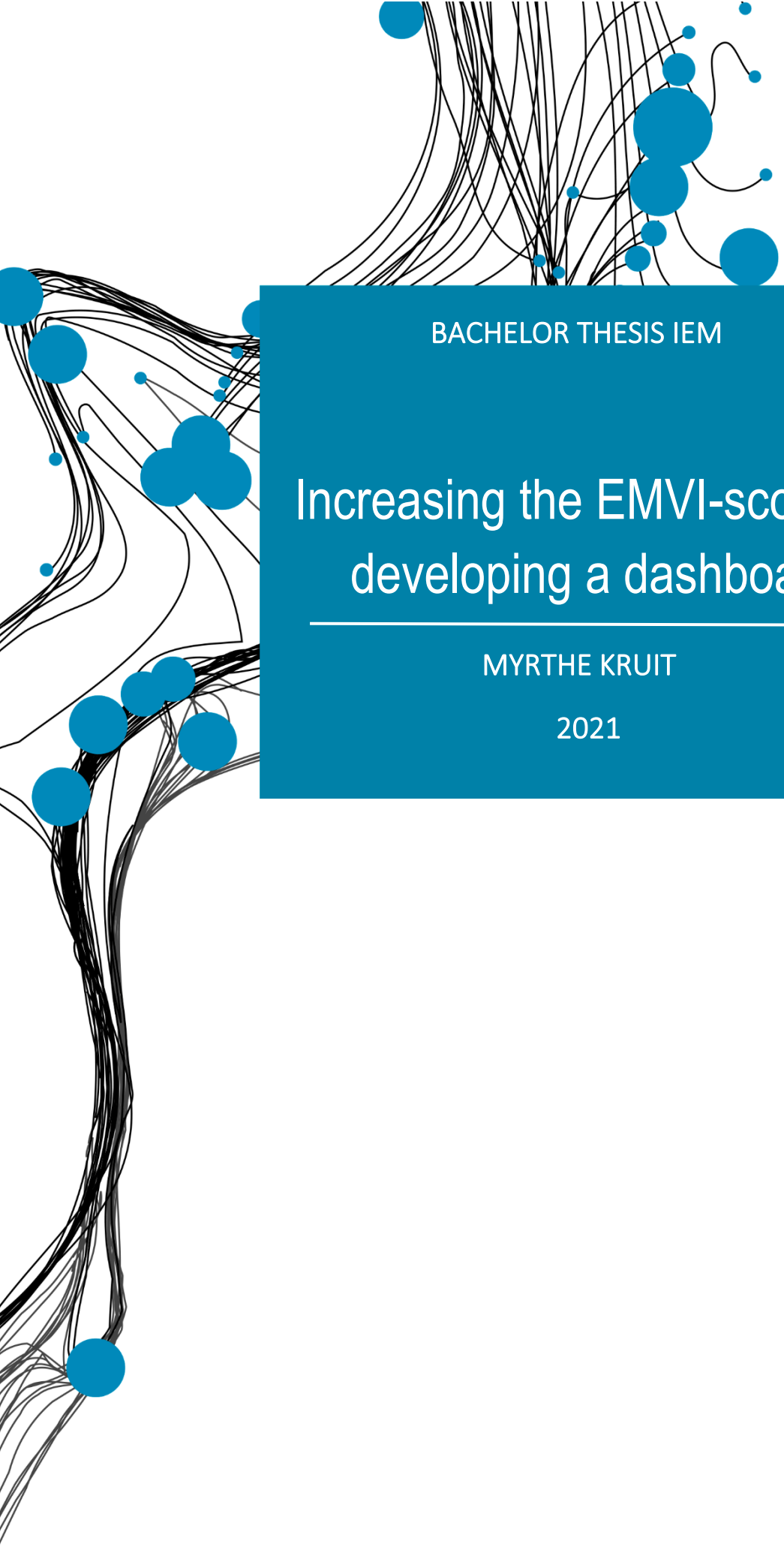

BACHELOR THESIS IEM

Increasing the EMVI-score by developing a dashboard

MYRTHE KRUIT

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Bachelor Thesis Industrial Engineering and Management

Increasing the EMVI score by developing a dashboard

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PREFACE

Dear reader,

In front of you lies the bachelor thesis I have written to complete the bachelor of Industrial Engineering and Management. I have worked on this research for the past half-year, starting from February 2021. I really enjoyed the freedom of starting my own project. Of course, sometimes it was challenging but I have learned a lot from this. In this preface, I want to thank everyone who has supported me in completing this research.

Firstly, I would like to thank everyone who worked at the company. It was a pleasure getting to know everyone and working with them in these strange times. They have provided me with a lot of knowledge and a pleasant working environment. It was really fun to be able to see some people from time to time when working at the office. A special thank you goes out to my company supervisor who was always ready to talk about the research, possible problems and called me to ask how I was doing.

Secondly, I would like to thank both my supervisors for the University of Twente, Abhishta Abhishta and Wouter van Heeswijk for the time and effort they put into supervising me. Abhishta Abhishta has been my first supervisor, guiding me through the entire process. He helped me with the academic part of my thesis and warned me of possible pitfalls. Wouter van Heeswijk was my second supervisor, providing useful feedback from a second perspective.

Lastly, I would like to thank my family and friends for being there for me. Working together on assignments and talking about the thesis has helped and motivated me a lot during these times in corona.

Myrthe Kruit,

September 2021

MANAGEMENT SUMMARY

PROBLEM OF THE COMPANY

The sector earth-, road- and hydraulic engineering is a very competitive market, especially the open tenders where the most economical advantageous contractor wins. In Dutch, these types of tenders are called EMVI tenders. An EMVI tender requires contractors to submit a price and an EMVI plan on the chosen criteria by the client. Usually, everyone can subscribe to an EMVI tender. This results in situations where more than 15 companies are competing for the win. Because of this competition, it is of the utmost importance to keep improving. However, in practice, many companies in the earth-, road-, and hydraulic engineering sectors are struggling with writing a good EMVI plan and getting a good score on that plan (EMVI score). Company X has the same problem. Over the last years, they have seen the number of EMVI tenders they win decreasing, so they asked themselves how they could improve their EMVI plans for more successful tenders in the future. We found that Company X does not use the feedback they gained in the evaluation moments optimally because there is no common format for the evaluation of tenders. In this research, we explore how a dashboard could help with providing a common format for evaluation moments, saving this feedback in one place and presenting an overview of the performance using this feedback. This results in the following research question:

'How can a dashboard help to increase the EMVI score by presenting an overview of the feedback?"

The idea of using a dashboard to measure the performance in tenders is new, not only for construction but also in other areas. In general, we found no application of dashboards for measuring the performance of tenders. This research provides a whole new strategy for companies on how to deal with tenders. When companies want to try this new strategy, this research provides them with a guideline on creating and implementing their own dashboard.

DEVELOPMENT OF THE DASHBOARD

We designed a dashboard for Company X according to the guidelines found in the literature. To measure the performance we needed to identify factors that influence the EMVI score positively. These factors are identified by a brainstorming meeting and a literature search. The factors found are then discussed in interviews, and a final list is drawn up with the following factors: experience of client with contractor, added value, SMART formulation, understanding of client's wishes, past project performance, tender process, monitor progress, goal. These factors are measured by KPIs and the KPIs are measured with the feedback Company X gets on the EMVI plans. Also, an implementation plan is written to ensure the adoption of the technological change. When the dashboard is finished, surveys are sent to evaluate the new situation and see whether the dashboard can help increase the EMVI score.

RESULT OF IMPLEMENTING THE DASHBOARD

The result is that overall the dashboard did improve the situation. It makes the daily tasks easier, provides employees with a common format for evaluation of the tenders, gives an overview of the performance on the EMVI plans, and provides a place where all the feedback can be stored. All these improvements lead to employees spending less time on finding feedback because they can find the right feedback more easily. But most importantly these improvements lead to identifying more improvement points so that the EMVI score can increase. First of all the dashboard can help to increase the EMVI score by monitoring the performance. By monitoring and visualizing the different KPIs, improvement points can easily be derived to increase the EMVI score. Second, the standard format allows Company X to analyse the feedback for improvement points. Third, the dashboard enables the user to store relevant data over multiple years. When all this data is taken into account, the employees can track their progress. When a certain value goes down, Company X can start researching the cause. Analysing and visualizing data over an extended time period is beneficial for improving the EMVI score. Fourth, when writing an EMVI plan, the dashboard is an easy tool to use when you need specific

information. Users can search through feedback on tenders from a particular client or search for the score on specific criteria. Having easy access to this information and therefore incorporating it in the EMVI plans will increase the EMVI score.

RECOMMENDATIONS

Based on the results from this research the recommendations to Company X are:

- Implement this dashboard as proposed in this research
- Keep improving the functionality of the dashboard
- Keep evaluating the KPIs
- Take a critical look at the internal/external evaluation
- Start research on a few EMVI criteria

Based on my experience during the internship at Company X, I recommend to:

- Talk about the mindset/vision when tendering
- Research the reputation of Company X

CONTENTS

LIST OF ABBRIVIATIONS

DSRM = Design Science Research Method

EMVI = Economisch Meest Voordelige Inschrijving (Most economically advantageous tender)

JPEG = Joint Photographic Experts Group

KPI = Key Performance Indicators

PDCA = Plan, Do, Check, Act

PDF = Portable Document Format

SLR = Systematic Literature Review

SMART = Specific, Measurable, Attainable, Realistic, Time-bound

VBA = Visual Basic for Applications

VPI = Verifiable Performance Indicator

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1 INTRODUCTION

In the framework of completing the Bachelor of Industrial Engineering and Management, we performed research at a company that is active in the earth-, road-, and hydraulic engineering sector. The company would like to stay anonymous and is therefore referred to as Company X. The main business of companies in the earth, road- and hydraulic engineering sector is designing and executing construction projects for private parties, the government, municipalities, and provinces. These clients award their projects to companies by determining a winner during the tender phase. A tender phase is a set period of time where the contractors can subscribe to the project and need to hand in the required documents. What documents are required and who can subscribe, depends on the type of tender. More on this in Section 1.2. This research will focus on the tenders where the Most Economical Advantageous Tender (MEAT) wins. In the Dutch construction market this is called Economisch Meest Voordelige Inschrijving (EMVI). Since the Dutch procedure differs from tender structures used in other countries and we do our research at a Dutch company, we will call it EMVI from now on. When joining an EMVI tender, the contractor must hand in a price offer and a quality plan (further referred to as EMVI plan). More on EMVI tenders in Section 1.2. For every type of tender the client can choose to invite several contractors or let every interested contractor subscribe. This last scenario can lead to tenders where 15 companies subscribe. Because of this competition, it is of the utmost importance to stay ahead in the competition. But how can you do that?

Company X came to us with this question and mentioned that writing the EMVI plan is a topic that is deemed extremely difficult by them and other contractors. Even the biggest contractors in earth-, road- and hydraulic engineering are still struggling and questioning themselves: how can we write a plan that delivers us the first place?. Since the scores on the EMVI plans have been decreasing for Company X, we will focus on why it decreases and how they can increase their scores (Chapter 1). We think a digital tool can help Company X gain more insight into the scores on their EMVI plans. The choice is to build a dashboard that will include a set of Key Performance Indicators (KPIs) that measure the performance of EMVI plans. These KPIs will be determined with the help of a literature search and walk-in interviews (Chapter 2). Visualizing these KPIs with a dashboard enables the contractor to determine the current state, improvement points or a strategy (Chapter 3). The data used to measure those KPIs is retrieved from the evaluation moments. In Chapter 4, we research how to implement such a technological change in the company. In the end, we will evaluate if the dashboard indeed helped improve the situation (Chapter 5).

This chapter will provide information about the company in Section 1.1 and the tender phase in Section 1.2. After that, we will dive into the problem definition in Section 1.3. After defining the problem, sub-questions are set up in Section 1.4 and the Problem-Solving Approach in Section 1.5. Lastly, in Section 1.6, we will elaborate on the deliverables.

1.1 DESCRIPTION OF THE COMPANY

The company at which we will execute this research is active in earth-, road- and hydraulic engineering. Since the company would like to stay anonymous, we will further refer to them as Company X.

Company X does projects for clients in a specific region in the Netherlands. It is part of one of the larger contracting companies of the Netherlands, and its main clients are governmental organizations or private corporations.

At Company X there are several parties involved, both internal- and externally. Internal stakeholders are the employees. External stakeholders are the government, provinces, municipalities, private corporations and subcontractors. Also, the people who live near the construction area are external stakeholders. When making decisions Company X needs to consider all these parties. Unfortunately, we can not provide further information without revealing too much about the company .

1.2 EXPLANATION OF TENDER PHASE AND EMVI TENDER

This section starts by explaining how the tender phase typically looks like and what the reasoning is between the different tender types. Afterwards, we dive into the EMVI tenders a bit deeper to gain a better understanding.

A tender is a procedure where a contractor can make an offer to win the contract with the client. The advantage of holding a tender phase is that several contractors submit an offer, and therefore the client can select the best offer. From the contractor's point of view, they first enter a preparation phase where they make the team and research the tender (see Figure 1.1). When everything fits into schedule, the company subscribes, and the tender phase starts. In this phase, the client sends the guideline with information about the project and in the end the contractor sends in the price offer and additional documents. The tender phase ends when the client has selected the winner. Lastly, Company X enters the evaluation phase, in which they evaluate the tender internally and externally.

Figure 1.1 Process Company X goes through per tender

Within Company X, two tenders are most common, a tender on price and a tender on EMVI. The difference is that the winning contractor of a tender on price was the cheapest and the winner of the EMVI tender is the most economically advantageous send-in and therefore has the best value for the price. Around eight years ago, the EMVI tender was introduced by the government so that the tenders become fairer. When a tender is only evaluated on price, this results in worse quality projects because the contractors want to lower the price as much as possible. However, in an EMVI tender a contractor can score a discount by promising high quality. So, this raises the opportunity to send in a plan with a better quality, which is more expensive but still wins. This way the tenders become fairer because the contractor who has the best price-quality ratio wins.

In this research, we focus on improving the performance on the EMVI tender; therefore, we will explain this tender in more detail. The tender phase of the EMVI tender results in two end products, an EMVI plan which focuses on the quality and a price offer. Creating those two documents are parallel and dependent processes. During these processes, the goal is to develop a price and an EMVI plan that fits the requirements and wishes stated in the guideline. The score on an EMVI plan is expressed in money and will be extracted from your price offer. We will shortly explain how the plan is scored. In the guideline, the client describes a few criteria they deem important. Examples of topics are collaboration, planning or disturbance of the neighbourhood. In Table 1.1, the client chooses social value and collaboration. The client also determines the maximum discount you can receive and how this is distributed among the criteria. In Table 1.1, you can see that the maximum discount is €300,000 and that the division is 60% (€180,000) for social value and 40% (€120,000) for collaboration. Then depending on how much added value you deliver on a criterium, you get a percentage of this discount. In Table 1.1 can be seen that Company Z scored 50% on social value, resulting in a discount of €90,000, and scored 75% on collaborations resulting in a discount of €90,000. The total discount received is €180,000. This means that when Company Z send in a price offer of €500,000 the evaluative price is €320,000. The contractor who submits the lowest evaluative price wins the tender. By changing the maximum discount, the client can determine the importance of quality.

Table 1.1 Example grading from & grading company Z

Grade	Description	Fictional discount
1	The tender offers no added value compared to the specifications	0%
2	The tender offers limited added value compared to the specifications	25%
3	The tender offers reasonable added value compared to the specifications	50%

4	The tender offers a lot of added value compared to the specifications		75%
5	The tender offers huge added value compared to the specifications		100%
		Maximum Fictional Discount	€300,000
Criteria	**Weight**	**Score**	**Fictional Discount**
Social value	60%	3	300,000*0.6*0.5=90,000
Collaboration	40%	4	300,000*0,4*0,75=90,000
		Fictional discount Company Z	€180,000

1.3 DEFINITION OF THE PROBLEM

Over the last years, the percentage of tenders Company X wins is decreasing. Figure 1.2 shows the percentage of how many tenders Company X won in the previous years. In 2018 they managed to win more tenders, however, as shown in Figure 1.2 the years after, the results have gone down again. When Company X does 5 tenders per year the data points are insufficient to show a trend, resulting in the deviations simply being noise. Due to the confidentially of the company the total number of tenders done each year can not be made public but we can say that we have enough data points to measure a trend.

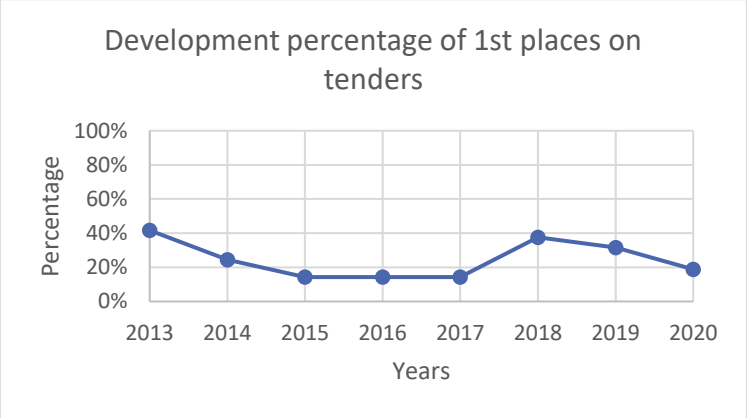

Figure 1.2 Development percentage of first places on tenders

Increasing this percentage is important because without winning tenders there is no work and therefore also no income. Next to that, a tender takes up around €40.000 in labor costs for an average-sized project, so getting the percentage up is important to decrease costs, increase revenue, and make more profit. Lastly, Company X indicated that getting projects is also very important because projects add a lot of value to them in knowledge and experience.

Company X plans on winning more tenders by focusing on receiving higher EMVI scores because higher EMVI scores contribute to winning more tenders. To see to which extend the EMVI plans can be a cause for winning fewer tenders, we look at the rate of getting the best EMVI plan. As Figure 1.3 indicates, the rate of getting the best EMVI plan is decreasing as well. Therefore this is considered the action problem of Company X with as main research question:

"HOW CAN COMPANY X INCREASE THEIR EMVI SCORES?"

