during busy periods these reminder-calls would take up too much time for the planning staff. From this it can be concluded that automating the reminder would be the best solution for all parties, this could either be done by e-mail or text message.

Intermediary

In the current process, the intermediary is not included within the actual planning process, it is merely getting notified about inspections which have been planned. The Intermediaries responsibility is to be the middle man between a.s.r. and potential customers. From talking to planning staff it became obvious that part of the poor communication is due to the intermediary. And also according to the staff, this impacts the success of an appointment. This means that the intermediary should be actively involved in the planning process in order to improve this communication and, in turn, help with the efficiency of the actual process. This would mean that once suitable spots for a certain inspection request have been found and tuned in with the potential customer, the corresponding intermediary should be contacted about the appointment. The intermediary would then be able to exert pressure on the potential customer to make the appointment go through successfully.

Technology

As described in the business process component of this redesign there are currently two different software solutions within the planning process. Also, as described, in order to improve the business process a dedicated software package should be implemented. This software should be able to receive the inspection requests as well as allow for the staff to create a planning for each expert. This software should also be able to send automated reminders to each client on a set interval before the inspection appointment. The changes to this component will therefore be the implementation of such a software package.

Customer
In the redesigned process, the customer is receiving a reminder trough e-mail or text message. Also, the customer will be involved in the planning of the actual appointment. This will increase cooperation with potential customers and improve communication.

Information and products
Both the information and products components do not change in the redesigned process.

Given all the proposed improvement measures above, a new proposed planning process can be drawn up. This will again be done using BPMN to illustrate correctly. This model can be seen in Figure 12. below.

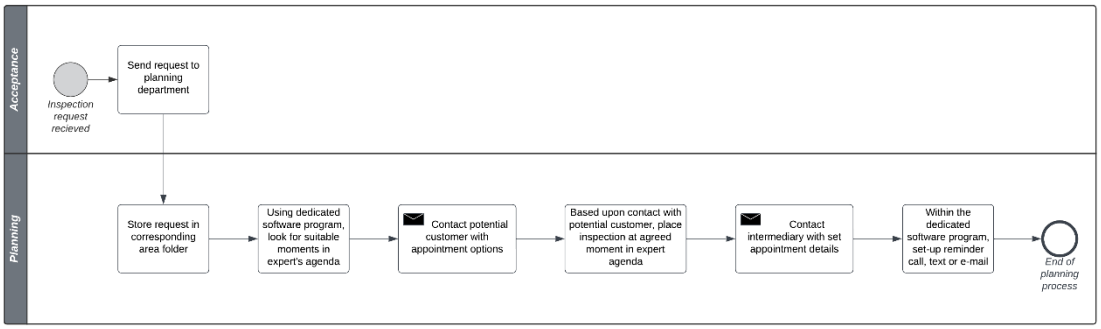


Figure 12. BPMN model of improved situation

4.3. Conclusion

The goal of this chapter was to answer the research question: '*How can Business Process Improvement practices be used to improve the efficiency of the inspection process?'*. Within this chapter the WCA has been used to systematically redesign the planning process, while using the BPMN modelling language to formally visualize the process before and after the redesign.

Based upon the seven components of the framework, different improvement measures have been drawn up. First, the two separate inflows of requests should be automized in order to save unnecessary manual work. Next to this a new software program should be implemented to also save unnecessary work for the planning staff. Also, the potential customer should be involved in the appointment making step, creating a higher chance for the appointment to be successful. These measures will greatly improve efficiency from the planning staff point of view.

Also, the intermediary should be included in the planning process upfront in order to increase communication and increase chance for a successful appointment. In order to even further increase communication an automatic reminder should be implemented into the new software package. These two measures will improve the efficiency of the process by improving communication.

All with all, the conclusion is that the proposed new design of the process as depicted in Figure 12. should be implemented in order to improve efficiency.

5. Data gathering and visualisation

Chapter 5. will work out a data gathering and visualisation solution for the company. By implementing such a solution the management is able to monitor the efficiency of the inspection process in real-time and take actions based on this. Therefore, after this chapter the research question: '*How can a data gathering and visualisation solution help improve the efficiency of the inspection process?*' can be answered.

In order to create this data gathering solution, both best-practices from the literature review in Chapter 3. will be used and discussion with the management will be held. Based on this literature review, the method for creating the data visualisation will be two-fold. First, KPIs will be drawn up by following the Lean Six Sigma theory and then checked against the SMART criteria. Secondly, for creating a performance dashboard there is not a fixed framework but the best-practices proposed in literature will be used and tweaked to the situation at a.s.r.

5.1. Data collection

In order to construct KPIs and visualize these in a performance dashboard there should be data about the inspection process. This means that all irregularities which occur during inspections should be noted. Based on the fact that the data collection in Chapter 2. was manually collected from all the prevention experts it is evident that there should be a more efficient method in place. From discussion with the management it seems that the most efficient and feasible method to collect this information is through the prevention experts themselves. This could for example mean that after every working day the experts fill out information for all the inspections which were planned that day. The platform for this could be an mobile app or online form, the exact details of such a possible data-gathering application are not within the scope of this research. When constructing the platform a.s.r. should keep in mind that the data which comes out is clean and correct. So for example, the amount of open text answers should be eliminated and the options should be set upfront.

5.2. KPI derivation

The KPIs will be derived based upon the Lean Six Sigma principle and then tested against the SMART criteria. Also, there will be a distinguishing between driver and outcome KPIs to make the visualisation more clear and to identify the cause-effect relation between the KPIS.