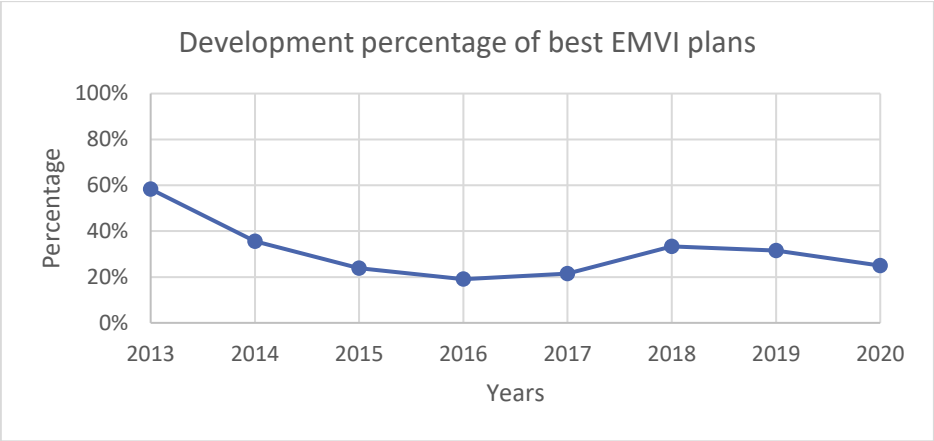

Figure 1.3 Development percentage of best EMVI plans

The reality is that Company X had the best EMVI plan in 20% of the tenders in 2020, but the norm is to increase this percentage to at least 50% in 2021-2022.

1.3.1 PROBLEM CLUSTER

To get an insight into the action problem, "The EMVI scores are not increasing", we performed several interviews with employees and a brainstorm at which ten employees were present. The list of problems retrieved from those activities is visualized in a problem cluster to establish the causal links between the various problems (Heerkens et al., 2021). The problem cluster can be seen in Figure 1.4.

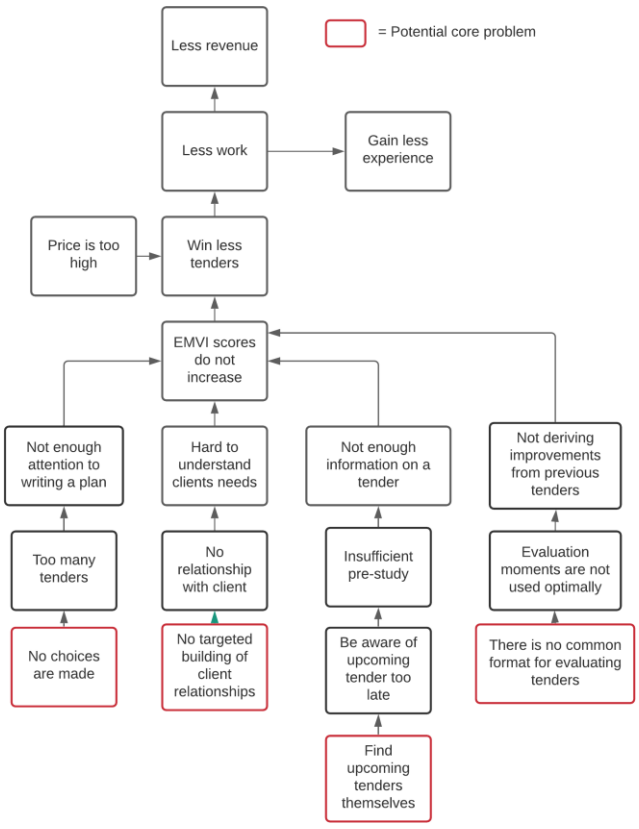

Figure 1.4 Problem cluster

As seen in Figure 1.4 the action problem causes and is caused by some other problems. First, we will address problems caused by the low EMVI score and afterwards, we will dive into the problems that cause the low EMVI scores.

A direct result of the low EMVI scores is that Company X wins fewer tenders. This is because the winning of a tender is dependent on the EMVI score and the price. Winning fewer tenders results in less work which then results in less revenue and less experience. More experience is a competitive advantage, and revenue is needed to survive, so it is crucial that Company X increases the EMVI scores.

We did a brainstorming session and interviews to search for problems that cause the EMVI scores to decrease. During the brainstorm, the employees made a mind map in which all problems and their relationships were made visible. This mind map can be found in Appendix A. From this mind map, four themes are put in the problem cluster. We will now go by each of them.

One of the causes is that there is not paid enough attention to the content and writing of the EMVI plan. This problem arises because Company X subscribes to a lot of tenders and therefore there is not enough time to go into detail for each plan. Company X subscribes to a lot of tenders because the decision-making process on when to subscribe to a tender is not optimal.

Another cause is that it is hard to understand the client's wishes. This is a problem since the wishes are not always transparent and put in the guideline. A way to overcome this problem is by having a better relationship with the client so that Company X can talk with them about these wishes. However, it turned out Company X can still improve their client relationships. This is because Company X has no policy on building client relationships. When solving this problem, a scorecard could be created so that Company X can see which clients still need attention. Also, a plan can be set up for solid client relationships.

Furthermore, a cause is that Company X does not have enough knowledge about a tender. An insufficient pre-study causes this because they are aware of an upcoming tender too late. When Company X is aware of a tender on time they can use their connections to ask questions about the project. When they subscribed to the tender this is not allowed anymore. This problem arises because Company X needs to find a tender themselves by searching social media, websites or news articles.

The last cause for the decreasing EMVI scores is that Company X does not derive enough improvement points from previous tenders. Company X has evaluation moments after each EMVI tender, including a score on their EMVI plan, an internal evaluation and an external evaluation with the client. However, Company X does not optimally use these evaluation moments because there is no standard format for evaluating itself and documenting the evaluations. In practice, this means that the feedback gained at the evaluation moment is in separate documents and unstructured. When this problem is solved, Company X would have a format for evaluating the performance of the EMVI plans, and they have one database in which all the relevant information is available.

1.3.2 CORE PROBLEM

After the problem cluster is set up, we can derive four potential core problems. The red outline in Figure 1.3 marks these core problems. By solving these problems, all problems that follow from it are influenced and therefore solving these problems will have the most significant impact. Since we have four problems left, we are deciding upon the most effective problem, which means the one with which we have the most impact for the lowest costs. The problems are discussed in Section 1.3.1.

We chose to solve the core problem:

'THERE IS NO COMMON FORMAT WHEN EVALUATING TENDERS'

Solving this problem is most effective because it directly plays into the action problem: 'How can Company X increase their EMVI score? When we solve this core problem, we can help Company X start analyzing their tenders and derive improvement points comparisons over several tenders instead of feelings. This can lead to new insights regarding their performance and therefore is solving this problem the most promising. Also, the expertise of the researcher fits best to this problem. We can solve this problem by introducing a format for evaluating the performance of the EMVI plans and introducing one database in which all the relevant information is available. From now on, all the data that is gathered during the evaluation moment will be referred to as feedback.

When we look into solutions that provide both freedom to develop a format for evaluation of the performance and the possibility of developing a database, a dashboard fits all the wishes. For a dashboard, we need to identify a set of Key Performance Indicators (KPIs), which enable us to develop a format for evaluating the performance of the EMVI plans. The visualization of KPIs enables Company X to identify trends, patterns and anomalies. This enables Company X to measure, monitor, and manage the performance of the EMVI plans more effectively (Eckerson, 2006; Few, 2006). Also, the dashboard will need a database to draw the information from. A significant benefit is that a dashboard can be created with the systems already in use by Company X.

Another option is building a database and using a Performance Measuring System to create a format for evaluating the EMVI plan. Then during monthly meetings, Company X can evaluate the feedback in the database. However this method takes up more time and makes it less easy to determine improvement points.

Because of the points mentioned before, we decided a dashboard is best suited to solve the core problem. We have built a dashboard that is connected to a database with features that help Company X analyze their feedback. This results in the following research question:

'HOW CAN A DASHBOARD HELP INCREASE THE EMVI SCORE BY PRESENTING AN OVERVIEW OF THE FEEDBACK?'

The objective of this dashboard is to structure the evaluation moments of EMVI tenders by introducing a common format. This will reduce the number of files with feedback, make it easier to analyze the feedback to derive improvement points for the EMVI plan and extend the time the feedback is taken into account.

1.4 SUB-QUESTIONS

To answer the research question: 'How can a dashboard help to increase the EMVI score by presenting an overview of the feedback?' and meet the objectives, knowledge is required. This knowledge will be acquired by answering eight knowledge questions. In this section, per knowledge question, the purpose, the research design, the data gathering method and the data analysis method is described.

1. *How does Company X currently deal with feedback on EMVI plans?*

   A better insight into the current situation is required to understand how the feedback is formatted to solve the research question. It also enables us to evaluate the dashboard by comparing the improved situation to the current situation. The three types of feedback and their format are explained, and the current feedback loop is presented. This knowledge is obtained by performing a descriptive study, where walk-in interviews will gather information. During the walk-in interviews, we will ask prepared questions with qualitative data as a result. Next to that, we will gather data by sending out a survey about the current situation. This data gathering method fits well with descriptive study (Saunders et al., 2019). The results can be found in Section 2.1.

2. *How to design a dashboard that monitors the performance of EMVI plans?*

   The purpose of answering this research question is to find appropriate designs for displaying data, in our case feedback, in a dashboard. By identifying the most suitable designs, a concept for our dashboard can be created. This knowledge question is explorative research where qualitative information is found through a Systematic Literature Review. This data will be analyzed and presented in an integrated piece of text. The concept will consist of features, functional analyses and ideas for a layout. The results can be found in Section 2.2

3. *Which approach can be used to identify KPIs for a dashboard?*

   It is of great importance to identify the relevant KPIs when designing a dashboard. Therefore, a literature study will be done to determine a fitting approach. The research we will conduct is descriptive with qualitative data. The data will be analyzed and presented in an integrated piece of text.

4. *What factors are related to a successful outcome of an EMVI plan?*

   This sub-question is important since knowing these factors means we can integrate them into the dashboard and then evaluate them. This question will be answered by conducting descriptive research. First, we will do a literature study to find factors that positively influence the EMVI score. Next, semi-structured interviews will be conducted to discover important factors different from the ones found in the literature. By analyzing the data, we create a list of possible factors for the database.

5. *Which KPIs should be selected to monitor the performance on EMVI plans, and how to measure and visualize those KPIs in the dashboard?*

   We will answer this sub-question to determine the final list of KPIs and the data that is needed for measuring the KPIs. We start by selecting the factors on their importance. Besides the factors found in sub-question 4, factors are added that do not relate to a successful outcome but that relate to monitoring the progress. For each factor, KPIs are determined to measure the factor. We will gather knowledge by investigating the data provided by the company. The data needs to be assessed on quality and completeness. Next to that, we will determine which media displays to choose for the dashboard.

6. *How should the dashboard be implemented within Company X?*
   To ensure that the dashboard will be used correctly, we will conduct exploratory research regarding the implementation of the dashboard. First, information is gathered from literature, and this information will be applied to this situation. Therefore, we will also do walk-in interviews to gather knowledge about the implementation specific to Company X. Resulting in a recommendation concerning the implementation.

7. *Did the dashboard meet the objectives and therefore improve the situation in Company X?*

   To evaluate the dashboard, we compare the old situation with the new situation. We do this with the help of the objectives and a survey. It is an explanatory study where the dashboard is the stimulus used to see changes in the situation. Here the independent variable will be the dashboard, and the dependent variable will be the situation. This section will also include a summary of the analysis of the feedback. More on how this is measured can be found in Section 1.5.1.

1.5 PROBLEM-SOLVING APPROACH

We will follow the Design Science Research Methodology (Peffers et al., 2008). This theory fits well with our research since we are trying to create an artefact that will solve a problem, namely the feedback has no common format. Also, DSRM fits well because the development of the dashboard is a design process in which we will use the existing knowledge from the employees to come up with a solution to the problem of how can Company X increase their EMVI score. The DSRM consists of the six steps visualized in Figure 1.4. All the sub-questions set up in Section 1.4 can be connected to one of the six stages of the DSRM.

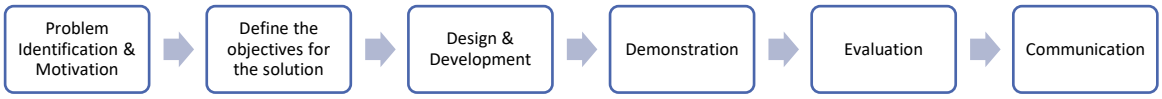

Figure 1.1 Visualization of DSRM (Peffers et al., 2008)

Steps one and two are already executed in the first phase of the research. These first two steps included several talks with employees to get to know Company X, their problems, and their impact. In step 3, Design & Development, we will answer a couple of research questions. First, the design of the dashboard and the approach to identify KPIs are determined by doing a literature review. Next, the research question about which KPIs the dashboard needs to monitor, how to measure, and how to visualize them is answered. When this information is known, the dashboard can be developed. For step 4, demonstration, we researched how the dashboard can be implemented. Then the dashboard can be demonstrated. Next, in step 5, the dashboard will be evaluated. Step 6, communication, is about presenting the results to the company and the University. This will be done by both a report and a presentation.

1.5.1 MEASUREMENT OF IMPROVEMENT

This research aims to measure if a dashboard can help with increasing the EMVI score. Since this is not measurable, we will evaluate it according to the four objectives stated in Section 1.3.2. These objectives are: to structure the feedback by introducing a common format, reduce the number of files with feedback, analyze the feedback to derive improvement points for the EMVI plan and extend the time the feedback is taken into account. To evaluate the change, these objectives are measured before and after implementing the dashboard. In Section 2.1, the survey results evaluate the current state. After implementing the dashboard, the variables will be evaluated with the results from the second survey and by the dashboard features. The situation with and without the dashboard is compared to answer the research question 'How did the dashboard improve the situation?'

1.6 DELIVERABLES

At the end of the research, the following deliverables can be expected. First, a set of KPIs that are important for the performance of an EMVI plan. These KPIs will be established by literature search and semi-structured interviews. Second a dashboard that analyses the performance of the EMVI plans and provides Company X with structured information regarding past projects. Third, an implementation plan for the dashboard will be delivered. The fourth deliverable is a list of recommendations and improvement points. Fifth, the research will be captured in a written report and a presentation.

2 BACKGROUND INFORMATION

We start our research by retrieving more background information. This provides us with content on which we can base our dashboard. First, more about the current situation in Section 2.1. Then we will gain information on how we can design the dashboard in Section 2.2. In Section 2.3, we will determine an approach on how to identify KPIs and lastly in Section 2.4, we research which factors influence the EMVI score positively.

2.1 CURRENT SITUATION

In this section, we will research how Company X currently deals with EMVI tenders and the evaluation moments. This background information can be used later to determine the implementation strategy and to evaluate the situation after implementing the dashboard. The research strategies used in this section are desk talks with employees and a survey. The desk talks were exploratory conversations in which general questions were asked. In Section 2.1.1, the three types of feedback that Company X receives are discussed. Next, in Section 2.1.2, we will determine the current business process of an EMVI plan. Lastly, in Section 2.1.3, the key variables are evaluated.

2.1.1 TYPES OF FEEDBACK

In total Company X has three feedback moments for different types of feedback. First, the internal evaluation, second the Intention to award letter, and third an external meeting with the client. We will go by each feedback type.

First, the internal evaluation, which, as the name reveals, is held internally with the people who worked on the tender. This evaluation is held after submitting the tender and before receiving the Intention to award letter. In this meeting the employees evaluate how the tender went and they talk about topics like planning, strategy, and how good they think the EMVI plan will score. Often when employees are busy, this meeting is skipped. There is an evaluation form to structure the meeting. However, it is not always adhered to. The data that can be used from this meeting are the minutes, the data type is qualitative text. We asked the employees to give the internal evaluation a grade on the usefulness. They gave the internal evaluation a three out of five on average (see Figure 2.1).

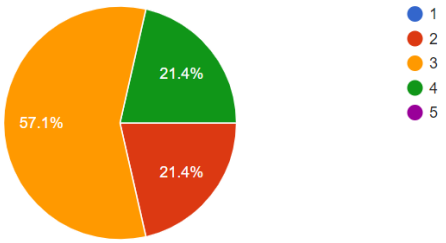

Figure 2.1 Result: "What grade would you give the usefulness of the internal evaluation? "

Secondly, the Intention to Award letter. This letter contains the result of the tender and the score on the award criteria. This data is qualitative, and the measurement level is ordinal since the grading template usually is based on assigning 'no added value, low added value, …" to each award criterion. The level of added value will determine the amount of discount per criteria. Then the total discount is calculated by assigning weights to each criterion and multiplying this with the discount.

Third, the external evaluation meeting, which is organized after the Intention to Award Letter if Company X remains with any questions. This meeting is with the client and with the employees who worked on the tender the most. There is no common format for these meetings, but according to the employees it is highly valuable to

gain some more in-depth information on why Company X got a certain score (see Figure 2.2). The information is written in text and, therefore qualitative data.

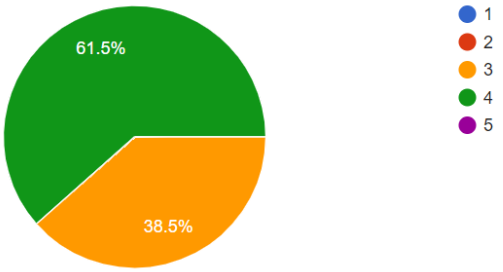

Figure 2.2 Result: "What grade would you give the external evaluation?"

2.1.2 BUSINESS PROCCES EMVI PLAN

The business process of writing an EMVI plan is visualized to get insight into the current structure. Mapping this process enables us to understand and change the situation later on. Since the goal of Company X is to increase the EMVI score, the Plan Do Check Act (PDCA) cycle can help give us insight into if their current process fits their goal. The PDCA is an iterative four-step management method used in business for continuous improvement of processes. The four steps are: plan, do, check and act. First, the business process is mapped and afterwards, it is compared to the steps of the PDCA cycle.

In Figure 2.3, the process of writing an EMVI plan is visualized. Company X is busy restructuring this process, so we will not dive in too deep. The general idea is that during a kick-off meeting the planning for writing the plan will be made with the help of the guideline. This includes setting deadlines and dividing responsibilities. Writing the EMVI plan is done by creating four versions; the bronze, silver, gold and platinum version. In each version, the EMVI plan will be worked out a bit more. The documents used during this process are the guideline and external sources. In the end, they will hand in the platinum version do an internal evaluation and wait for the result. The result is sent to them through an intention to award letter. Afterwards, an external evaluation is planned in case there are questions left.

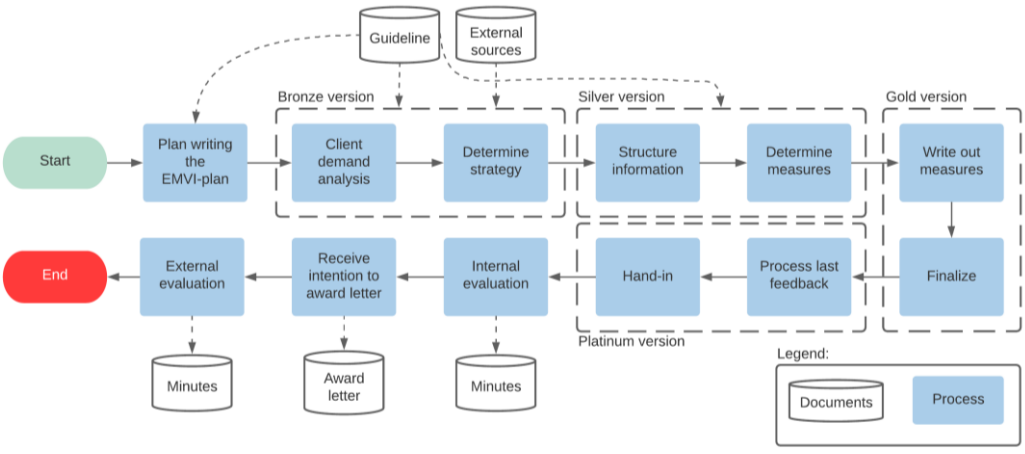

Figure 2.3 Process of writing an EMVI plan

When comparing the current process to the PDCA cycle, Company X does the steps: plan, do and check (see Figure 2.4). However, because there is no common format for evaluating tenders, it is harder to document the feedback and act on them. It appears that the core problem of this research causes that the PDCA cycle is not completed completely. Solving the core problem by developing a dashboard should help Company X to also do

the last step of the PDCA cycle and act on their feedback. When the PDCA cycle is completed this enables continuous improvements in the future.

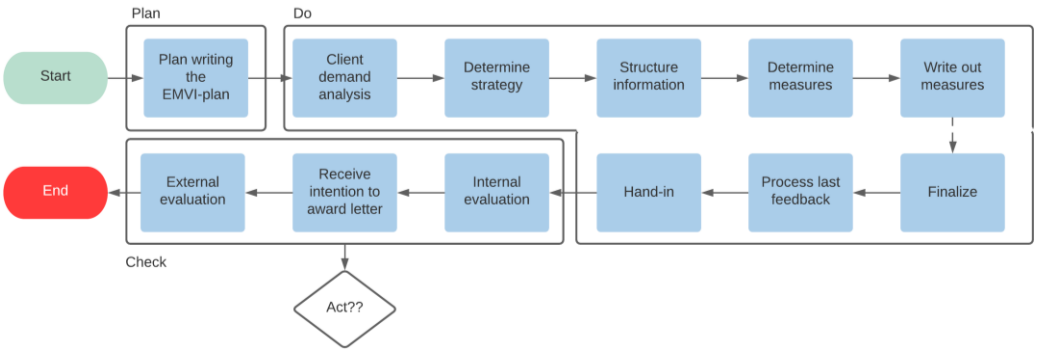

Figure 2.4 PDCA cycle in EMVI writing process

2.1.3 MEASURE OF KEY VARIABLES

To evaluate if the dashboard improved the situation, we set up objectives that we can measure before and after the implementation of the dashboard. The objectives of implementing the dashboard are: to structure the evaluation moments by introducing a common format for the feedback, to reduce the number of files with feedback, to analyze the feedback to derive improvement points for the EMVI plan and lastly to extend the time the feedback is taken into account. Each objective is discussed in this section. Knowledge of the objectives is gained partly by exploratory talks with employees and partly by the survey that 14 employees filled in. The survey can be found in Appendix D. Afterwards we also talked with employees about the current situation and we summarized that in section; Review of employees about the current situation.

FORMAT OF THE FEEDBACK

The first objective is the format of the feedback. Currently, the format of the feedback differs in two points. Firstly, the feedback retrieved at evaluation moments is saved in different formats: JPEG, mail and PDF , which makes it hard to make comparisons. And secondly, the evaluation moments do not have a common format to specifically measure the performance of the EMVI plans. This makes analysing several tenders impossible because there is no data available.

NUMBER OF FILES WITH FEEDBACK

The second objective is the number of files with feedback. Right now, each feedback file is saved separately in a OneDrive. This could make it challenging to find the correct information. Also, this contributes to the time it takes to find the correct information. From the employees, a majority (53.8%) agreed that it is difficult to find the correct information (see Figure 2.5). About the statement that it takes longer to find the correct information, most employees felt neutral. However, the distribution in Figure 2.6 also shows that 42.9% (totally) agrees with the statement.

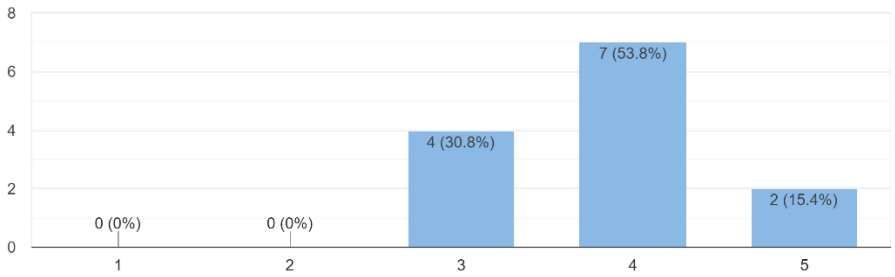

Figure 2.5 Result: When looking for feedback is hard to find the right information. 1= totally disagree; 5= totally agree

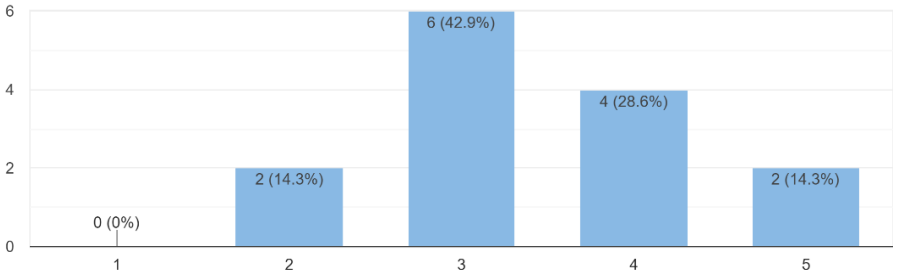

Figure 2.6 Result: When looking for feedback it takes long to find the right information. 1= totally disagree; 5= totally agree

ABILITY TO DERIVE IMPROVEMENT POINTS

The third objective is the ability to derive improvement points from the feedback. Currently, improvement points are derived per tender not from analyzing several tenders. The employees are divided about whether it is easy to draw conclusions from several tenders or not. As shown in Figure 2.7, 42.9% feels neutral and the rest is divided over agree and do not agree with a slight tendency to agree.

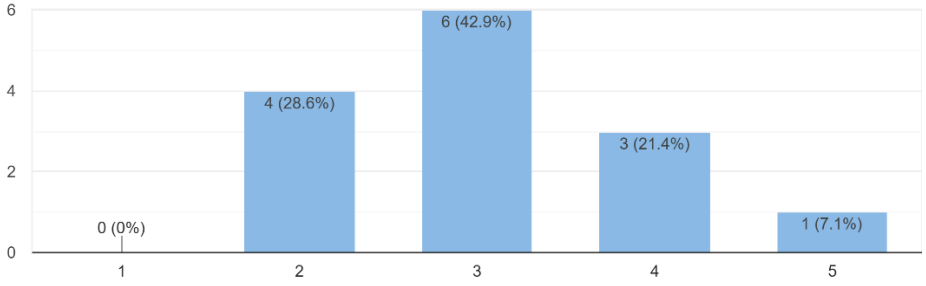

Figure 2.7 Result: I can easily draw conclusions from several tenders about how to improve the EMVI score. 1= totally disagree; 5 = totally agree

THE TIME THE FEEDBACK IS TAKEN INTO ACCOUNT

Lastly, the objective, the time the feedback is taken into account. Currently, the feedback is looked at after each tender. Improvement points are considered in the back of the employees' heads, and that way, they take it with them to the next tender. In a while, these points are likely to fade away, and therefore they are not taken into account anymore. When asking the employees if they agree with the statement that there is not looked back enough at feedback from the past, the biggest groups are neutral (35.7%) or agree (35.7%) with this statement (see Figure 2.8).

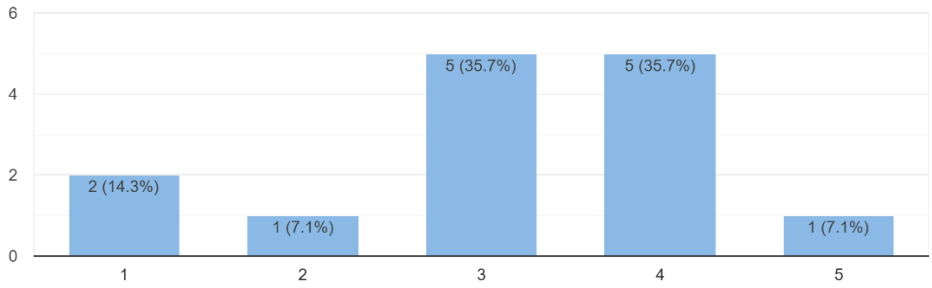

Figure 2.8 Result: The feedback from the past is not taken into account often enough. 1= totally disagree; 5= totally agree

REVIEW OF EMPLOYEES ABOUT CURRENT SITUATION

In the survey, employees had the chance to leave comments. These comments are useful to get a better and more detailed image of the current situation. Most comments were about the format of the evaluation moments and the overview of the feedback. For the overview of the feedback, one of the comments was “A simple database with all feedback in it would be very useful”. Another comment was that right now the information from the internal and external evaluation is difficult to find, a central place to store the feedback would really help them. Lastly, an employee said that a good documentation system where everything can be traced more quickly is definitely an improvement. There were also some comments about the format for evaluation. These were: “External evaluations do not always give us the answers we are looking for. Think about a different approach.” and “We do not have a format for the external evaluation, we could gain more by asking the right questions.”

2.1.4 TAKE AWAY: CURRENT SITUATION

From the current situation, we know that Company X has 3 evaluation moments; the intention to award letter, the internal evaluation and the external evaluation. It turns out that especially the internal- and external evaluations can be used to retrieve more information. When we constructed the business model of writing the EMVI plan it becomes clear that Company X gathers data at these evaluation moments but they do not act on the feedback. The results of the survey and employee reviews help us understand why. The survey tests all the four objectives of the dashboard the results are in bullet points below.

- The feedback is in too many separate files. This causes that 69.2% of the employees experience that searching for feedback is hard and 43% experience that it takes long to find the right feedback. Also in the reviews from the employees it turns out that there is no good overview of the feedback and that there is a need for a database with all the feedback in one place.
- Lack in format of the evaluation moments is a problem now, a new approach to monitor the performance is needed according to the reviews of employees. Also, a way to avoid the feedback being in several formats (PDF, JPEG, word) is needed.
- The feedback from the past is not taken into account enough according to 42.8% of the employees. This percentage is not that high and is therefore not the most important point for them. But from the talks of the employees it turns out they do not look at tenders from the past for improvement points and without analysing historical data you can not derive improvement points. In this case, we think the ignorance of the employees caused the lower score on this objective.
- Analysing the feedback to derive the improvement points is not necessarily hard according to the average response of the employees. However, when we look at the scores on the other objectives the improvement points they derive are most likely not based on several tenders since there is clearly no overview of the feedback. We think the employees do not know the possibilities and that this influenced their response.

2.2 LITERATURE REVIEW ON DESIGNING OF DASHBOARD

In this section, we will execute a systematic literature review to learn how to design a dashboard that monitors the performance of the EMVI plans. The aim is that this knowledge enables us to design a dashboard that can monitor KPIs regarding the EMVI scores. The key concepts in this research will be design, dashboard and KPI. These key concepts are defined as follows.

First, the definition of design is 'an outline, sketch, or plan, as of the form and structure of a work of art, an edifice, or a machine to be executed or constructed.'(Dictionary.com, 2021). In this research, 'design' will regard the looks and the structure of the dashboard. KPIs are defined as a set of indicators that assess the performance of the desired project. Since the performance of each project should be assessed differently, KPIs are very dependent on the project. In this section, we will start with the definition of a dashboard (Section 2.2.1). After that, the types of dashboards will be discussed (Section 2.2.2). Then we will go by all the components of a dashboard (Section 2.2.3). And lastly, the design of a dashboard (Section 2.2.4). The search process can be found in Appendix B.

2.2.1 DEFINITION OF A DASHBOARD

A dashboard is a visual display of essential information in a company or process. This data is typically displayed as a combination of graphics and text. This visualization enables people to visually identify trends, patterns and anomalies and reason about what they see. The visual display should fit entirely on a single screen so the information can be monitored at a glance (Few, 2006). More on the design of a dashboard in Section 2.2.4. Now that we know more about the look of a dashboard, let us discuss the functionality. A dashboard is a multilayered application built on business intelligence and data integration infrastructure (Eckerson, 2006). Dashboards are unique because they combine three crucial tasks in one application, namely: monitoring, analyzing and managing. Therefore, the goal of a dashboard is to enable organizations to measure, monitor, and manage business performance more effectively (Eckerson, 2006). Visualizing the important data and using build-in features dashboards help organizations increase corporate agility, optimize performance, and achieve strategic objectives. However, the extent to which this visualization of the business performance is successful depends on the information used and visualized. Therefore, dashboards should be created through a series of analyses of the data and should be determined by key metrics that matter for the company (Cahyadi & Prananto, 2015). The key metrics must be tailored specifically to the company's requirements. Otherwise, they won't serve their purpose. This results in dashboards always being customized (Few, 2006). More information on data collection and selection is in Section 2.2.3. In this research, we use the dashboard to visualize the performance of EMVI plans.

2.2.2 TYPES OF DASHBOARDS

As mentioned earlier, dashboards combine three tasks: monitoring, analyzing and managing. However, the degree to which a dashboard focuses on one of these three depends on the application. Few (2006) defined three different types of dashboards: a strategic dashboard, an analytic dashboard, and an operational dashboard. It is important to define the type we want to build because the design should look different (Few, 2006), see Table 2.1. Which type of dashboard we should choose is dependent on the purpose of the dashboard. A strategic dashboard is used to focus on high-level performance measures, including forecasts to predict the path into the future. An analytic dashboard mainly analyzes the root cause of problems by exploring relevant and timely information from multiple perspectives and at various levels of detail (Eckerson, 2006). To do this, information in analytical dashboards often demands more contexts, for example, comparisons, extensive history or subtler performance indicators (Few, 2006). Lastly, operational dashboards monitor a situation and alert the user when certain values dive under the set norm. Therefore, these dashboards should be designed with a dynamic and immediate nature. An analytic dashboard fits best for this research because the action problem is: How can Company X increase their EMVI score. With an analytic dashboard, we can find the root cause of possible problems by analyzing information at various levels of detail.

Table 2.1 Types of Dashboards (Few, 2006)

	Strategic dashboard	Analytic dashboard	Operational dashboard
Display	Simple	Sophisticated	Simple
Update frequency	Static snapshots	Static snapshots	Real-time
Interactivity	No	Yes	Yes
Goal	Long-term strategic direction	Discover cause-effect relationships	Grab your attention when an operation fails

2.2.3 COMPONENTS OF DASHBOARD

When designing a dashboard, it is important to know which components a dashboard consists of. This allows us to gain an understanding of how our dashboard should be constructed. In this section, we will address the three layers of information and the components and their definition.

First, the three layers/views of information. According to Eckerson (2006), a dashboard is built up in three layers, a top-, middle- and bottom layer. From top to bottom, the layers display more detailed information. This allows users to navigate through the dashboard by a drill-down path. An example would be to click on a graphic in the top layer to access the data displayed in a table in the middle layer. Then when you click on the table, you are directed to the raw data in the bottom layer. An overview of these layers can be found in Figure 2.9. These three layers of information are helpful to provide context and let the user analyze the data at various levels.

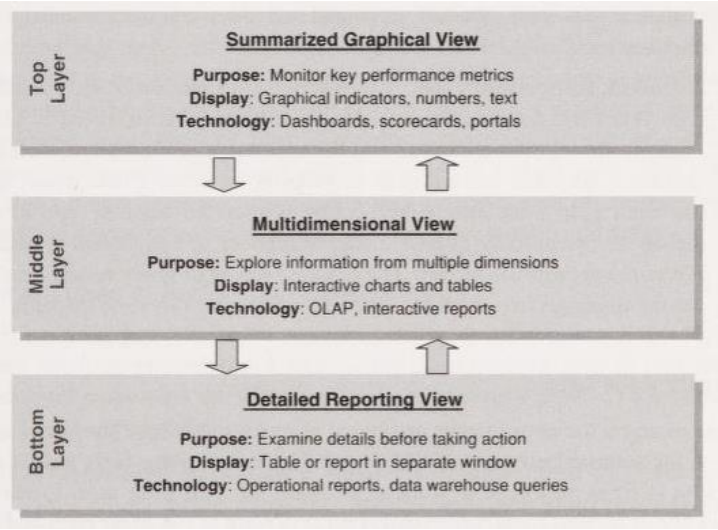

Figure 2.9 Layers of information (Eckerson, 2006)

A dashboard consists of 6 different components: data, technology, user, organization, features, and graphs and metrics (Cahyadi & Prananto, 2015). All these components are displayed in viewlets on the top layer of the dashboard. Viewlets are rectangular widgets that display media. In Table 2.2, the different Dashboard components and their design elements are listed. We will discuss the components data, metrics, and types of media displays separately.