The first step in the process to derive the KPIs is to discuss with the main stakeholder, the management, which KPIs are seen as necessary. From this discussion it became evident that the main measures should be 'Total amount of inspections' and the 'Total amount of failed inspections' to give a general overview of the efficiency. These measures would result in the KPI 'Fraction of failed inspections'. Then, to give insight into the details of the failed inspection, the reason for failure should be collected. The measures for collecting this are based on the most occurring irregularities found in Chapter 2. and are the following; 'Missed due to poor communication', 'Missed due to no-show', 'Missed due to last-minute cancel' and 'Moved inspections'. From these specific measures, KPIs which measure the percentage of failures due to a specific reason can be derived. Next to this, from the discussion it became obvious that there should also be a measure to collect irregularities which might have not occurred during the data collection period in Chapter 2; 'Missed due to other reason'. The list of KPIs which can be derived based on discussion with the management can be seen in Table 4.

KPI	Description
Percentage of **F**ailed **I**nspections (**PFI**)	Percentage of inspections which have failed over a specific time period
Percentage due to **P**oor **C**ommunication (**PPC**)	Percentage of failures due to poor communication over a specific time period
Percentage due to **N**o-**S**how (**PNS**)	Percentage of failures due to no-show's over a specific time period
Percentage due to **M**oved **I**nspection (**PMI**)	Percentage of failures due to moved inspections over a specific time period
Percentage due to **L**ast-Minute **C**ancellation (**PLC**)	Percentage of failures due to last-minute cancellations opver a specific time period
Percentage due to **O**ther **R**eason (**POR**)	Percentage of failures due to other reasons over a specific time period

Table 410. KPI overview based on management discussion

As mentioned before, the KPIs for this data visualisation will be constructed according to Lean Six Sigma (LSS) theory. In LSS the KPIs are being tested against a pre-set goal and benchmark, based on this test corrective or improvement actions can be taken (Al-Aomar, 2012). This means that the KPIs in Table 5. fit this description. The management must set a goal for each specific KPI in order to test the real-time value to this goal. When looking at the KPIs in Table 5. these all match this description since the management can set a goal for both the total percentage of failures and also for each specific failure reason.

As set-out in the literature review, the KPIs should fit the SMART criteria in order for them to be useable for the management. Overall, setting SMART KPIs helps to clarify the objectives, track progress towards those objectives, and ensure that everyone involved is working towards the same goals.

These KPIs will also be divided into the two categories mentioned before; driver KPIs and Outcome KPIs. Driver KPIs have a result on the outcome KPIs and show clear cause-effect relation. Within this situation it can be seen that the specific reasons for failed inspections add up to the total amount of failed inspection. Meaning that the specific failure KPIs drive the result of the total failure KPI. So it can be said that the KPI 'PFI' is the outcome KPI and the specific reason for failures are driver KPIs.

Next to this, in order for the management to act accordingly in case of inefficiency, data about which intermediary and which expert is involved should be visualised. These two measures are both outcome KPIs of the specific failure driver KPIs. For each failure there is one intermediary and one expert. This results in the KPIs 'Failed inspections by Expert' and 'Failed inspections by Intermediary'. If the management observes a certain expert or intermediary accounting for a larger than usual share of failed inspections, it can act accordingly by talking to the concerned party. When such an observation persist it can decide to take corrective actions. These KPIs should help the management to get a grip on the source of the efficiency.

Also, in order to quantify the costs of failed inspections it could be useful to measure how many driven kilometres and working hours are being wasted because of failed inspections. Within the data collection of this research such data has not been collected, which makes that in the dashboard proof of concept, these can not be included. However, when designing the performance dashboard there should be room for implementing the measures when it is implemented in the future. These measures would be 'Number of kilometres wasted' and 'Number of working hours wasted'.

5.3. Visualisation

Now that the KPIs have been drawn up, the actual visualisation trough a performance dashboard should be set up. This will be done using best practices from the literature research. Which means the dashboard has three main goals: Refine strategy, Increase visibility and Increase coordination. The dashboard should be a steering wheel for the management, it should give insight into daily operations and performance in order to act accordingly when performance is low.

When creating the dashboard, the five aspects proposed by Bugwandeen and Ungerer (2019) will be taken into account. These aspects are: Content, Data analysis, Visual effects, Functionality and platforms. These steps have been set out within the literature research in chapter 3.

Also, when setting up the performance dashboard, the most effective ways of visualizing the KPIs will be used. This means choosing the right graphs for the right data and visualisation types. The different graphs to visualize KPIs have been proposed by Evergreen and Emery (2018).

Based upon the best practices described above and the KPI selection from section 6.3. the performance dashboard to monitor the efficiency of the inspection process has been drawn up and can be seen below in Figure 10. For a more detailed view of the dashboard, Figure 10. can also be found as Appendix 1. As can be seen, the dashboards consists of four graphs, a 'general information' and a customisation part. Below, the different parts of the constructed performance dashboard will be discussed in detail.