Table 2.2 Components of dashboards (Cahyadi et al., 2015)

Dashboard component	Design elements
Data	Data warehouse, database systems and data quality
The technology used for the dashboard	Platform, system architecture, software and information systems
Name of user	Characteristics
Name of organization	User roles, culture, requirements
Features	Functionality, drill-down, and slice-dice features
Media displays and metrics	User interface and metrics selection

METRICS

Metrics track and provide data on the organization's standard business processes. The most common metrics used in dashboards are Key Performance Indicators (KPIs) these metrics help the user to reach a goal by helping to define the strategy and a clear focus. There are two types of KPIs namely leading indicators and lagging indicators (Eckerson, 2006). Leading indicators predict the future and lagging indicators show information based on the past. Another characteristic of KPIs is that they need to be actionable, which means that if the KPI goes down, the user should know what corrective measures to take to improve the performance. There is no purpose in measuring performance if users cannot change the outcome. How to identify KPIs can be read in Section 2.3. Limit the number of KPIs by sparing only those that are essential. When KPIs are derived, the feasibility of suggested KPIs is evaluated by determining whether they can be measured with the data that is available (Lempinen, 2012). When the data is not available, the set of KPIs should be adjusted. However, a researcher might also want to initiate new procedures, so that lacking information can still be captured. This can involve activities**,** such as setting up a regular customer or employee survey (Lempinen, 2012). In our research, we could do this by asking more specific questions at the external evaluation with the client.

DATA

The component "data" is all about where and how to capture data. First, we need a supporting infrastructure that stores the data. The supporting infrastructure can vary from very simplistic manual methods of recording data to sophisticated information systems depending on how complex the available data is (Lempinen, 2012). Among the types of dashboards, mainly analytical dashboards rely on good data integration and data warehousing (Eckerson, 2006).

Then, the data in the dashboard. Often the required data is a set of KPIs and the data to measure them. When we measure KPIs, we should be able to motivate the connection between the data used to measure the KPI and the KPI itself (Heerkens et al., 2021). Besides this, we also need other information to design an effective dashboard. We need to supply enough context for the KPIs to be able to interpret them and act accordingly (Few, 2006).

Next, the data types in dashboards. According to Few (2006), quantitative data is most commonly used in dashboards and the data is typically displayed as variation in timing, enrichment through comparison or enrichment through evaluation. Variation in timing measures and monitors what happens over a time period. Enrichment through comparison compares two values to gain insight into your performance. Lastly, enrichment through evaluation measures whether a performance is good or bad. If we use data in graphs, make sure to encode the quantitative values accurately. For example, in Figure 2.10, people could falsely assume the revenue is three times the costs because the designer did not start the scale at 0.

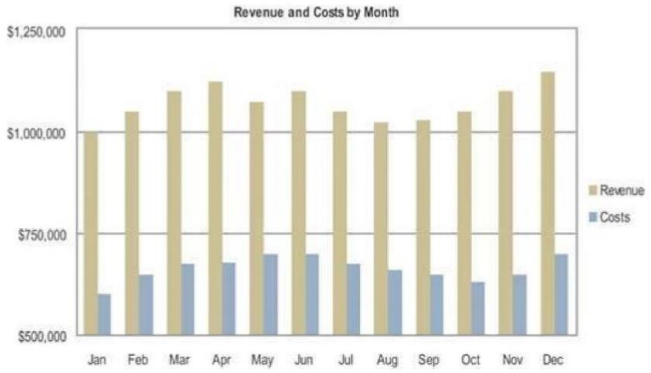

Figure 2.10 Example of incorrectly encoded quantitative values (Few, 2006)

Lastly, the data quality. It is crucial to ensure completeness and data quality (Cahyadi & Prananto, 2015; Lempinen, 2012). When data is in poor condition, the user needs to clean it up and prepare it. There are some guidelines regarding data quality. These guidelines will certify that maximum data quality standards are achieved (Cooper & Schindler, 2003). To avoid dirty data, our dataset should possess the following characteristics: correctness, completeness, accuracy, consistency, uniformity (Cuesta, 2013). To achieve these characteristics, the researcher needs to screen the data for missing values, outliers, types of distribution and clean data where necessary via transformation and exclusion. Next to that, the researcher needs to investigate how data has been generated and ensure that data is in standard format (Lempinen, 2012). The completeness of data refers back to Section 'Metrics', where it is stated that the KPIs should be measurable with the available data.

MEDIA DISPLAYS

A dashboard is a combination of text and graphics, but with a focus on graphics. Therefore, there are a lot of different types of media displays. They are divided into six categories: graphs, images, icons, drawing objects, text, organizers. Few (2006) elaborated on each category. In Appendix C, a list can be found. Later on, that information will be used to decide on media displays. Choosing inappropriate display media is one of the most common design mistakes made. The developer should choose according to two fundamental principles: it must be the best way to display a particular type of information and it must be able to serve its purpose even when sized to fit into a small place (Few, 2006). Also, designing them well is very important for communicating clearly and effectively. More on the design in Section 2.2.4

2.2.4 DESIGN OF DASHBOARD

As mentioned in Section 2.2.1, the goal of a dashboard is to enable the users to visually identify trends, patterns, anomalies, and reason about what they see. Designing dashboards well is essential for communicating this clearly and effectively. To ensure that the user uses the dashboard to its fullest potential, it should be exceptionally well organized. We can do this by following the upcoming guidelines regarding arranging the data, the amount of media displays, the reduction of non-data pixels and the use of colour.

First, the KPIs should be fragmented in one screen. So, you can see important relationships among them (Cahyadi & Prananto, 2015). The data displayed on this screen shouldn't be detailed since this will only slow the viewer down. For arranging the media displays, the most important data should be prominent in the upper left corner and the least important in the lower-right corner. Also, it is wise to support meaningful comparisons by placing them in the same graph or placing them next to each other (Few, 2006). Also, discourage meaningless comparisons.

Second, for media displays, the research of Treude & Storey (2010) found that 77% of the researched dashboards have between five and ten media displays. This is in line with Eckerson (2006), who indicates that seven media

displays are the best choice depending on the use. These are no strict guidelines because it depends on the use but we will keep it in mind.

Third, Few (2006) argues reducing non-data pixels is a must to achieve an efficient dashboard. Non-data pixels are pixels that do not represent data. So, for example, the gridlines in a graph or the extra space 3D graphs take in. When these non-data pixels are needed, then you should de-emphasize them. The goal is to let the user focus on the important aspects.

Fourth, the use of colour is important since it can positive- or negatively influence the clarity of the dashboard. Differences in the colour of objects should always be meaningful otherwise, it is not very clear. Colour should be used to (de)emphasize objects of the dashboard. For example, to (de)emphasize important KPIs, meaningful comparisons, or to indicate the performance (red, orange, green). Also, try to avoid excessive use of colour. Pick one or two colours and use darker or lighter shades to (de)emphasize objects (Few, 2006).

2.2.5 TAKE AWAY: DESIGN OF DASHBOARD

A dashboard is a visual display of the most important information about a company. It measures the performance with the help of a set of KPIs that is customized to the company. When determining KPIs, we make sure that data is available to measure them. There are three types of dashboards: a strategic-, analytical- and operational dashboard. Each type has its own design characteristics. Since, in this research, the focus will be on an analytical dashboard, we need to design it with an interactive-, sophisticated display, using statistic snapshots of information. The dashboard will consist of three layers of information; a top-, middle- and bottom layer, through which the user can navigate with the help of a drill-down path. The dashboard will include a data warehouse, in which the data can be stored. This data will be assessed on completeness and quality. Media displays will visualize the data. We need to make sure to pick the right display for the information. Designing can be done by following the guidelines regarding arranging the data, the amount of media displays, the reduction of non-data pixels, and colour. When we acted on all the information, we created a dashboard that communicates the right information clearly and effectively.

2.3 LITERATURE REVIEW ON KPI IDENTIFICATION

In this section, we want to learn which approach to use when identifying KPIs with the help of a literature review. This literature review aims to create an overview of different approaches used to identify KPIs. We will do this by examining examples in the literature. When this overview is created we can make a decision on which methods we adopt in this research. This section starts with our search strategy, following by the study selection. The research design for the systematic literature review is based on (Kitchenham, 2004). Lastly, an integrated piece of text will be presented.

2.3.1 SEARCH STRATEGY

Before starting the search, we determine search terms by writing down synonyms and boarder terms for each key concept. The key concepts of our search are approach, identify and KPIs. These search terms can be found in Table 2.3

Table 2.3 Search terms

Key concepts	Synonyms	Narrower	Broader
Approach	x	Method, methodology	Framework
KPI	Key Performance Indicator, KPIs, KPIs,	x	"Performance, indicator", measurement, "performance indicator",
Identify	Determine, establish	Point out	Select, assessment

The final search is documented in Table 2.4. Scopus is used as a database because it has peer-reviewed articles, focuses on multiple subjects, and owns many sources. We start with a search query that includes almost all the search terms. However, this yielded a lot of articles and not all relevant. During the process, we adapted the query to achieve the best result.

Table 2.4 Final search

Search query	Database	Hits	Comments/relevance
(approach OR method) AND identify AND KPIs	Scopus	379	Sources are all about KPIs. Especially the sources where they need to identify KPIs are relevant

2.3.2 STUDY SELECTION

In- and exclusion criteria are used by researchers to select sources after the search. In this research, we exclude sources when they address existing KPIs for certain areas. For example, maintenance or operations. We are not interested in those KPIs, we are interested in how to develop your own set of KPIs. Also, studies about the selection or assessment of already known KPIs are not relevant because we do not have KPIs already. Since many articles identify KPIs, only the 12 most relevant to this study are selected. In Table 2.5, the study selection can be found.

Table 2.5 Selection process

Total #of hits	**379**
Removing duplicates	-0
Selecting based on the title	-119
Selecting based on abstract	-213
Removed after complete reading	-35
Total selected of review	12
Books	1
Articles	11

2.3.3 INTEGRATED REVIEW

Identifying the right KPIs is of great importance when you want to design a successful dashboard(Eckerson, 2010; Sultan et al., 2017). But at the same time, it is also one of the major challenges when designing a performance measurement system (Carlucci, 2010). Therefore, it is crucial to select the right approach. In this literature review, we looked at 12 different papers and their approach. In these papers, we identified five methods that could be used when determining our approach. They are all shortly discussed, and an overview is provided in Table 2.6. The conclusion includes determining our strategy based on the approaches found in the literature, our expertise, the available data, and the project's nature.

The first, most used method, is interviewing experts and/or stakeholders. This makes sense because every performance measurement system should be customized to the client (Few, 2006). When conducting the interviews, the goal is to identify the relevant objectives and goals (Eckerson, 2010; Lien et al., 2019). When these goals are clear, the KPIs can be identified with help of the experts and/or stakeholders. This method can be used alone (Eckerson, 2010; von Geibler et al., 2006), in combination with a literature review(Amrina et al., 2019; Chang et al., 2011; Coppola et al., 2014; Dwivedi & Madaan, 2020; Lien et al., 2019) or in combination with a study of two case companies(Onyemeh et al., 2016). When you use more methods in your approach, it is essential to verify the final list of KPIs with the company experts before continuing with the development of the architecture (Chang et al., 2011).

As mentioned, a literature review is often combined with interviews. So the second method is a literature review to identify already known KPIs for your area. When there is literature available to help you identify KPIs for your area, you can be more sure you included all relevant KPIs. Besides the combination with interviews, the literature review is also used as the only method by Rødseth et al. (2015). Chang et al. (2011) also included an industry analysis in the literature review.

The third method we identified is the use of data mining techniques. This method is meant to automate the identification of KPIs using the historical data of the company (Sultan et al., 2017; Tardío & Peral, 2015). This approach sounds promising. However, when applying this method, the quality and availability of data need to be considered. Next to that, the importance of engaging the stakeholders should not be lost out of sight.

Fourth, Corsini et al. (2016) constructed new KPIs using multivariate statistical analysis. This method can evaluate the maximum correlation between the dataset and the objective. However, as with data mining, the quality and availability of an extensive dataset should be taken into account.

Lastly, Onyemeh et al. (2016) used a two-company case study besides the interviews with experts. This was done to get more detailed information. However, they mentioned it was challenging to get companies to agree with this.

Table 2.6 shows the overview of KPIs identification approaches. The numbers represent in which order the methods were applied. For example, Lien et al. (2019) first did an interview, then a literature search and lastly, an interview again. As can be seen, the method “interview with the experts and/or stakeholders” is used most often with eight times. When we look at the whole approach, the combination of an interview with a literature review is used most often, five times. Using this approach, 5 out of 5 authors ended by having contact with the experts/stakeholders, regardless of whether it was just a verification or an interview.

Table 2.6 Overview of KPIs identification approaches

	Interview	**Literature review**	**Data mining**	**Multivariate statistical analysis**	**Case-study**
(Onyemeh et al., 2016)	1				2
(Corsini et al., 2016)				1	
(von Geibler et al., 2006)	1				
(Tardío & Peral, 2015)			1		
(Lien et al., 2019)	1&3	2			
(Dwivedi & Madaan, 2020)	2	1			
(Amrina et al., 2019)	2	1			
(Sultan et al., 2017)			1		
(Rødseth et al., 2015)		1			
(Chang et al., 2011)	1&3	2			
(Coppola et al., 2014)	2	1			
(Eckerson, 2010)	1				

2.3.4 TAKE AWAY: KPI IDENTIFICATION

After the knowledge we gained by the literature review we can conclude which approach we use in this research. We will start by eliminating the methods that do not fit our research by looking at the factors: our expertise, the availability of data, and our project's nature. First data mining, this method requires a great amount of data and specific expertise. When looking at the data available, my experience and the limited timeframe of this research this method is not preferred. The method multivariate statistical analysis is also not preferred because our data is very diverse and not enough to base our KPIs on. A case study would be a suitable method because it is making use of already existing knowledge. However, the problem with this method is that the earth-, road- and hydraulic engineering sector is very competitive, so a competitor would not allow us to receive inside information. Then the only methods left are the methods literature review and interview with experts/stakeholders. Since the most common approach is to use both methods, we will also do that. A brainstorm with ten employees from Company X is done to talk about which factors influence the EMVI score. After that, we will conduct a literature review to find important factors. Lastly, we will determine the final list of KPIs and discuss it with four stakeholders within Company X.

2.4 FACTORS INFLUENCING THE EMVI SCORE

In this section, we aim to gain more knowledge on what factors are related to a successful outcome of an EMVI plan. When knowing these factors, they can be used to measure the performance of the EMVI plans. First, in Section 2.4.1, we will conduct a literature review to identify factors and later in Section 2.4.2, we will verify this result with the brainstorm held earlier.

2.4.1 LITERATURE SEARCH

First, we documented the search process and afterwards the result is presented and evaluated. The research question we used for the literature search is adapted to the international equivalent of EMVI which is the 'most economically advantageous tender (MEAT)'. The question the literature review should be answering is: 'Which factors influence a successful outcome of a MEAT tender?'. The research design of the literature review is based on (Kitchenham, 2004). First, we explain the search strategy and source selection and then we present the result of the literature review in a integrated piece of text.

SEARCH STRATEGY

Key concepts of this search are factors, successful and most economically advantageous tender. These concepts will form the basis for each search query. However, to make sure every relevant article is included, Table 2.7 shows the search terms with synonyms, broader- and narrower terms.

Table 2.7 Search terms

Key concepts	Synonyms	Narrower	Broader
Factors	Aspect,	Indicator, cause	Element, influence
Successful	Outstanding	Winning	Advantageous, positive
Most economically advantageous tender	Quality plan, award criteria, economically most advantageous tender, EMAT	Tender bid, EMVI plan, EMVI score	best value tender, evaluation criteria

We will use the key concepts, their synonyms, and their narrower terms for the starting search query. The broader terms can be used when too few results are retrieved. For this search, we will search three databases: ScienceDirect, Scopus and Civil Engineering Database. These databases are selected because of their focus and scientifically proven sources. In Table 2.8, you can see the final search query and results for each database.

Table 2.8 Final search

Search query	Database	Hits	Comments
(“Quality plan” OR “award criteria” OR “Most economically advantageous tender” OR tender bid OR EMVI plan OR “best value tender” OR “evaluation criteria” OR EMVI score)	Civil engineering database	124	Good results, even though a lot of sources were about evaluation criteria for other purposes.
(“Quality plan” OR “award criteria” OR “Most economically advantageous tender” OR "tender bid” OR “economically most advantageous tender” OR EMAT) AND tender	Science Direct	21	The maximum number of booleans is 8, so the search query is simplified
(“Quality plan” OR “award criteria” OR “selection criteria” OR “Most economically advantageous tender” OR tender bid” OR EMVI plan OR EMAT OR “economically most advantageous tender”) AND tender	Scopus	170	

STUDY SELECTION

In- and exclusion criteria are used to select sources after the search. Sources are excluded when they are about which criteria clients should choose because in our research the client has already chosen their criteria. Also, sources about the prediction of contractor performance are not relevant. In Table 2.9 the selection process can be seen.

Table 2.9 Selection process

Total #of hits	**315**
Removing duplicates	-53
Selecting based on the title	-132
Selecting based on abstract	-99
Removed after complete reading	-26
Added after screening references	+1
Added for more depth on a topic (while writing)	+5
Total selected of review	11
Books	0
Articles	6
Web page	5

INTEGRATED REVIEW

To give a clear overview of the factors found in the literature, they are listed and elaborated below. In Table 2.10 a summarized overview of all the factors is presented. Afterwards in the discussion, we will evaluate if the information found in the literature is sufficient to continue the research.

Innovation

Writing new innovative ideas in the EMVI plan will show that you are flexible and demonstrate that you can deal with fast-changing situations and rules (Zemaitis, 2020).

Added value

Added value is a factor that is closely related to innovation and differentiation. When scoring high on these values you will bring a lot of added value. The goal is not to just write a plan where you explain what you are doing but to write a plan that convinces the client that you can offer something that other bidders cannot (Nelson, n.d.). Adding value is about offering more value for money NOT being cheaper, for example, you may be able to add a service to your bid that costs you little or nothing but saves your customer money (Zemaitis, 2020). In the end, most clients will give their grade depending on how much added value you provided per selection criteria.

Differentiation

Differentiation is about presenting your unique selling points in a way that differentiates you from the rest (Zemaitis, 2020). Make sure the unique selling points stand out (Succes Plan, n.d.).

Social value

For public sector tenders, you now often need to demonstrate social value too. This concerns the economic, social and environmental well-being of the "relevant area" (Zemaitis, 2020). For this factor, it is important to think about what gives the client a headache and provide fitting solutions (House of Tenders, 2018).

Experience of company

Research shows that clients value the company's experience as an important factor (Hatush & Skitmore, 1997a, 1997b; Jennings & Holt, 2010; Watt et al., 2010). It gives them a level of certainty that the contractor is able to execute the project.

Experience of working with the contractor

Some research determines the client relationship as an important factor when choosing a contractor (Hatush & Skitmore, 1997a; Jennings & Holt, 2010; Watt et al., 2010)(Watt et al., 2010). Positive earlier collaborations can influence the confidence a client has in the contractor.

Past Project Performance

Past project performance is determined to be an important factor (Hatush & Skitmore, 1997b). Nowadays clients do not just want to read about past performance, but they want to see proof. In EMVI plans you can show proof of past performance by using verifiable performance indicators (VPI's).

Reputation

In the literature, reputation is valued as an important factor (Jennings & Holt, 2010; Watt et al., 2010). If someone's reputation is good clients have more confidence in your performance.

SMART formulation

When searching the Dutch literature SMART writing is mentioned as an important factor for the success of an EMVI plan (Booij, 2013; House of Tenders, 2018; Succes Plan, n.d.). SMART stands for Specific, Measurable, Acceptable, Realistic and Time-bound. When writing SMART you give the client insight into the plan while explaining all necessary details. The research from Booij (2013) says that the part measurable usually requires the most improvement.

Outsourcing the writing of the EMVI plan

Nelson (n.d.) points out that sometimes it is wise to outsource the writing. They can help you with writing a clear and attractive plan. Next to that, they can also help you with being creative and stand-out.

DISCUSSION

In the disscussion, we will evaluate the completeness of the literature review, how this subject was represented in the literature and lastly if we gained enough information to consider this sub-question answered. First the

completeness of the literature review. This is about whether we found the most important articles concerning our subject. Since we executed a systematic literature review according to the steps presented by Kitchenham (2004). I think we can consider our search complete. Also, the search terms that we used were very accurate because the articles we found were almost always about the MEAT tenders and how the evaluation of quality is/should be done. However, when continuing to the second question: how was this subject represented in the literature, we found that the information was often not applicable to our subject or the Dutch construction industry. In the literature about MEAT tenders, there could be established three main streams of research. First the framework for evaluating the quality of a contractor. This is not useful for our knowledge question because the framework is known and chosen by the client. We want to know how the contractor can deal with this framework. The second stream is about which selection criteria the client should adopt. This research is interesting for the client but not for the contractor. The selection criteria are set so we want to know how contractors can deal best with these criteria to hand in a winning bid. The last stream is about how the client can predict the performance of the contractor. As with the second stream, this information is useful for the client but not particularly for the contractor. Then some papers did evaluate which factors were deemed important by clients but these papers were not completely applicable to the Dutch tenders since those papers included factors as social value or sustainability. However, in the Netherlands, the clients chose the award criteria so those factors are predetermined. Overall, we can conclude that material is scarce about how contractors can deal with bidding on MEAT tenders. As a result, there was not enough relevant information to be found in the literature and therefore we turned to non-scientific sources such as websites. With all this information the sub-question is answered. However, there can be questioned how reliable and complete this answer is. However, when considering that the interviews and brainstorm sessions can complement and verify the information found in the literature, we can say that the literature review can be used.

2.4.2 COMPARISON EMPLOYEE INPUT AND LITERATURE

First, we compare the factors found in the literature with the results of the brainstorming meeting to get a complete overview. In Table 2.10 all the factors are listed and we created a summarized overview. For each factor we noted how many times it appeared in the 10 sources and if it was deemed important by the employees during the brainstorm meeting. With a +, +- and – we indicated if the factors are mentioned in the brainstorm. +- means that the subject is discussed but the factor is not literally mentioned. Next to that, we placed some comments d for context. After this comparison, we talked with 4 employees to determine the final list of factors. The factor 'Outsourcing writing of EMVI plan' changed to 'Tender process and 'Understanding of client's wishes' is added. The final list can be found in Table 3.1

Table 2.10 Summarized overview of factors

Factor	# of occurrence in Literature	Brainstorm	Comment
Innovation	1	-	
Added value	2	+	
Differentiation	2	+	
Social value	2	-	Is usually an evaluation criterion set by the client
Experience of contractor	4	-+	
Experience of the client with a contractor	3	+	
Past Project Performance	2	+	
Reputation	2	-+	Mentioned during talks but not in the brainstorm meeting

SMART formulation	3	+	
Outsourcing writing of EMVI plan	1	-+	Employees emphasize the importance of writing style

2.4.3 TAKE AWAY: FACTORS INFLUENCING THE EMVI SCORE

In this chapter, we conducted a literature review to find factors that influence the EMVI score positively. In total a list of 10 factors is found and compared with the brainstorm results. The final list of factors is:

- Experience of client with contractor
- Added value
- SMART formulation
- Understanding of client's wishes
- Past project performance
- Tender process
- Experience of contractor
- Reputation
- Differentiation
- Social value
- Innovation

3 KPI SELECTION, MEASUREMENT, AND VISUALISATION

After we determined the factors that influence the successful outcome of an EMVI , we can select the factors that will be KPIs in the dashboard. In this Chapter, we will find an answer to which KPIs should be selected for the dashboard and how to measure and visualize them. We do this by conducting semi-structured interviews with 4 employees who are experts in this area. The purpose of the interviews is to customize the dashboard to Company X its needs. The questions we asked were about: the relative importance, if any factors were missing or not useful as KPI, and how to measure the KPIs. Furthermore, we added KPIs to measure the progress. Lastly, we elaborated on the design of the dashboard, including visualization of the KPIs.

3.1 SELECTION OF FACTORS FOR THE DASHBOARD

In Section 2.4, a list with 11 factors was derived by us. However, the design guidelines set up in Section 2.2 state that the dashboard ideally monitors 7 KPIs. Also, the KPIs should be measurable and actionable. Therefore there is made a selection from the list of factors. In Sub-section 3.1.1, the selection is made based on the relative importance assigned by four employees. Next, in Sub-section 3.1.2, the KPIs that monitor the progress are explained and a final list is presented.

3.1.1 SELECTION OF FACTORS BY IMPORTANCE

To determine the importance we used the fixed-sum question format. Employees were asked to divide 50 points among the factors so that the average could be taken. When assigning weights, the respondents needed to keep in mind that the final KPI needs to be actionable, which means that if the KPI goes down, you should know what corrective measures to take to improve the performance (Section 2.2). There is no purpose in measuring performance if users cannot change the outcome. In Table 3.1, the results can be found. Considering the average importance score and the interviews, the factors with a red marked average score are not chosen. We will shortly elaborate on why.

For the experience of contractor usually the client knows that the contractors who submit a plan are able to do the job. When it is a bigger tender, there is a pre-qualification based on the technical experience of the contractor. So, the experience of the contractor is often a prerequisite instead of added value. Furthermore, is this factor also a bit represented by past project performance. Therefore, the conclusion is to exclude this factor from the list. Next, the reputation of the contractor. Even though this is an essential factor in winning the tender, it is tough to measure. Clients will not give you an honest answer to this question, and employees cannot objectively grade this, so further research is required to answer this question and come to a recommendation. Also, the factor differentiation is excluded. This factor mainly scored so low on importance because it is very closely related to the added value. When your plan is positively different from the rest, you provide more added value. Social value and innovation are both ranked low because they are criteria the client chooses and therefore do not occur in every EMVI plan.

Table 3.1 Relative importance of factors determined by letting employees divide 50 points over the factors

Factor	Employee 1	Employee 2	Employee 3	Employee 4	Average
Experience of client with contractor	7	15	9	8	9.75
Added value	10	10	9	9	9.5
SMART formulation	5	10	9	7	7.75
Understanding of client's wishes	10	0	N/A	9	6.33
Past project performance	5	5	9	6	6.25

Tender process	10	7	5	3	6.25
Experience of contractor	3	0	9	3	3.75*
Reputation	0	0	0	6	1.5*
Differentiation	0	3	0	0	0.75*
Social value	0	0	0	0	0*
Innovation	0	0	0	0	0*

*The factors with red marked averages are not included in the final list of factors included in the dashboard

3.1.2 MONITORING THE PROGRESS

Besides monitoring the factors that have a positive influence on the EMVI score it is also useful to monitor the progress to see if actions improved the scores. Next to that, the goal should be visualized to see to which extend it was reached. The progress is measured by presenting both the place on the tender and the place on the EMVI score over the past years. The goal of Company X is to win 50% of the tenders in 2021/2022. This will also be measured by presenting the percentage of tenders they have won in the current year. The final list of factors is:

- Experience of client with contractor
- Added value
- SMART formulation
- Understanding of client's wishes
- Past project performance
- Tender process
- Monitor progress
- Goal

3.2 MEASURING OF FACTORS

To monitor the factors they need to be measured with available data and KPIs. In Section 3.2.1, we discuss the way the data is stored and the quality of the data. Then Section 3.2.2 discusses how the factors are measured by KPIs.

3.2.1 GATHERED DATA

As mentioned in Section 2.2, data gathering is all about how and where to capture data. First, we need a supporting infrastructure that stores the data is and second the data needs to be of good quality. We will store the data in an Excel file because the dashboard will also be created in Excel more on this choice in Section 3.3. The quality of the data is important for valid results. We screened for missing values to achieve high-quality data, but most missing values were scores on the criteria. These tenders are still included in the data set since the missing data does not change the results. Next to that, we also determined outliers. They occur when one client gives a low or high score in comparison to the rest. These outliers cannot be removed because they are helpful when identifying strengths and weaknesses. Also, removing them would make the results incomplete. Since we are not executing statistical tests we do not need to check for the types of distribution. Lastly, a check is done on how the data is generated. Since Company X generates the data and since the data does not involve results of an interview or observation but results of a tender, there are no threats to the data quality.

3.2.2 MEASURES

For each factor we determine KPI(s) that measure the factor. The KPI is measured with the available data. In case the data does not provide a proper measurement, we can choose to create new data by asking questions at the internal and external evaluation. The data used to measure the KPIs and how the KPIs will be displayed is explained (Section 2.2). All KPIs are lagging because we want to draw conclusions from data in the past and monitor if the actions taken will increase the scores over time. When making the KPIs measurable, we need to consider that the client is often subjective and that therefore some measures are only a rough estimation. At the KPIs in question, we provided some comments.

Experience of client with contractor

The first KPI we use to operationalize this factor is the number of times Company X already did a tender for a client. This impression is used to see whether they can use data from previous tenders when working on a new tender. Furthermore, it is relevant to know which experience the client had with Company X, therefore the second KPI is the average score on tenders per client measured by displaying the average percentage Company X gained of the maximum score, per client. Employees can use this to roughly see with which client Company X has the highest chance to win. This data will be displayed by enrichment through evaluation.

Added value

We will measure this factor by the KPI: added value scored per criterium. For this KPI the grades per criteria can be used. Since the grading is different per client the scores will be expressed in percentages. The results are used to assess whether a criterion scores good or bad. This indication can be used by employees to determine which criterium needs improvement. This data will be displayed by enrichment through evaluation. When we draw conclusions from this data, we need to consider that the scores given on criteria are often subjective judgments. Therefore, it is important to dive deeper into the results to see whether a criterion is worth improving before putting a lot of effort into it.

SMART formulation

We measure the factor "SMART formulation" by monitoring 4 KPIs: score on writing SMART, score on writing specific, score on measurable measures and score on if the measures were realistic. Unfortunately, there is no quantitative data available to monitor this KPI. Clients do write comments about this in the evaluation, so it is a point that is considered important. Therefore, we will measure these KPIs by asking specific questions to the client at the external evaluation. One question will be asked in general and some specific about each theme. The questions are presented below. For the answer, we ask them to give a grade between 1 and 10.

1. To which extend is the EMVI plan writing according to the SMART principle?
2. To which extend were the measures fitting(specific) to the tender?
3. To what extend were the measures measurable?
4. To which extend were the measures realistic and did you believe we could live up to them?

Understanding of client's wishes

Measuring this factor is rather difficult since the client's wishes are very subjective. This wish can change per client and even per tender. However, it is still deemed an important factor and therefore this KPI will provide an overview on the performance over a period of time. We measure this factor by giving a quarterly overview of the percentage of the maximum EMVI score gained by Company X. When you understood the client's wish very well, they will grade your plan as a lot of added value. Understanding the client's wish can be done by looking back at previous tenders and by having a good client relationship. This KPI will be displayed as a variation in timing.

Past project performance

Past project performance is not about knowing how Company X performed but more about showing the client that the method you propose worked in the past at a similar project. To do this, contractors use verifiable performance indicators (VPIs). For creating VPIs, Company X has an information system in place so the KPIs are not about providing VPIs but about testing how they are used. The two KPIs used to monitor the past project performance are: use of VPIs and good use of VPIs. Since there is no data available this KPI is measured by asking the client questions at the external evaluation:

1. To which extend were the VPIs fitting?
2. How do you feel about the use of the amount of VPI's on a scale from 1 to 10? 5 = exactly good

Tender process

The process of writing the tender is also important, not only for a good outcome but also to understand the outcome. Monitoring this factor can be used by the employees to control themselves when they slack off a bit but also to see whether there is a relationship between a good process and a good score. When analyzing the process of the tender we identified four important subjects as KPIs: tender strategy, tender team, planning, client contact. At the internal evaluation, people should give a grade between 1-10 for each subject.

Monitor progress

The progress is monitored by displaying the variation over time. Per year the places on the tender are displayed.

Goal

The goal is to have the best plan in 50% of the tenders and for the other 50% the goal is to be 2nd or 3rd. This will be measured by keeping track of the places on the EMVI plan each year.

3.3 DASHBOARD DESIGN

In this section, the design choices are explained. The design choices are based on the information in Section 2.2. First, in Section 3.3.1, we chose a media display for the KPIs, then in Section 3.3.2 we explain the place of the KPIs on the dashboard. Next in Section 3.3.3 we looked at how we incorporated the design guidelines from Section 2.2 in the dashboard. Furthermore, we elaborate on some features that are included in the dashboard in Section 3.3.4. And lastly, in Section 3.3.5 some pictures of the finished dashboard. Note: all data in the pictures is randomly generated and does not represent the status of Company X.

3.3.1 VISUALIZATION KPIS

As mentioned in Section 2.2 it is important to choose the right media display. A list of different types of media display and for what they can be used can be found in Appendix C. In Table 3.2 on the next page, the list of KPIs with their media display and explanation can be found.

Table 3.2 Visualization of KPIs

Factor	KPI	Media Display	Comments
Experience of client with contractor	Amount of tenders per client	A table	Data becomes less clear when using a bar chart. For the EMVI score per client, the background is made red-green according to the score.
	Average EMVI score per client		
Added value	Score on added value	A table with the criteria, the percentage scored on the criteria and the number of times the criteria is chosen by the client	We want to see the combination between how often a criterion is used and the score. This could also be done by a scatter plot; however, you cannot filter the results and also it is very hard to see which dot is which criterium. The table is programmed with VBA.
SMART formulation	SMART general	Bar graph	1 question per bar
	Specific		
	Measurable		
	Realistic		
Understanding of client's wish	Percentage gained of the maximum EMVI score	Line graph with trendline	Each marker is a new quarter. There is chosen for a line graph because then we can display the trend over the years.
Past project performance	Amount of VPIs	Bar graph with indicator	A bar is shown from 0 to 10 and then an indicator shows the current state.
	Use of VPIs	Bar graph with indicator	
Tender process	Tender strategy	Bar graph with indicator	Display per question and an average.
	Tender team	Bar graph with indicator	
	Planning	Bar graph with indicator	
	Client contact	Bar graph with indicator	
Monitor progress	Place on tender	Stacked bar chart	Because we want to compare percentages of places (not the same number of tenders per year)
Goal	Place on EMVI plan	Stacked bar chart	We want to compare percentages of places on EMVI plan (not the same number of tenders per year) because the goal is to become first 50% of the time.

3.3.2 PLACES OF KPIS ON DASHBOARD

As mentioned in Section 2.2, the place of a KPI on a dashboard is very important. To summarize, the most important KPIs should be in the left upper corner/middle and the least important KPIs in the right lower corner. Also, KPIs that are related to each other are placed next to each other for easy comparison. In Figure 3.1, the placement of the KPIs on the one screen dashboard can be found. The places are indicated and referred to by the number 1 to 8.