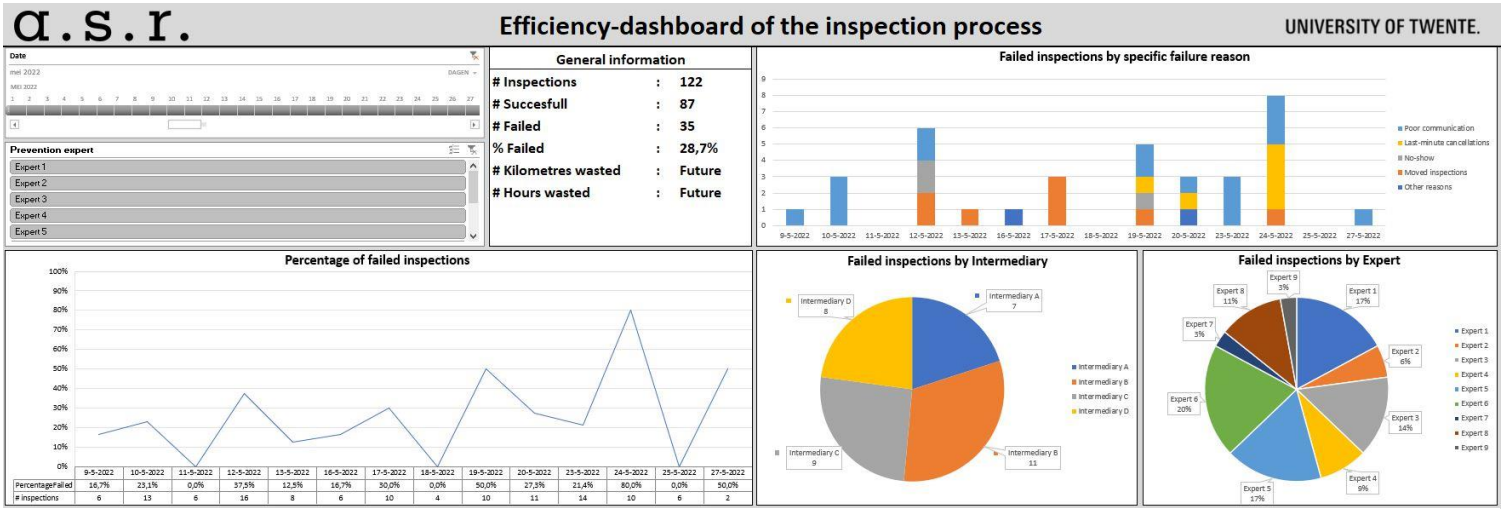
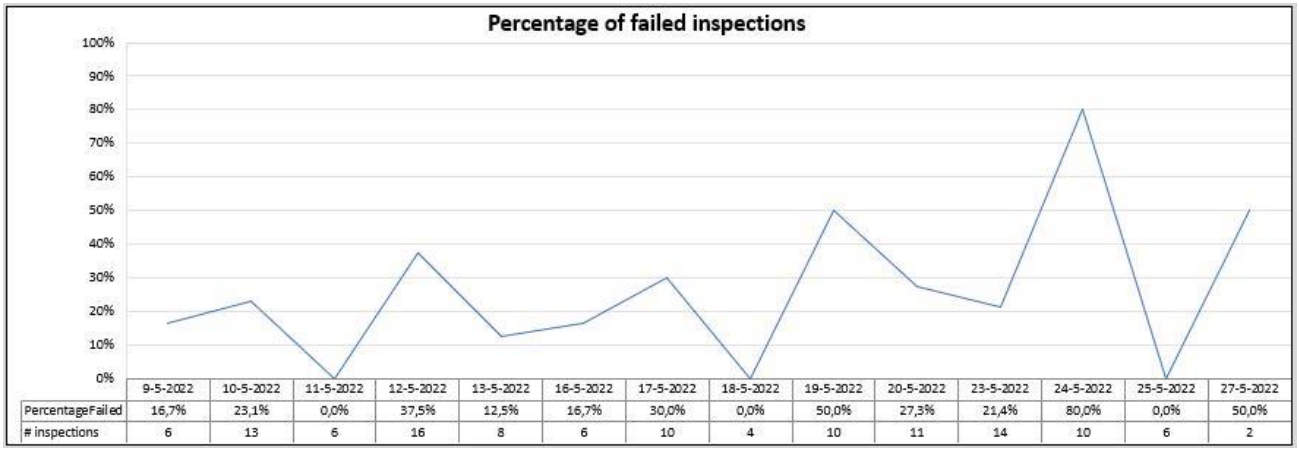


Figure 13. Performance dashboard

Graphs



	9-5-2022	10-5-2022	11-5-2022	12-5-2022	13-5-2022	16-5-2022	17-5-2022	18-5-2022	19-5-2022	20-5-2022	23-5-2022	24-5-2022	25-5-2022	27-5-2022
PercentageFailed	16,7%	23,1%	0,0%	37,5%	12,5%	16,7%	30,0%	0,0%	50,0%	27,3%	21,4%	80,0%	0,0%	50,0%
# inspections	6	13	6	16	8	6	10	4	10	11	14	10	6	2

Figure 14. Percentage of failed inspections

In order to visualize the Percentage of failed inspections KPI, a line graph has been chosen. According to literature, a line graph is a best practice to showcase performance over time. As Sedrakyan et al. (2019) states it, line-charts can emphasize the magnitude of change over time and draw attention to trends. The KPI percentage of failed inspection is a KPI which should be visualised over time, in order for the management to recognize patterns and act accordingly. Below the line graph, a data table can be seen, this table showcases the percentages as well as the total inspections of each specific day. This puts the data in perspective by also showing the amount of inspections and not only the percentage of failures.

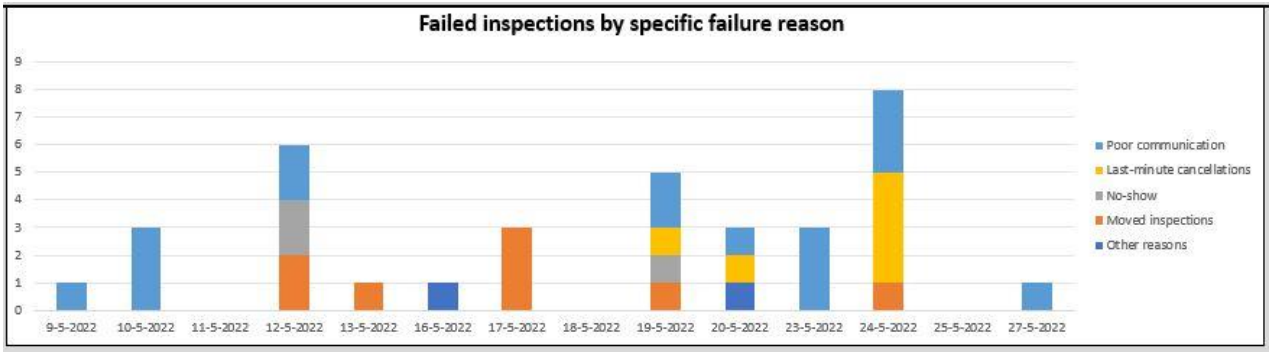


Figure 15. Failed inspections by specific failure reason

In order to visualize the specific reasons for failed inspection, the stacked bar chart in Figure 15. has been chosen. Again, from literature it is learned that a bar chart is a best practice to showcase performance over time. The reason for picking a stacked bar chart over the line chart in Figure 14. is the fact that the stacked bar chart showcases the different reasons for failure better. It visualizes the proportion of each failure in the total amount of failures. This allows the management to see which reasons occur more than others, and act accordingly. Or as Sedrakyan et al. (2019) states, the stacked horizontal bar charts is recommended when observation of time-related aspect is relevant.