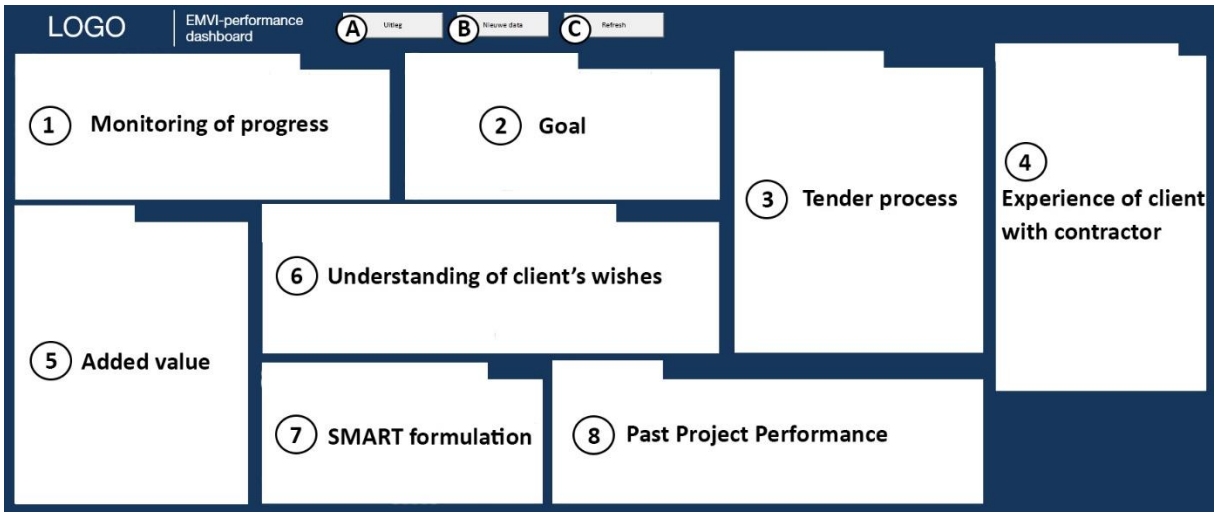

Figure 3.1 Places of KPIs on the dashboard

On place one, we visualized the distribution of places on tenders. On place two, the distribution of places on the EMVI plan per year. These two KPIs measure the progress and if the goal is reached yet. Therefore, they are very important and placed in the left upper corner. For the other KPIs Table 3.1 is used to determine the importance. Most important is the KPI "experience of client with contractor", however it is not placed high because the measurements are not totally representative. Therefore this KPI is now more helpful as context instead of a performance measure. So we placed it on place four in the right corner. The following three important KPIs: Added value, SMART formulation and Understanding of client's wishes are all placed on the left side/middle on places 5, 6, and 7. We placed the KPI 'Understanding of client's wishes' in de middle close to places 1 and 2 because they all measure the performance over a period of time. Placing them together enables employees to quickly analyze what happened at a point in time across the three graphs. The two KPIs that scored lowest on importance are: tender process and Past Project Performance, therefore they got a place on the right lower side.

3.3.3 DESIGN GUIDELINES

In this section we will shortly elaborate on the design guidelines stated in Section 2.2. To summarize, the guidelines recommended having one screen with around seven displays, reducing non-data pixels and using colour to emphasize relationships or data. Lastly, the colours you use must not be too much. When looking at our design in Figure 3.2 Complete dashboard overview, we can say that we adhered to the guidelines by creating a one-screen dashboard with eight media displays. Also, we kept the non-data pixels to a minimum by leaving out unnecessary information and de-emphasizing the gridlines. In the dashboard, the colour scale green-yellow-orange-red is used as an indicator for good or bad. This helps the employees see immediately if a score is bad or good without diving into the details. For the background and details there is chosen for dark blue. This way, it could be used in graphs, and it also makes the KPIs stand out.

Figure 3.2 Complete dashboard overview

3.3.4 FEATURES

To make the dashboard functional, we built three features with Visual Basic for Applications (VBA). This makes the use of the dashboard easier. The features are discussed below.

First, a way to show a user guideline. When you click on button A (see Figure 3.2), a panel appears with an explanation about the dashboard. See Figure 3.3. In this user guideline the purpose, the filters and the buttons are explained. Also, some information is added about possible errors.

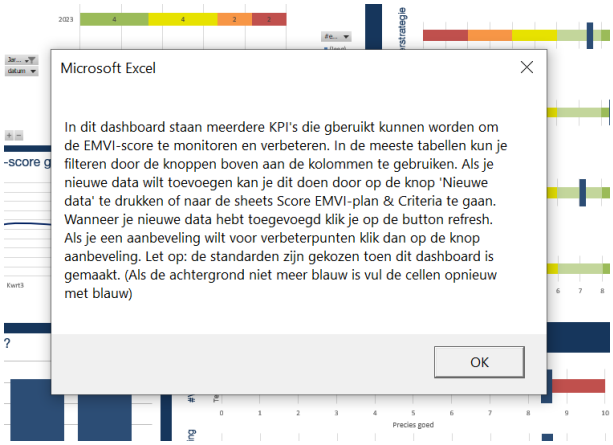

Figure 3.3 Textbox with user guideline

Second, a way to enter new data. When the user presses button B a user form appears. The data that is retrieved is stored in the correct table and format. A user can also add the data to the table manually but this makes the use easier. In Figure 3.4, the user form can be seen.

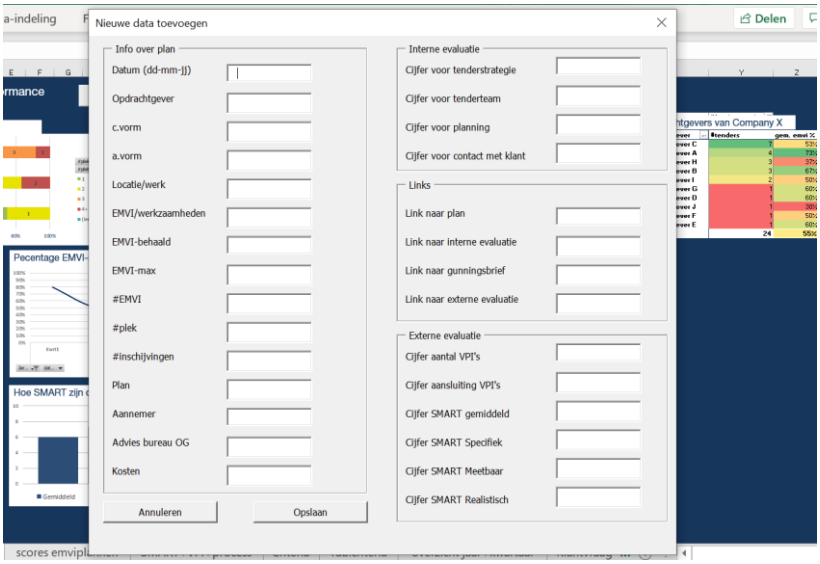

Figure 3.4 User form to add new data

Last, button C to refresh the data. Some graphs and tables are updated as soon as employees add new data, however for pivot tables, the VBA coded table and pivot graphs this is not done. Therefore, the user would have to refresh every table to see changes in the dashboard. With the refresh button, a user can update all the tables and graphs with only one click while staying on the same worksheet.

3.3.5 THE DASHBOARD

In this section, we will dive a bit deeper into the dashboard and the meaning of the KPIs. With the help of some snapshots, the KPIs and the results are listed and explained. Keep in mind that the data showed in the graphs is random, so the results explained in the text do not correspond with the picture. Also, the dashboard is made in Dutch, the translation is provided in the text.

Figure 3.5 Overview dashboard part A

1. *Monitoring of progress ("verdeling plek op tender per jaar")*
   From this graph Company X can derive which percentage of the tenders they win. Also, they can see how this percentage develops over time. Next to that, the numbers in the stacked bar charts represent the number of tenders, indicating the total number of tenders done in a year. Currently, the percentage of tenders they won is decreasing over time. Ideally, this percentage will increase again because of the improvements Company X implemented. This graph can be filtered on years.

2. *Goal ("Verdeling EMVI score per jaar")*
   The goal is to get a first place on 50% of EMVI plans. In this graph this goal can be tracked and the progress over the years can be seen. The years before the highest percentage won is 35%, so this graph needs to show a significant improvement over the coming years. This can be done by improving the EMVI plans with the dashboard or other information. This graph can be filtered on years.

5. *Added value ("score per criterium")*
   In this table, the criteria that the clients choose can be seen. Per criterium both the average percentage of points scored and the number of times it occurred are mentioned. We recommend filtering the table on occurrences from high to low. This way the most common criteria are at the top and you can then scan through the scores. This table is very interesting for Company X to find improvement points. We advise to start with researching the criteria with a green cell for occurrence and the lowest scores on

percentage. This way Company X can maximize the impact of their improvements. In this case it would be PvA, Kansendossier and Risico.

6. *Understanding of client's wishes ("Percentage EMVI score/max-score gehaald")*
   In this graph Company X can see which percentage of the EMVI score they gained over the years. Remarkable is that this graph doesn't change much over time, this contradicts the graph that shows a percentual decrease in first places. Does this mean that the competitors are getting better where Company X is just staying at the same level? We cannot say that for sure since we did not include the competitors' performances in this graph. When Company X would improve its EMVI score, this graph should show an upwards trend in the coming years.

7. SMART formulation ("Hoe SMART zijn de EMVI plannen?")
   We do not have any data for this KPI yet, so we cannot draw any conclusions. When the first five new tenders are added, Company X can get an indication of their performance.

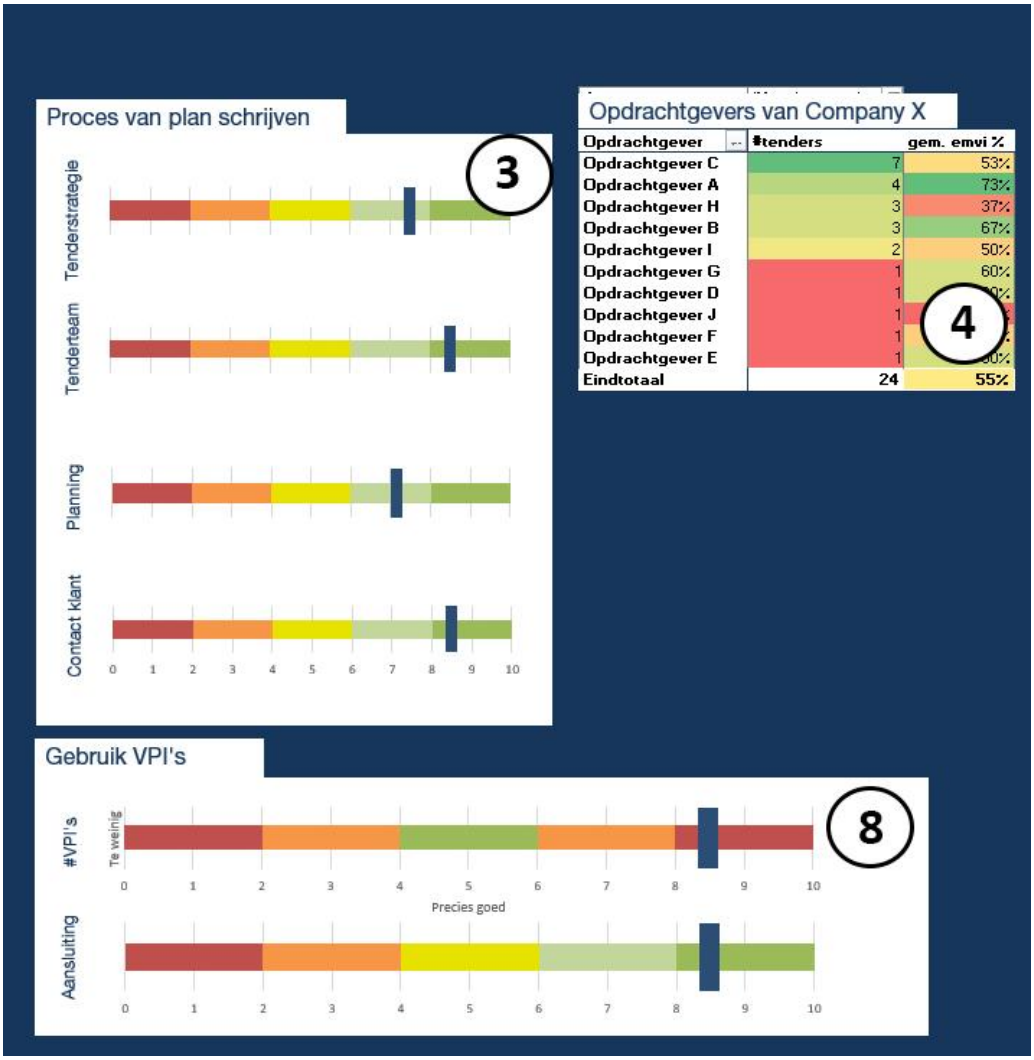

Figure 3.6 Overview dashboard part B

3. *Tender process ("Proces van plan schrijven")*
   We do not have any data for this KPI yet, so we cannot draw any conclusions. When the first five new tenders are added, Company X can get an indication of their performance. The performance is visualized by an indicator so that the user can easily see the performance.

4. *Experience of client with Company X ("Opdrachtgevers van Company X")*
   This table is mainly there for context when starting on a tender. When Company X needs to decide whether they want to subscribe or not they can use this table to see how they scored in the past. Since this was also a problem stated in Figure 1.4 Problem cluster, it also contributes to another problem. When the user wants to know more about a client he can double click on the #tenders for that client. A new sheet opens with all the tenders done for that client. This makes it easy to access information such as which criteria they asked last time, what did Company X hand in and who was responsible.

8. *Past Project Performance ("Gebruik VPI's")*
   We do not have any data for this KPI yet, so we cannot draw any conclusions. When the first five new tenders are added, Company X can get an indication of their performance. The performance is visualized by an indicator so that the user can easily see the performance.

3.4 TAKE AWAY: KPI SELECTION, MEASUREMENT, AND VISUALISATION

This chapter aims to have a completed dashboard in the end. The first step we took in this chapter is determining the final list of factors that will be monitored in the dashboard. After the employees graded the factors by importance and the ability to measure them a final list with the following factors is drawn up: experience of client with contractor, added value, SMART formulation, understanding of client's wishes, past project performance and the tender process. Since the goal of the dashboard is to improve the EMVI plans we also included two KPIs that measure the progress. The next step in this chapter was to make the factors measurable by creating KPIs. Those KPIs are measured by data already available or by generating new data by asking questions at the internal and external evaluation. Once we determined how to measure the factors we determined how to visualize them. In the end we used two tables, two stacked bar graphs, 7 bar graphs and one trendline graph. In the graphs and tables we used a colour scale green-orange-yellow-red to indicate the performance. The place of the KPIs on the dashboard was determined by the importance of the factor. At the end of Chapter 3 we have a completed dashboard.

4 IMPLEMENTATION

In this chapter we research how the dashboard should be implemented. The aim is to find a fitting model for implementing a dashboard and guiding this technological change. Finding a fitting model is relevant since the implementation is an important success factor in how well the dashboard will be used and if it will be used (Kotter, 1995). This chapter will concern implementing the dashboard in the team and the company's procedures instead of the technical details. This is because human potential is a factor that should play the key role in dealing with technological changes (Ćirić & Raković, 2010). We used literature to gain knowledge on a fitting implementation model and afterwards, the model is used as a guideline to write the implementation plan.

When implementing a technological change an organization will face a different set of challenges than when working on the daily tasks (Leonard-Barton & Kraus, 1985). So when looking at a fitting model the challenges that come with introducing technological change need to be considered. According to several authors a good change management approach is the decisive factor of technological change because it addresses these challenges (Ćirić & Raković, 2010; Gerdsri et al., 2010; Shan Nakigudde & Nakigudde, 2019; Wipfli, 2014). When looking at a change model, the 8-steps model of change of Kotter (1995) is often used in Information Technology projects (Shan Nakigudde & Nakigudde, 2019). This model has proven to work in a similar environment because it is successfully applied at an Orthopedic Surgical Practice Group where they wanted to digitalize the practices (Auguste, 2013). This case is similar to implementing the dashboard because our goals are similar. We both want employees to start updating and using the information in a digital platform. The eight steps of the 8-steps model of change are: create urgency, form a coalition, create a vision, communicate the vision, empower to act on the vision, create short-term wins, build on change and anchor the changes.

Another reason why the 8-step model of Kotter fits well is because it also addresses the human factor. They put focus on one of the biggest challenges that is identified: the resistance of employees (Ćirić & Raković, 2010; Leonard-Barton & Kraus, 1985; Wipfli, 2014). When employees do not support, understand or see the urgency of the technological change they will not use it and the dashboard would soon become useless. To reduce the resistance (Leonard-Barton & Kraus, 1985) propose to set up a project team to manage the technological change. Also, the involvement of stakeholders during the development of the technological tool is an excellent way to reduce resistance (Ćirić & Raković, 2010). Kotter (1995) addresses both the project team and the involvement of employees, together with other factors such as creating a sense of urgency and clear communication. Other authors also use the 8-step model of Kotter as a basis to create a new methodology for the implementation of technological changes (Gerdsri et al., 2010).

So, the 8-steps model of change from (Kotter, 1995) is used as a guideline because the literature has given us enough confidence that it works when implementing technological tools or systems. The eight steps are: create urgency, form a coalition, create a vision, communicate the vision, empower to act on the vision, create short-term wins, build on change and anchor the changes. Each step will be evaluated. Even though steps 1, 2 and 3 are already done at the point of writing, we can still evaluate if it was enough.

Step 1: Create a sense of urgency

To ensure your change will be accepted, people need to see the urgency of it. Therefore, it is essential to explain why it is necessary to make the change (Kotter, 1995). In this case, the company did ask me if I could help them make the change. Also, they already created a sense of urgency themselves by creating presentations about the decreasing EMVI score. According to (Kotter, 2012) starting honest discussions is a good way to get people talking and thinking. In the beginning, we hosted a brainstorming session with ten employees about which factors influence the EMVI score. At the beginning of this session, the urgency was explained. In conclusion, there is created enough sense of urgency.

Step 2: Form a powerful coalition

When a sense of urgency is created, it is important to have people that visibly support and lead the change. When selecting these key persons, think about the added value they bring to create a diverse coalition (Kotter, 2012). Since the change in this research has a lot of influence on the tender management and less influence on other departments, all three employees from the tender department are in the change coalition. Next to that, their manager and my company supervisor are in the coalition. These people are informed and asked for input so that they support the project.

Step 3: Create a vision for change

Creating a vision for change helps people understand why you are asking them to do something. When the end goal is clear, people are more inclined to help out (Kotter, 2012). In this research, the end goal is a dashboard that helps to determine improvement points by putting feedback in the same format. The vision on how to achieve this is explained in Sections 1.4 and 1.5.

Step 4: Communicate the vision

When communicating the vision, it is important to be open and clear to prevent resistance (Kotter, 1995). Since the change is most important for the people in the coalition, they already hear a lot about the vision during talks and interviews. However other people in the company should also hear about it. Therefore, when the dashboard is done, we will present why and how to use it. Afterwards, the employees are asked to fill in a survey to evaluate the dashboard. Next to that, we will offer to do a presentation at the end of the research. Even though Kotter (2012) says one presentation is not enough to communicate the vision, in this research, it is because the people that need to use it are already in the coalition.

Step 5: Remove obstacles

When following these steps, it is likely to run into obstacles. The most common obstacles are people resisting the change or processes that are getting in the way. To ensure a smooth change these obstacles should be removed. (Kotter & Schlesinger, 2008) discovered that resistance among employees is mainly caused by misunderstandings or beliefs the change is not necessary. This obstacle can be dealt with by executing steps 1, 2 and 4. The second obstacle, processes that are getting in the way, can be removed by having a clear overview of the process that needs to change and how it should change. In Figure 2.3, the current process of writing an EMVI plan can be found, and in Figure 4.1 the new process after the implementation of the dashboard can be found. The changes are marked in red. The information that is gathered in the dashboard is used when creating the bronze and silver versions (see Section 2.1.2).

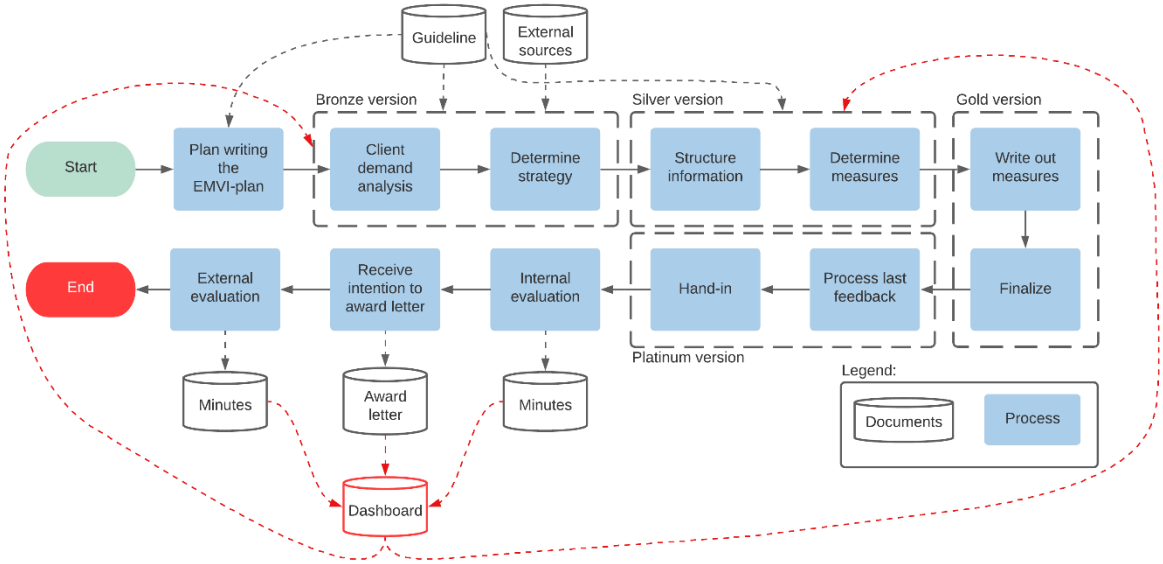

Figure 4.1 Renewed process of writing an EMVI plan

Step 6: Create short-term wins

If the dashboard is created, the improvement points that can be derived are short-term wins these can be seen in Section 6.4, recommendations. Also looking for information should take up less time.

Step 7: Build on the change

After the short-term wins of step 6, the company should keep in mind that quick wins are only the beginning of achieving their goal. When they want to win 50% of the tenders, they need to keep looking for improvements and implement those improvements(Kotter, 2012). Since I am leaving after my graduation and can not continue improving, this message is communicated clearly to the team. We discuss what has been achieved and what still needs to be addressed in the future.

Step 8: Anchor the changes in corporate culture

Finally, step 8. In this research, step 8 is about making sure the dashboard is used in every tender for the future. There should be appointed one person responsible for checking the dashboard at every kick-off meeting to ensure this. Next to that, this person should insert the results after the tender. One employee should be responsible for tracking the progress in the dashboard. Dividing responsibilities is important since shared responsibility often turns out to be no responsibility.

4.1 TAKE AWAY: IMPLEMENTATION

Having a good implementation plan is crucial for the adoption of a technological change in a company. Therefore we did a literature review to determine a good plan. We end up finding that the 8-steps model of change of Kotter is very suitable for implementing our dashboard. It has proven to work in scenarios where researchers tried to implement an IT project. Also, the 8-step model of change is built to tackle the biggest challenge that arises when dealing with technological change within an organization: resistance from employees. Step 1 to 5, which consist of creating a sense of urgency, form a powerful coalition, create a vision for change, communicate the vision and remove obstacles, are executed already and is reflected on in this chapter. For steps 6 to 8, which consist of: create short term wins, build on the change and anchor changes in corporate culture we wrote down a plan on how to achieve it. By following these plans Company X should be able to successfully implement the dashboard.

5 EVALUATION

In this chapter, we aim to find if the dashboard improves the situation and solved the problems the employees experienced. We do this with reviews of the employees and by evaluating if the objectives are met. Besides determining if the dashboard improved the situation we also validate the set of KPIs. The time for this research is limited, so the dashboard is not in use when evaluating the dashboard. Therefore we introduced the dashboard by a demonstration. To gather the opinions of the participants they are asked to fill in a survey after the demonstration. The survey aims to find out if the objectives of implementing the dashboard are met by asking the same questions as the first survey but this time the employees are asked to determine if the dashboard makes the situation better or worse. Next to that, we talked with several employees about the dashboard and wrote down a summary of these reviews.

5.1 REVIEW OF EMPLOYEES ABOUT THE DASHBOARD

During the review about the situation without the dashboard, several employees indicated that there was a strong need for a place where all the feedback can be stored. The feedback was stored everywhere and was difficult to find. This resulted in a bad overview of the feedback. Not having an overview resulted in difficulties when determining improvement points. Also, the lack of a common format for evaluation moments caused Company X to not get the right knowledge from the client. After the demonstration of the dashboard, we asked the employees about the dashboard and why they think it is valuable.

Employee 1: “It is wonderful how the dashboard provides us with an overview of our performance. Next to that, it is perfect that it is built into our already existing excel file, this way it does not take more time to document the feedback. The dashboard will greatly help us with identifying improvement points for our EMVI-plans. Good work.”

Employee 2: “The biggest advantage is that we now have an overview of our performance in the dashboard. When something goes down we can act on that. What is also really helpful is that we can now see a summary of all the plans we did for a client. Having all relevant information available in one excel file is really valuable”

Employee 3: “I think this dashboard will be a very useful tool for KWS. In the past, too little data was collected and then stored everywhere and therefore it could no longer be found. Hats off”

Employee 4: “The dashboard provides a good indication of performance on EMVI plans. This enables us to know which adjustments should be made for improvement. It is necessary to go into depth and the dashboard helps us with this.”

Employee 5: “The analysis on all the different EMVI criteria is really interesting. We did not look at it this way before and I can already see some trends in there. Knowing this allows us to work on the specific criteria and improve the EMVI score.”

The reviews of the employees are very positive and proof that the biggest problem they experienced, the feedback was stored everywhere and there is no overview, is solved. They are happy with the overview the dashboard provides. Another complaint was that there was no common format for evaluation moments. Creating this format is experienced as very positive because Company X can collect more data and measure the performance on the EMVI plans. In the beginning, the employees were a bit sceptical about measuring the performance of the EMVI plans because every plan is different. But it is delightful to see that they are most enthusiastic about the insight the dashboard provides into the performance. During the demonstration, the employees were positively surprised by what collecting and analysing this data can do for them. The employees are confident that they can make improvements to the EMVI plans with help of this dashboard. The result of the survey also backs up this statement because all employees think the dashboard improves the situation a lot. (Figure 5.1).

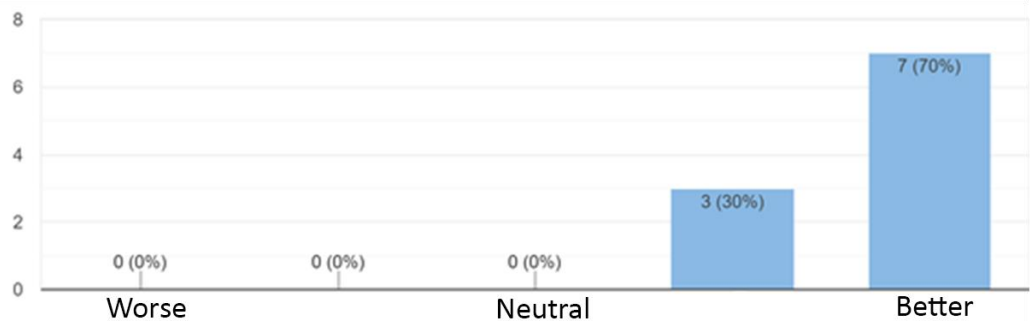

Figure 5.1 Results of question: "The dashboard makes the situation..."

5.2 EVALUATING THE OBJECTIVES OF THE DASHBOARD

At the beginning of this research 4 objectives were set up so we can measure if the dashboard improves the situation. The objectives of implementing the dashboard are: to structure the feedback by introducing a common format, reduce the number of files with feedback, analyze the feedback to derive improvement points for the EMVI plan, and extend the time the feedback is taken into account. In the next paragraph, each objective is elaborated on. First, we look back at the measure of the objective at the beginning and then we look at the results of the objective with the dashboard.

5.2.1 FORMAT OF THE FEEDBACK

Before we introduced the dashboard, the feedback retrieved at evaluation moments was saved in different formats: JPEG, mail and PDF , which makes it hard to make comparisons. We put all relevant quantitative feedback into the dashboard but for the qualitative feedback it was a challenge because it is difficult to store textual feedback in the excel file. With the new format for external and internal evaluation moments, this problem is mostly solved because we introduced a set of KPIs and then measure them by asking questions during these evaluation moments. So the most important information asked during the evaluation moments are quantified and put in the dashboard. Therefore the textual files are not needed often anymore. The second point in which the format is of the feedback differs is that the evaluation moments did not have a common format to specifically measure the performance of the EMVI plans. This made it hard to determine improvement points because Company X did not gather structured information about the performance. During this research we researched the factors that positively influence the EMVI score. We used these factors later on to determine KPIs that measure the performance of the EMVI plans. The KPIs and how they are measured form the format for the evaluation moments. This objective went from not achieved to completely achieved by implementing the dashboard.

5.2.2 NUMBER OF FILES WITH FEEDBACK

The problem was that the feedback is in all different files. For each evaluation moment, there was a different file so when looking for improvement points or data the employees had to scan through several folders to find the right information. This made that 69.6% of the employees experience it as hard to find the right feedback and 43% thinks that it takes too long. The dashboard solved the problem of a lot of different files because as mentioned at the objective "format of the feedback" all information is now gathered in an excel file. So, the employees only have to look at the dashboard for the most important information. Even when an employee needs more background information on a certain type of work or criterium they can now look into the dashboard which tender can provide information and then click on the feedback files added in the sheet for more information. All in all these improvements should make it easier to find information. 89% percent of the employees do think this is easier with the dashboard (Figure 5.2). Also, most people (80%) agree that the

dashboard will shorten the time looking for feedback (Figure 5.3). Therefore we can conclude that this objective improved a lot with the dashboard.

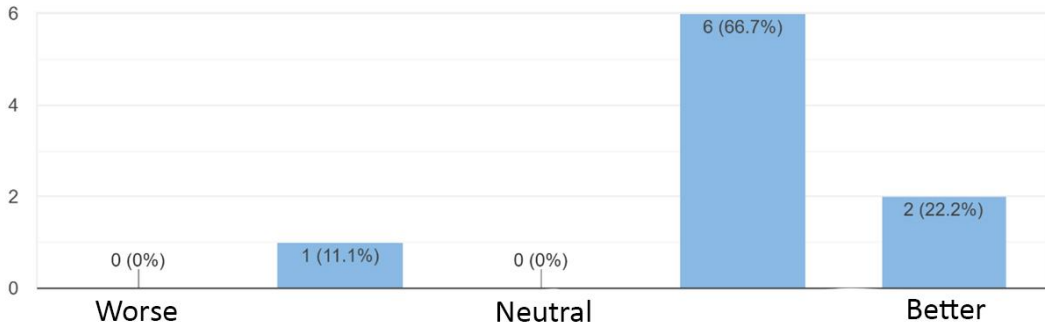

Figure 5.2 It is hard to find the right information. The dashboard makes it ....

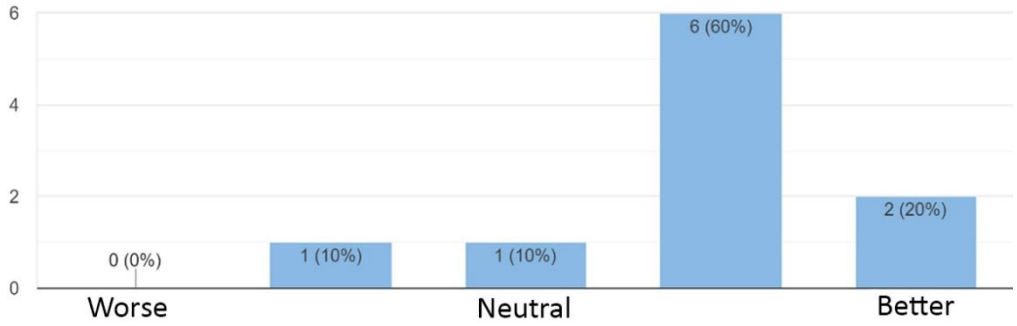

Figure 5.3 When looking for feedback it takes long to find the right information. The dashboard makes it...

5.2.3 ABILITY TO DERIVE IMPROVEMENT POINTS

The goal of Company X is to improve their EMVI score but to be able to do that they need to know where to improve. Deriving improvement points from several tenders was not hard according to the employees but because the other objectives indicated that there was no overview over the feedback we assume these improvement points were not made over several tenders. We think the employees did not know the possibilities and this influenced their scores. In Figure 5.4 it can be seen that 100% of the employees do think the dashboard makes determining improvement points over several tenders easier. It is nice to see that the dashboard positively surprised them. In the beginning, this objective was graded best so the employees thought determining improvement points was not that hard but after we have shown the dashboard and how it can monitor the performance they think the dashboard improved this objective the most. The dashboard helps to determine improvement points because we created a set of KPIs and made them measurable. Therefore, Company X is able to derive improvement points by looking at the KPIs. To check the validity of the dashboard we asked the employees to indicate whether they think the set of KPIs is giving good insight into the performance. In Figure 5.5 can be seen that 90% of the people agree with this statement. From the results, we can conclude that this objective makes the situation a lot better and that the KPIs that monitor the performance are valid.

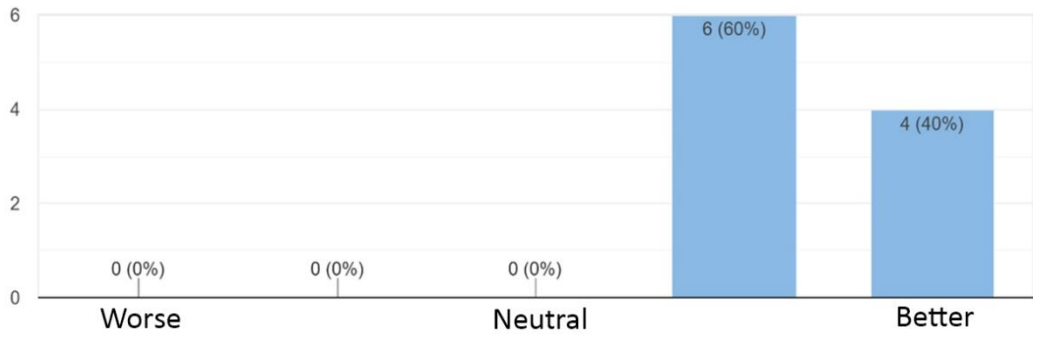

Figure 5.4 It is hard to determine improvement points when looking at several tenders. The dashboard makes it...

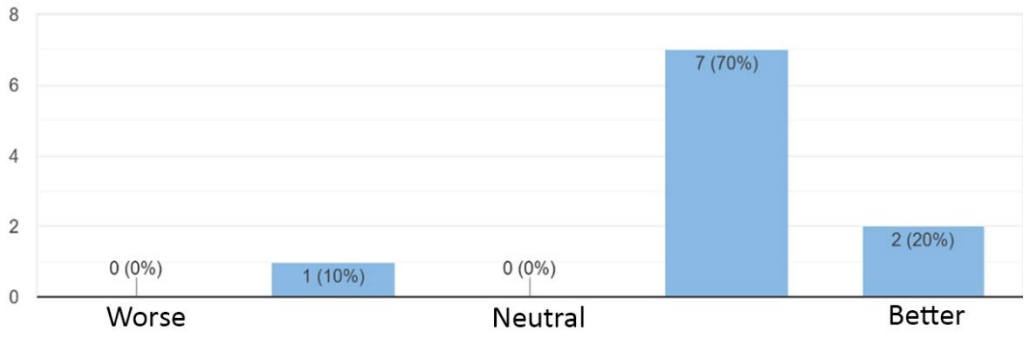

Figure 5.5 The set of KPIs gives good insight into the performance of the EMVI plans.

5.2.4 TIME THE FEEDBACK IS TAKEN INTO ACCOUNT

Currently, the employees look at the feedback after each tender but it is not analyzed over a longer period of time. This causes that they can not easily determine improvement points from the past. Since the dashboard aims to provide feedback by monitoring tenders from the last years, feedback is now taken into account as long as they want. 90% of the employees are of the opinion that the dashboard improves the situation of where even 50% totally agree.

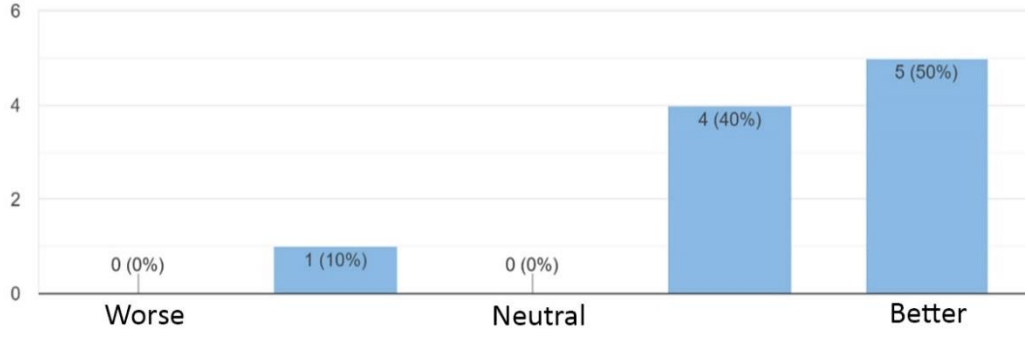

Figure 5.6 Too little attention is paid to feedback from the past. The dashboard makes it...