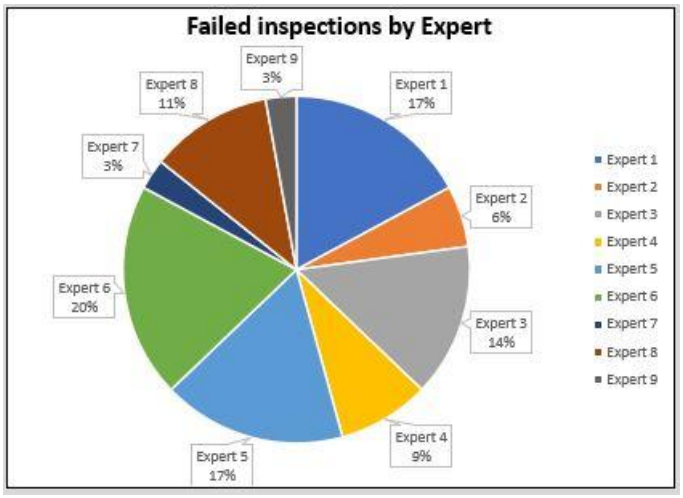


Figure 16. Failed inspections by Expert

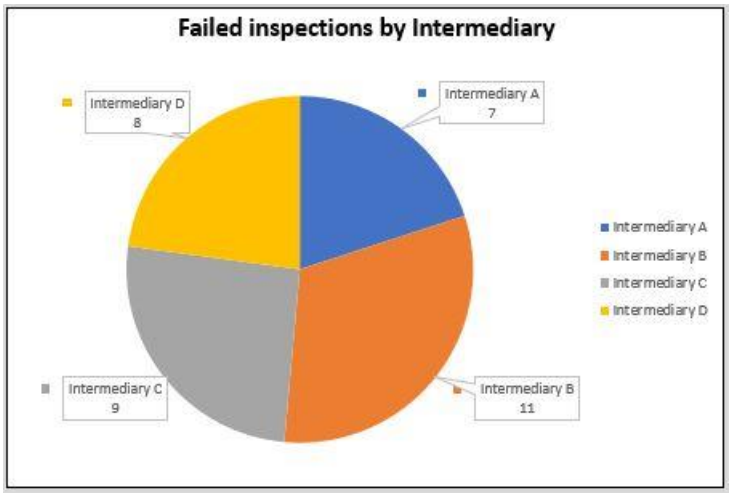


Figure 17. Failed inspections by Intermediary

To visualize the failed inspections for each prevention expert, the pie chart which can be seen in Figure 16. has been chosen. According to Sedrakyan et al. (2019) A pie-chart is used to visualize the proportions of a whole using numbers that ideally sum up to 100%. This graph does not visualize performance over time but it shows the performance at a selected time period. When the management wants to see the performance over time for a specific expert it can use the customisation slicer as described above. In the same manner, the failed inspections for each intermediary is visualised in a pie chart, as can be seen in Figure 17. This gives the management insights into the performance of specific intermediaries, allowing them to act accordingly when one of the intermediaries is constantly underperforming.

General information

General information		
# Inspections	:	122
# Succesfull	:	87
# Failed	:	35
% Failed	:	28,7%
# Kilometres wasted	:	Future
# Hours wasted	:	Future

Figure 18. General information

The General information part of the dashboard gives the management the ability to directly see the performance for a given time and selection of prevention experts at a first glance. As can be seen in Figure 18. above, it shows the amount of inspections, the amounts of failed and successful inspections and the percentage of failures. When the company starts collecting data about wasted kilometres and working hours in the future, this data will also have a place in the general information part of the dashboard.

Customisation

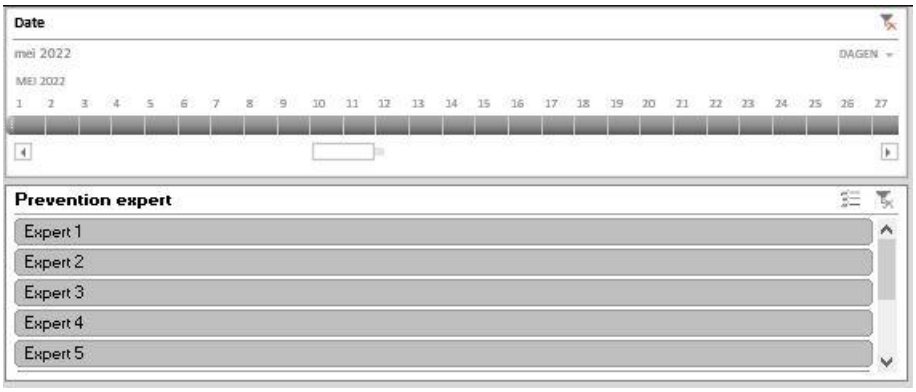


Figure 19. Customisation tools

The dashboard has two methods for customisation, first the time-frame can be changed by using the Timeline which can be seen in Figure 19. above. It is possible to pick single days as well as time periods. In Figure 19. it can be seen that all the days of May have been selected, which results in the dashboard showing all data for the month May. The same could for example be done for the period 9-11 May or only for the 23rd of May. The second method is choosing a single or a set of experts, in order to show performance for the experts specifically. This can be done by clicking the buttons in the slicer which can also be seen in Figure 19.

As mentioned in the introduction of this chapter, the performance dashboard should be designed using the listed best practices from literature. Below the dashboard will be set out against these best practices. The first best practice will be the three goals of a dashboard proposed by (Eckerson, 2010).

Refine strategy

This goals states that the dashboard should be used as a steering wheel, when a.s.r. drives out of direction the management should be able to correct based upon this dashboard. Within this dashboard the (in)efficiency is showcased over time, meaning that when new data is been gathered continuously, this dashboard will give a long-term view of the operation. This allows the management to take corrective actions when efficiency is too low and this way correct the 'steering wheel'.

Increase visibility

Also, the dashboard should give a detailed insight into daily operations and its performance. This dashboard does not only show long term development of the efficiency. It also shows the causes for possible inefficiency in detail, the management can analyse which intermediaries or experts are responsible for most of the inefficiency. Also it can see which types of failure mostly drive the efficiency.

Increase coordination

The dashboard should also encourage acting accordingly when performance is low. As described in the point above, this dashboard gives a very detailed view into what is driving inefficiency. This makes that acting accordingly is fairly easy, the management can specifically pick out staff, partners or reasons for inefficiency to act on.

Secondly, the dashboard will be se out against the five aspects proposed by Bugwandeen and Ungerer (2019). These are seen as the best-practice guidelines for designing a performance dashboard.

Dashboard content

According to literature the dashboard should display KPIs which are necessary for strategy, in order to allow for effective decision-making. In this dashboard all KPIs from section 6.3. are implemented, which together give a detailed image about the (in)efficiency of operations. These KPIs are SMART defined based on the LSS framework which allows for effective decision-making.

Dashboard data analysis

Also according to literature, the dashboard should allow for further insight by making use of analytical tools. However, these should be kept manageable for users. Within this dashboard there are two analytical tools, the first being a TimeLine and the second being a slicer allowing to select certain experts or groups of experts. These two tools gives the management the ability to further analyse the data and gain useful insights but since there are only two, are kept manageable.

Dashboard visual effects

Literature states that dashboards should be visually attractive, arranged correctly and only consist of one well-defined screen which enables to give useful information at a glance. When looking at this dashboard, it ticks all these boxes. The design of this dashboard has been kept simple and sleek, focusing on the important visualisations. Also it is build in one screen and arranged logically.

Dashboard functionality

It is debatable if it is beneficial to allow for much customisation in a dashboard, according to Bugwandeen and Ungerer (2019). To much customisation can be seen as the dashboard containing many buttons and/or sliders which makes it not easy to work with. As described in the data analysis part above, this dashboard has two analytical tools. These tools are realized trough two types of slicers. The fact that there are only two, and the fact that these are arranged logically, makes that the dashboard maintains an easy to work with design.

Dashboard platforms

In order to implement an actual dashboard, literature suggests that a specific software package is put in place. An example for such a package is PowerBI, which a.s.r. also uses in their operations currently. However, the design for this dashboard is merely a Proof-Of-Concept and therefore worked out within Microsoft excel. The design of this dashboard can be recreated within available software packages at the company to make it more suitable for implementation.

5.4. Validation

In order to measure the manner in which this dashboard will be accepted by the company, a validation should be conducted. In order to do so, a representation of the dashboard has been shown to the three employees which will potentially be using the dashboard. The validation will be a questionnaire with nine statements, which have to be scored. The employees will have to choose an answer ranging from strongly disagree to strongly agree. This will then result in a score from 1 to 5 for each statement.

5.4.1. Statement choices

The statements that will be used are based upon the three most important benefits for implementing a performance dashboard by Eckerson, 2010. These benefits are listed below:

- ***Refine strategy/Use as steering wheel***
- ***Increase visibility***
- ***Increase coordination***

Also, one more category has been added, namely User-Experience. This category measures how easy-to-use the dashboard is to the employees cooperating in this validation. This measure is also of importance, if the dashboard would be terrible to use it will probably not be accepted well by employees.

For each of these four categories, statements have been drawn up in order to give insight into how employees rate that specific category. These statements are listed below.

User-Experience
- Information is easy to find in this dashboard
- The graphs in this dashboard are easily interpretable
- The customisation tools in this dashboard are easy to use
- The layout of this dashboard contributes to its ease of use

Increase coordination
- This dashboard gives a clear image of the overall efficiency of the inspection process

Increase visibility
- This dashboard gives a clear image of the efficiency of each expert
- This dashboard gives a clear image of the efficiency of each intermediary

Use as a steering wheel
- This dashboard helps to act accordingly to inefficiencies
- This dashboard contributes positively to the inspection process

5.4.2. Results

Based upon the drawn up statements, the results in Figure 20. below have been gathered from the selected employees. The exact scores for each statement can be seen in Appendix 2. The scores will be discussed for each category below.

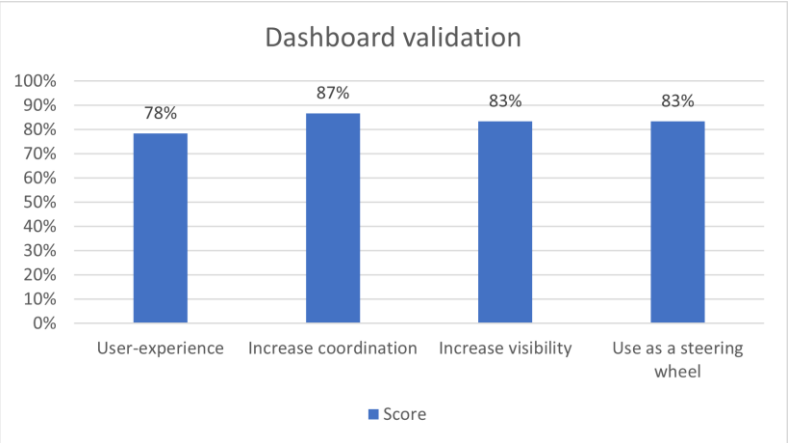


Figure 20. Validation scores

User-experience

As can be seen in Figure 20. This category has scored 78%, which is the lowest out of four categories but still a relatively high score. When looking into more detail, the statement: 'Information is easy to find in this dashboard' scored almost a perfect score. Which shows that the employees are almost perfectly content with the information layout of the dashboard. The least performing statement was: 'The customisation tools in this dashboard are easy to use' with 2/3 of the points, which means that there is room for improvement in this part of the dashboard.

Increase coordination

The increase coordination category only consists of one question, which got the highest score at 87%. From this it can be certainly concluded that the employees experienced a good overview of the overall efficiency of the process. This makes that the dashboards satisfied this category taken from Ungerer (2019). The fact that this category only has one question and thus one measure-point could however be a point of discussion for the validity if this category.

Increase visibility

This category scored a 83% on the validation, divided over 2 likewise questions. The first being the efficiency for each expert and the second being the efficiency for each intermediary. Even though these measures are both being visualized using the same method, they scored 20 percentage points apart. It stands out that the efficiency of each intermediary is not visualized as clearly as the efficiency of each expert. This discrepancy needs further research and might show another point for improvement.

Use as a steering wheel

Lastly, the use as a steering wheel category. This category also scored a 83% on the validation and is again made-up out of two questions. These questions scored about evenly high and together illustrate that the employees think this dashboard is suitable to being used as a steering wheel. Meaning that this dashboard could guide choice about which course the company wants to go with regards to the planning process.

Overall

The overall acceptance score is 81%, which shows that the selected employees have a high chance of accepting the dashboard when it would be implemented. However, as discussed in this section, there a two potential points of improvement which should be researched further. This will be done by discussing the lower scoring statement with the corresponding employees.

The two points of improvement which should be researched are the lower score for the customisation tools ease of use and the lower scoring visualisation of the efficiency for each intermediary. When discussing these points with the corresponding employee, which is '#3' in Appendix B., it became obvious that there was a clear explanation for these two lower scores. According to the employee "the efficiency for each intermediary is much less clear than for each expert because only experts can be selected, and not intermediaries". Which means that the lack of a customisation tool to choose the efficiency for each intermediary results in the low score for the two mentioned points. Concluding, this means that in the improved performance dashboard there should be a customisation tool to select intermediaries.

5.5. Improved performance dashboard

Based on the validation questionnaire there were two points which stood out because of their lower scores. These points have been discussed with the corresponding employee and it became obvious that the dashboard lacks the possibility to customise for each intermediary. There is however the possibility to customise for each expert, which was also reviewed as being user friendly. In order to improve the performance dashboard, possibly increasing the probability for acceptance even higher, a new customisation option has to be included. This results in the improved dashboard listed below in Figure 21. For a more detailed view of the dashboard, Figure 21. can also be found as Appendix 3.

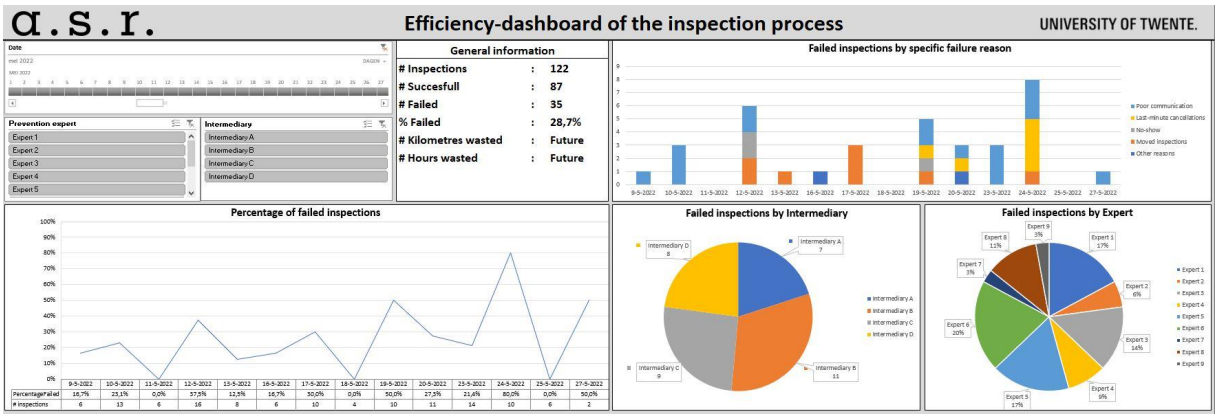


Figure 21. Improved performance dashboard

Unfortunately, there was not enough time left at the end of this research to conduct another round of the same validation questionnaire. Which would probably have returned an even higher score for the probability of acceptance, due to the improvements made based upon the low scoring feedback points. Overall, it can be concluded that there is at least a 83% score on the acceptance of this dashboard, potentially being even higher when another validation round is conducted.

5.6. Conclusion

The goal of this chapter was to answer the research question: '*How can a data gathering and visualisation solution help improve the efficiency of the inspection process?*'. In order to answer this question a systematic way of drawing up such a solution has been used, consisting of four steps.

The first step being a data gathering solution, which should be setup at the core, meaning at the prevention experts themselves. This should be done via some kind of platform or application which allows the experts to fill-in data directly after an inspection has been conducted. With this solution it should be kept in mind that the outcome should be 'clean data'

The second step is the construction of KPIs, these have been drawn up using the Lean Six Sigma (LSS) theory as well as the SMART criteria. The LSS theory makes use of pre-set goals or benchmarks to test the score of certain KPIs over a certain timeframe against. The will allow the KPIs to be used as a steering wheel, meaning that the management can act accordingly when inefficiency gets passed a certain threshold.

After the KPIs have been drawn up, these should be visualized inside a performance dashboard. With the design of this dashboard certain best practices from literature have been used in order to make the usability as high as possible.

This performance dashboard has then been validated by the employees which will use such a dashboard after implementation. From this validation it can be said that the dashboard has a high change of being accepted at a score of 81%. However, there were still two points of improvement

which stood out and should be researched further. Based on this, the performance dashboard was extended by adding a customisation tool to select each intermediary. This new dashboard could not be validated again due to a lack of time. Therefor the conclusion is that the dashboard at least has a 81% acceptance score, but this could be even higher when a new validation is being executed in further research.

6. Conclusion and recommendations

Chapter 6. will conclude this research, ultimately answering the main research question listed below. It will entail recommendations for a.s.r. and also it will give suggestions for further research.

"How can the inspection process for prevention-experts at a.s.r. Nederland be optimized in order to improve the efficiency?"

6.1. Conclusions

In order to answer the main research question, sub-questions have been drawn up. In order to properly answer the main research question, first each sub-question will be answered below.

- *How is the planning process currently being conducted and what are the points of improvement?*

It can be concluded that the inspection process is indeed inefficient and the numbers back up the problem statement given by a.s.r. before this research started. Chapter 2. shows that in 28,7% of the cases an appointment experiences irregularities. Firstly, from the details of the inefficiency it can be seen that poor communication is a cause of a substantial part of the appointments with irregularities. It can therefore be concluded that improving the communication part of the process could potentially greatly improve efficiency. Also, it can be seen that handling last-minute cancellations is another field of improvement for the process. This could for example mean revamping the process in such a way that better communication gets standardized and the process is able to cope with cancellations better. Secondly, during the research of the current situation it became evident that there is very little insight into how the inspection process is performing in real-time. This because no data is gathered about the inspections at all. From this it can be concluded that when the management would put in place a data gathering and visualisation solution, it would have insight into the efficiency of the process and can act accordingly.

- *What could be learned from literature about the points of improvement?*

Based upon the literature review about business process redesign a few conclusions can be drawn. Firstly, in order to redesign the planning process at a.s.r. the WCA framework should be used, this framework will help by making the redesign orderly. The different aspect of this framework will cover all 'stakeholders' inside the process in order to ensure a smooth redesign. Next to this, the BPMN modelling language should be used in order to formally model the business process. In order to derive the right KPIs the Lean Six Sigma (LSS) method should be used. The management at a.s.r. should set goals for the amount of irregularities within the inspection process and the KPIs should give insights into the performance of these goals. Also, to help the KPIs fit this LSS method the SMART criteria should be used in order for them to be usable for the management. Lastly, it should be identified which KPIs are driver KPIs and which are outcome KPIs in order to identify cause-effect relations in the measures. When looking at the visualisation of the data, it is obvious that a performance dashboard should be used. This dashboard should have three main goals, namely: refine strategy, increase visibility and increase coordination. For the design of this dashboard there is no generic template but the best practices described in this literature review will help steer this design. Also, when choosing the right visualisation practices for this dashboard, the LSS method should be kept in mind. Which means that the charts which best describe change over time should be used in order to enable to compare the values to goals and past values.

- *How can Business Process Improvement practices be used to improve the efficiency of the inspection process?*

Based upon the seven components of the WCA framework, different improvement measures have been drawn up. First, the two separate inflows of requests should be automized in order to save unnecessary manual work. Next to this a new software program should be implemented to also save unnecessary work for the planning staff. Also, the potential customer should be involved in the appointment making step, creating a higher chance for the appointment to be successful. These measures will greatly improve efficiency from the planning staff point of view. Next to this, the intermediary should be included in the planning process upfront in order to increase communication and increase chance for a successful appointment. In order to even further increase communication an automatic reminder should be implemented into the new software program. These two measures will improve the efficiency of the process by improving communication.

- *How can a data gathering and visualisation solution help improve the efficiency of the inspection process?*

It can be concluded that a.s.r. has to implement some kind of data gathering solution, through a platform or application which allows the experts to fill-in data directly after an inspection has been conducted. With this solution it should be kept in mind that the outcome should be 'clean data' Also KPIs should be drawn up, these should be drawn up using the Lean Six Sigma (LSS) theory as well as the SMART criteria. The LSS theory makes use of pre-set goals or benchmarks to test the score of certain KPIs over a certain timeframe against. The will allow the KPIs to be used as a steering wheel, meaning that the management can act accordingly when inefficiency gets passed a certain threshold. After the KPIs have been drawn up, these should be visualized inside a performance dashboard. With the design of this dashboard certain best practices from literature should be used in order to make the usability as high as possible. A performance dashboard has been constructed and validated. Following from this, the conclusion is that the dashboard at least has a 81% acceptance score.

Now that all sub-questions have been concluded, the main research question can be answered.

- *How can the inspection process for prevention-experts at a.s.r. Nederland be optimized in order to improve the efficiency?*

To conclude, the way in which the inspection process can be optimized in order to improve the efficiency is two-fold. Firstly, the current planning business process should be redesigned and secondly, there should be a data gathering and visualization solution in place.

Process redesign

As concluded in the sub-questions, there should be put in place several improvement measures in order to increase the efficiency of the planning process. Together, these measures result in an improved and redesigned business process. These measures are:

- The two separate inflows of requests should be automized in order to save unnecessary manual work.
- A new software program should be implemented to also save unnecessary work for the planning staff
- The potential customer should be involved in the appointment making step
- The intermediary should be included in the planning process upfront
- An automatic reminder should be implemented into the new software program

Data gathering and visualisation
A.s.r. has to implement a data gathering and visualisation method, in order to monitor current efficiency of the process. In order to measure the efficiency, the following KPIs should be used:

- Percentage of Failed Inspections (PFI)
- Percentage due to Poor Communication (PPC)
- Percentage due to No-Shows (PNS)
- Percentage due to Moved Inspections (PMI)
- Percentage due to Last-Minute Cancellation (PLC)
- Percentage due to Other Reason (POR)
- Failed Inspections per Intermediary (FIE)
- Failed Inspections per Expert (FIE)
- Number of Kilometres Wasted (NKW)
- Number of Working hours Wasted (NWW)

These should be visualized inside a performance dashboard, for which a design has been made in Chapter 5. This design has been validated and it can be concluded that the improved version of the performance dashboard at least has a 81% acceptance score. Which means that a.s.r. should implement the performance dashboard.

6.2. Recommendations

Based upon the conclusions drawn in the previous section, recommendations for a.s.r. can be drawn up.

The first recommendation for a.s.r. is to invest in redesign the planning business process. Within this research points of improvement have been found, and improvement measures have been proposed. Redesigning the process will help a.s.r. improve the efficiency of the planning process.

Another recommendation is to start the collection of more data, since currently no data is being collected at all. This will help give insights into the efficiency of the process significantly.

The next recommendation is to use the proposed KPIs in order to monitor the efficiency based upon the newly gathered data. Which will show more about the efficiency of the process.

The last recommendation is to implement a performance dashboard based upon the proposed design, in order to visualize the KPIs and therefor the efficiency of the planning process. This will enable the management to use the dashboard as a steering wheel and act accordingly to inefficiencies.

6.3. Further research

This research also leaves some points for further research, which will be set-out within this section.

Firstly, in further research the current situation should be analyses by using more data. Because of the time constraint the analysis within this research only uses gathered data from a three week period.

Next to this, in further research the proposed improvement measures for redesigning the process should be tested and validated. This will ensure that the measures are executable in practice and will help streamline the process redesign.

Also, the improved performance dashboard should be validated again in further research. By doing this it can be checked if the improved parts actually improve the score in the second validation.

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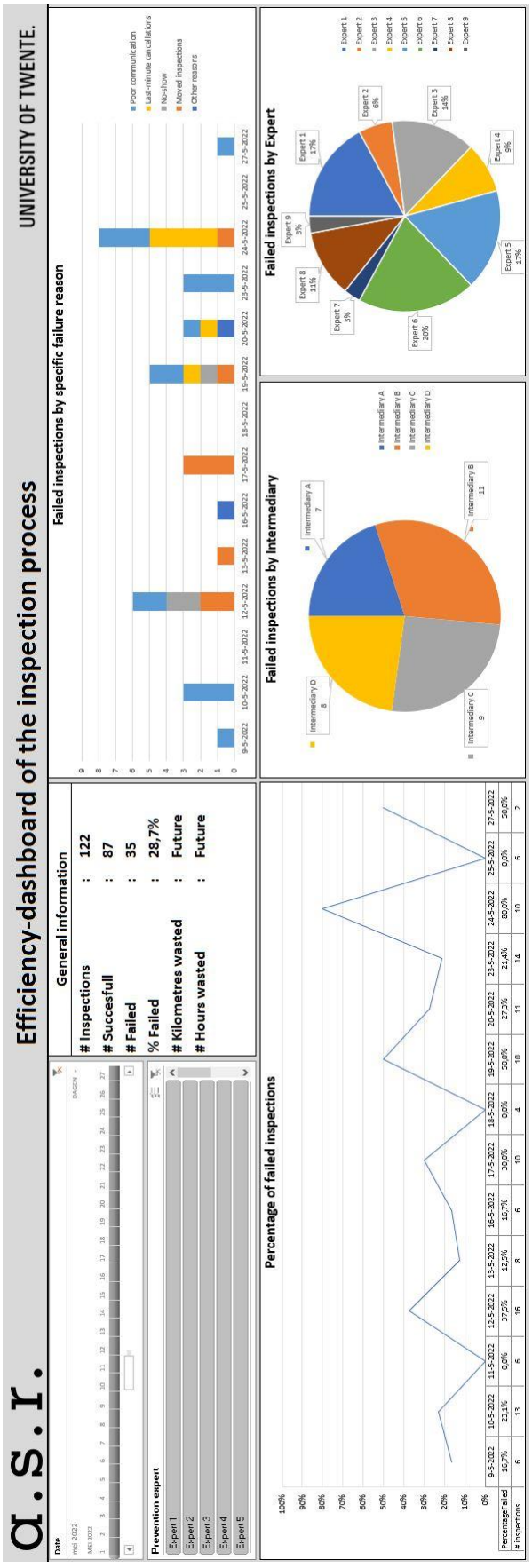
Appendices

Appendix 1. Performance dashboard



Appendix 2. Validation outcome

Vragen	*#1*	*#2*	*#3*	*Sum*	*Perfect score*	*Percentage*
User-experience	**15**	**17**	**15**	**47**	**60**	**78%**
Information is easy to find in this dashboard	4	5	4	13	15	87%
The graphs in this dashboard are easily interpretable	4	4	4	12	15	80%
The customisation tools in this dashboard are easy to use	3	4	3	10	15	67%
The layout of this dashboard contributes to its ease of use	4	4	4	12	15	80%
Increase coordination	**4**	**5**	**4**	**13**	**15**	**87%**
This dashboard gives a clear image of the overall efficiency of the inspection process	4	5	4	13	15	87%
Increase visibility	**8**	**10**	**7**	**25**	**30**	**83%**
This dashboard gives a clear image of the efficiency of each expert	4	5	5	14	15	93%
This dashboard gives a clear image of the efficiency of each intermediary	4	5	2	11	15	73%
Use as a steering wheel	**8**	**9**	**8**	**25**	**30**	**83%**
This dashboard helps to act accordingly to inefficiencies	4	4	4	12	15	80%
This dashboard contributes positively to the inspection process	4	5	4	13	15	87%
				110	135	81%

Appendix 3. Improved performance dashboard