5.3 TAKE AWAY: EVALUATION

When looking at the results, we can say that the dashboard made the situation a lot better and helps Company X to start improving on their EMVI plans. During the reviews the employees let us know that the dashboard is really helpful and provides them with a great overview of the feedback. They value this overview a lot because it enables them to monitor the performance and find improvement points. When looking at the objectives the result is that the dashboard improves all objectives, with as a result that the daily tasks of the employees are easier. They can more easily find feedback, it takes a shorter amount of time, and they can analyze the past tenders. Altogether, the dashboard enables the employees to do their job better, easier and to keep improving over the coming years. A side note to this evaluation is that the dashboard is not used yet and therefore this evaluation can turn out more or less positive than when the dashboard is put into use.

6 CONCLUSION & RECOMMENDATIONS

This chapter concludes this research with first, a short recap of the problem, then in Section 6.1 the conclusion per sub-question and an answer to the research question. Next, the restrictions are discussed in Section 6.2. The scientific relevance is described in Section 6.3 and lastly in Section 6.4 the recommendations to Company X.

Company X is active in earth-, road-, and hydraulic engineering sector. In this sector, contractors get projects by winning tenders. The tenders from the government and provinces are won by having the most economical send-in. This means the quality of the EMVI plan and the price will determine which contractor gets the contract. The problem from Company X is that they are scoring less good on the EMVI plans and therefore win fewer tenders. The main question from Company X is: “How can we increase our EMVI score?”. Increasing the EMVI score is a very difficult process because tenders differ a lot and when grading the EMVI plan the client can be subjective. When talking to a lot of employees the conclusion was that the core problem standing in the way of increasing the EMVI score is that there is no common format for evaluating tenders. This makes it hard to execute analysis and derive improvement points. Developing a dashboard seems like a good solution because it can provide an overview of the performance of the EMVI plans. Also by creating a set of KPIs that measure the performance we provide Company X with a common format for their evaluation moments and with the database connected to the dashboard we provide them with a place to store all the data. The main question of this research is therefore:

‘How can a dashboard help to increase the EMVI score by presenting an overview of the feedback?”

To measure the improvements the dashboard brings, we set up five objectives: structure the feedback by introducing a common format, reduce the number of files with feedback, analyze the feedback to derive improvement points for the EMVI plan, and extend the time feedback is taken into account. Next to that, we have employee reviews about the situation with and without the dashboard.

6.1 CONCLUSION

At the end of this section, we answer the research question, but that could not be done without answering the sub-questions. Below the sub-questions and their conclusion can be read.

1. *How does Company X currently deal with feedback on EMVI plans?*

   A better insight into the current situation is required to understand how the feedback is formatted now. It also enables us to evaluate the dashboard by comparing the improved situation to the current situation. We obtained this knowledge by performing a descriptive study, where walk-in interviews gather information. Next to that, we gathered data by sending out a survey about the current situation. From these talks we found that there are three types of feedback in the current situation: the internal- and external evaluation and the Intention to Award letter. So, there is a lot of feedback available. However, when comparing the PDCA cycle for process improvement with the current process, it turns out that Company X does the plan, do, check but can improve acting on the feedback. When we asked the employees about the current situation they indicated that the feedback is all over the place and that they would benefit greatly from one place to store all the feedback, also they think the evaluation moments can be used more efficiently. We tested the objectives with a survey and the results show that in the current situation the objectives are not met.

- The feedback is in too many separate files. This causes that 69.2% of the employees experience that searching for feedback is hard and 43% experience that it takes long to find the right feedback. Also in the reviews from the employees, it turns out that there is no good overview of the feedback and that there is a need for a database with all the feedback in one place.
- Lack in format of the evaluation moments is a problem now, a new approach to monitor the performance is needed according to the reviews of employees. Also, a way to avoid the feedback being in several formats (PDF, JPEG, word) is needed.
- The feedback from the past is not taken into account enough according to 42.8% of the employees.

- Analysing the feedback to derive the improvement points is not necessarily hard according to the average response of the employees. We think the employees do not know the possibilities and that this influenced their response.

2. *How to design a dashboard that monitors the performance of EMVI plans?*

   The purpose of answering this research question is to find appropriate designs for displaying data, in our case feedback, in a dashboard. This knowledge question is explorative research where qualitative information is found by us through a Systematic Literature Review. The conclusion is that we need to create a one-screen view with graphs that visualize the set of KPIs that are customized to the user. How the developer visualizes the KPIs is crucial for the successfulness. Also, some design guidelines need to be considered. We considered and acted upon all this information to create a dashboard that communicates the correct information clearly and effectively.

3. *Which approach can be used to identify KPIs for a dashboard?*

   It is of great importance to identify the relevant KPIs when designing a dashboard. Therefore, we did a literature study to determine a suitable approach. After analyzing 12 papers and reviewing the different methods, the conclusion is that we first do a brainstorming meeting, then a literature review and lastly, four interviews to make a selection.

4. *What factors are related to a successful outcome of an EMVI plan?*

   This sub-question is important since knowing these factors means we can integrate them into the dashboard and then evaluate them. We answer the question by conducting descriptive research. First, we conduct a literature study to find factors that positively influence the EMVI score. Next, we compared the factors found in the literature with the brainstorming results. In the end, we could draw up a list of 11 factors that influence the EMVI score positively.

5. *Which KPIs should be selected to monitor the performance on EMVI plans, and how to measure and visualize those KPIs in the dashboard?*

   This sub-question is answered to determine the final list of factors, which KPIs are used to measure them and the needed data for measuring the KPIs. First, factors are selected by importance. Besides the factors found in sub-question 4, we added KPIs that do not relate to a successful outcome but that relate to the analysis of the grades given by the clients. This results in the following list of KPIs: experience of client with contractor, added value, SMART formulation, understanding of client's wishes, past project performance and tender process. We measures the factors by KPIs and the KPIs are measured with the help of the available feedback or by generating new information by asking questions during the internal- and external evaluation. The visualization and final dashboard can be found in Sub-section 3.3.

6. *How should the dashboard be implemented within Company X?*

   To ensure that the dashboard is used correctly, we conducted an exploratory research regarding the implementation of the dashboard. We did a literature study to retrieve information and we found that the 8-steps model of change from Kotter (1995) is a good framework for implementing the dashboard. Then we applied this model to Company X. This method fits well because it has proven to work for implementing IT projects, and it considers the resistance of employees, which is one of the biggest challenges in change management. All eight steps are walked through for a successful technological change.

7. *Did the dashboard meet the objectives and therefore improve the situation in Company X?*

   To evaluate the dashboard, we compare the old situation with the new situation. We did this with the help of the objectives and a survey. When looking at the results, we can say that the dashboard made the situation a lot better and helps Company X to start improving on their EMVI plans. During the reviews the employees let us know that the dashboard is really helpful and provides them with a great overview of the feedback. They value this overview a lot because it enables them to monitor the performance and find improvement points. When we look at the objectives the result is that the dashboard makes all objectives better, with as a result that the daily tasks of the employees are easier. The employees can more easily find feedback, it takes a shorter amount of time, and they can make analyses over the past tenders. Altogether, the dashboard enables the employees to do their job better, make daily tasks easier and to keep improving over the coming years. A side note to this evaluation is that the dashboard is not used yet and therefore this evaluation can turn out more or less positive than when the dashboard is put into use.

Now that all sub-questions are answered, we can answer the research question:

"How can a dashboard help to increase the EMVI score by presenting an overview of the feedback?"

In the section where we executed the evaluation of the dashboard it already became clear that the dashboard improves the situation on a lot of different points. The employees were very enthusiastic and the objectives were met or improved a lot. The biggest improvements are that the dashboard makes the daily tasks easier, provides an overview of the performance, creates a structure for the evaluation moments and lastly provides a place where all the feedback can be stored because the dashboard is connected to an excel sheet.

Make daily tasks easier

The implementation of the dashboard makes several daily tasks of the employees a lot easier. Firstly, the dashboard makes it easier to find the correct information. This statement is supported by 89% of the employees. When it gets easier to find the correct information it also takes less time to find information. 80% of the employees agree that the dashboard reduces the time it takes to find the right information. The dashboard enables users to easily search through feedback on plans from a particular client or search for the score on specific criteria. Having easy access to this information makes it easier to incorporate it in the EMVI plans, and therefore the EMVI score increases.

Automatically generated overview of performance

Before the implementation of the dashboard, Company X did not have an overview of their performance. When you do not have clear what factors positively influence the performance of the EMVI plans and also do not have a general overview of your performance you can not determine where you need to improve. The dashboard provides this overview by monitoring the KPIs that represent the factors that influence the EMVI score positively. The strength of using a dashboard for this is the visualization of all KPIs on one screen. This provides the user with the performance of the EMVI plan in one glance. By monitoring and visualizing the KPIs, improvement points can easily be derived to increase the EMVI score. 100% of the employees that filled in the survey say the dashboard helps them a lot by determining improvement points. Also from the reviews with the employees after the demonstration of the dashboard we can conclude that they are greatly satisfied with the overview the dashboard provides and the possibility to act on the feedback.

Provide a structure for evaluation moments

The dashboard provides the company with a standard format for the evaluation moments. Without the format the employees indicated that they felt a lot of potential was unused in the evaluation moments. The dashboard monitors KPIs and these KPIs needs to be measured; therefore, questions are set up to ask during internal and external evaluations. Creating this format is experienced as very positive because Company X can collect more data and measure the performance on the EMVI plans. This standard format helps Company X to focus on the right questions during the evaluation moments and to gather the relevant data. So this standard format allows Company X to analyse the feedback for improvement points.

Create a place to store all the feedback

During the employee reviews at the beginning of the research several employees indicated that there is a big need for a place where all the data can be stored. That is understandable because having all the data in one place is crucial for both the accessibility of the data and the possibility to make analyses and make improvement points. The dashboard provides the employees with a place because it runs on an excel sheet where all the data is stored. As mentioned earlier this makes the daily tasks of the employees easier but it also creates the opportunity to do something with the data from the past years. This enables the employees to track and analyse the progress. Analysing and visualizing data over a more extended time period is beneficial for improving the EMVI score. 90% percent of the employees say that the dashboard extends the time the feedback is taken into account a lot.

After phrasing how the dashboard helps Company X improve their EMVI score, we can conclude that solving the research question also helps Company X solve their initial question: “How can we improve our EMVI score?”. When Company X implements the dashboard and looks at the scores of the KPIs, they will find points to improve. For the available data, we made recommendations on where to start (Section 6.4). Also during the research we found that the approach we used to improve the EMVI tender is not used before and there this research can be very relevant for other companies. More on scientific relevance in Section 6.3

6.2 RESTRICTIONS

6.2.1 RELIABILITY & VALIDITY

In this section, we will discuss the reliability and validity of this research. Reliability refers to replication and consistency. If a researcher can replicate an earlier research design and achieve the same findings, then that research would be being reliable (Saunders et al., 2019). There are some threats to the reliability when doing interviews: participant error, and researcher bias and error (Saunders et al., 2019). Participant error occurs when the participants perform differently in the interview. This can occur when the interviews are, for example, held on Monday morning or Friday afternoon. Therefore, we will avoid this. Researcher error concerns any factor which alters the researcher’s interpretation. To minimize this threat to reliability, I need to make sure I’m well-rested and prepared for the interview well. Lastly, the researcher bias. Researcher bias is any factor that induces an incorrect response. For example, when questions are not asked objective. This will be minimized by setting up a detailed script. By taking all these threats and comments into account our research ends up being as reliable as possible.

Validity refers to the appropriateness of the measures used, the accuracy of the analysis of the results, and the findings' generalizability Saunders et al., 2019). We will assess our research on internal and external validity. First, internal validity refers to the extent that the findings are the answer to our research question (Heerkens & van Winden, 2021). In our research, the biggest threat to the internal validity is the determination of a set of KPIs and how to measure these KPIs. When those things are not accurate the relationships between the EMVI plans and the performance are inaccurate. To maximize the internal validity, these KPIs and measures are double-checked by doing both literature search, interviews and a survey. External validity is concerned with the question:

can a study's research findings be generalized to other relevant contexts (Heerkens & van Winden, 2021)? This research could be generalized to other companies in the same sector because the KPIs that are found are specific to EMVI plans from a road-, earth- and hydraulic engineering sector. As soon as you might change the type of projects the topics and grading might change resulting in inaccurate KPIs. When you want to apply this to another sector the KPIs need to be redefined, the framework of how we do it is still useful. Even though you can use the KPIs for the performance of an EMVI plan in the same sector it is wise to evaluate the KPIs with the company to see if they agree. In the end, a performance dashboard is almost always customized to the client (Few, 2006).

6.2.2 LIMITATIONS

A limitation in this research is that the feedback from clients is often not objective. The EMVI plans are sent in anonymously however, from the content can be derived who delivered what. This means the client grades the EMVI plan while taking into account who the contractor is. Some clients may want to do this as fair as possible however, it is known that clients grade the EMVI plans based on their relationship with the contractor. As a result, the outcomes of the tender might not be fair. Even though this problem is a limitation to the accuracy of this research, we will not take it into account when designing the dashboard for sake of simplicity. However, we should keep it in mind when looking at the results.

Another limitation is the time available for this research. Ideally, this bachelor thesis is finished in half a year so decisions are made on the depth of this research. An example is that the interviews with clients were cancelled because arranging a meeting took too long. Also the functionality of the dashboard could be improved with more time. In Section 6.4, recommendations are made for further research.

Lastly, a limitation is that the way tenders are assessed in the Netherlands is specific therefore, this dashboard and the factors found need to be reviewed when adopted in another country.

6.3 SCIENTIFIC RELEVANCE

The idea of using a dashboard to measure the performance in tenders is new. Not only for construction but also in other areas. In general, there is found no application of dashboards for measuring performance of tenders. This research is relevant because it provides a new insight to companies with a whole new strategy to deal with tenders. When companies want to try this new strategy, this research provides them with a guideline on creating and implementing their own dashboard.

When looking at the scientific relevance to the earth-, road- and hydraulic engineering sector we found that the literature provides a lot of knowledge from the client's point of view. The sources are about how the client can predict the performance by choosing the right criteria and about which framework the client should choose for assessment. However, if we are looking at peer-reviewed articles there cannot be found a lot of information from the contractor point of view. So, there might be a knowledge gap. This research tries to cover this knowledge gap by researching how to improve an EMVI tender from the contractors point of view. Also, in the literature a difference can be spotted in important factors in research worldwide or research devoted to the situation in the Netherlands. It was also interesting to see that there is close to no research on improving on the EMVI tenders, while this is a framework used for over eight years in the Netherlands. This research provides Dutch companies in this sector with important success factors when writing an EMVI plan.

6.4 RECOMMENDATIONS

After working on this project for half a year, I gained a lot of input and experience within Company X. Therefore, I also have recommendations on where to improve after this research. So, first we will discuss the research specific recommendations and afterwards the recommendations for the next steps.

Research recommendations

1. *Implement the dashboard as proposed in steps 6, 7 and 8 in Chapter 4, Implementation.*
   After the evaluation, we concluded that the dashboard did improve the situation. Therefore, the recommendation is to incorporate the organisation's dashboard as proposed in steps 6, 7, and 8 in Chapter 4, Implementation. This implementation strategy is based on literature and has therefore proven to work in the past. The dashboard should be checked at the start of every tender to see whether there is available information about the client or criteria. This way the understanding of the clients needs can be improved. Also, when deciding whether or not Company X should subscribe to a tender, the dashboard can be used to see if they scored well on a similar tender in the past.
2. *Keep evaluating the KPIs*
   Since KPIs are very project- and time-specific (Few, 2006), I recommend Company X to evaluate the KPIs over the years to keep the dashboard relevant. The best way to do this is by organizing another brainstorm to see whether the important factors are still the same or changed. Another recommendation is to conduct interviews with clients when evaluating the KPIs. Unfortunately, it was not possible now due to time restrictions but their input will be very valuable.
3. *Improve the functionality of the dashboard*
   Since this dashboard is built in a short period of time I recommend looking into expanding the functionalities. The first things to incorporate are, in my opinion: adding a year filter to the SMART, tender process and criteria measurements. Right now, there is not a lot of data yet, which makes it an unnecessary tool. However, in the future, you might want to exclude certain years.
4. *Improve the internal- and external evaluation*
   There is a format for the internal evaluation, but the employees do not grade this very high (Section 2.1.1). For the external evaluation, there is not a common format. This research already established some required questions for measuring the KPIs, and I recommend building further on this to gather more data and gain insight into the performance.
5. *Start with more research on EMVI criteria*
   Over time there will emerge improvement points from the dashboard. When looking at the current situation we recommend to start working on the different criteria. Together with the company a few criteria are selected for further research. The recommendation is to read the written feedback about these criteria and see if Company X can create a strategy accordingly.

Recommendations for further research within Company X

6. *Talk about a vision/mindset*
   From personal talks and group discussions it appears that not everyone has the same vision/mindset. This isn't necessarily a bad thing, however it seems to get into the way of improvements. One person thinks X is most important and wants to improve on that but the other person thinks that is not the problem, and therefore the improvement is not embraced by everyone. This can be due to a vague vision from Company X. During the brainstorm, the employees agreed that the absence of a vision negatively impacted their EMVI score. Therefore it is recommended to think about what mindset Company X requires from its employees and to think about their vision.
7. *Research about the reputation of Company X*
   One criterion that was deemed important is the reputation of Company X. That is however very complex to measure and therefore not included in the dashboard. It is a strength to know how clients see you

because you know what to disprove and emphasize. Therefore it might be interesting to hire an intern who can research this and write an approach to changing it.

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APPENDIX

A. RESULTS BRAINSTORMING MEETING

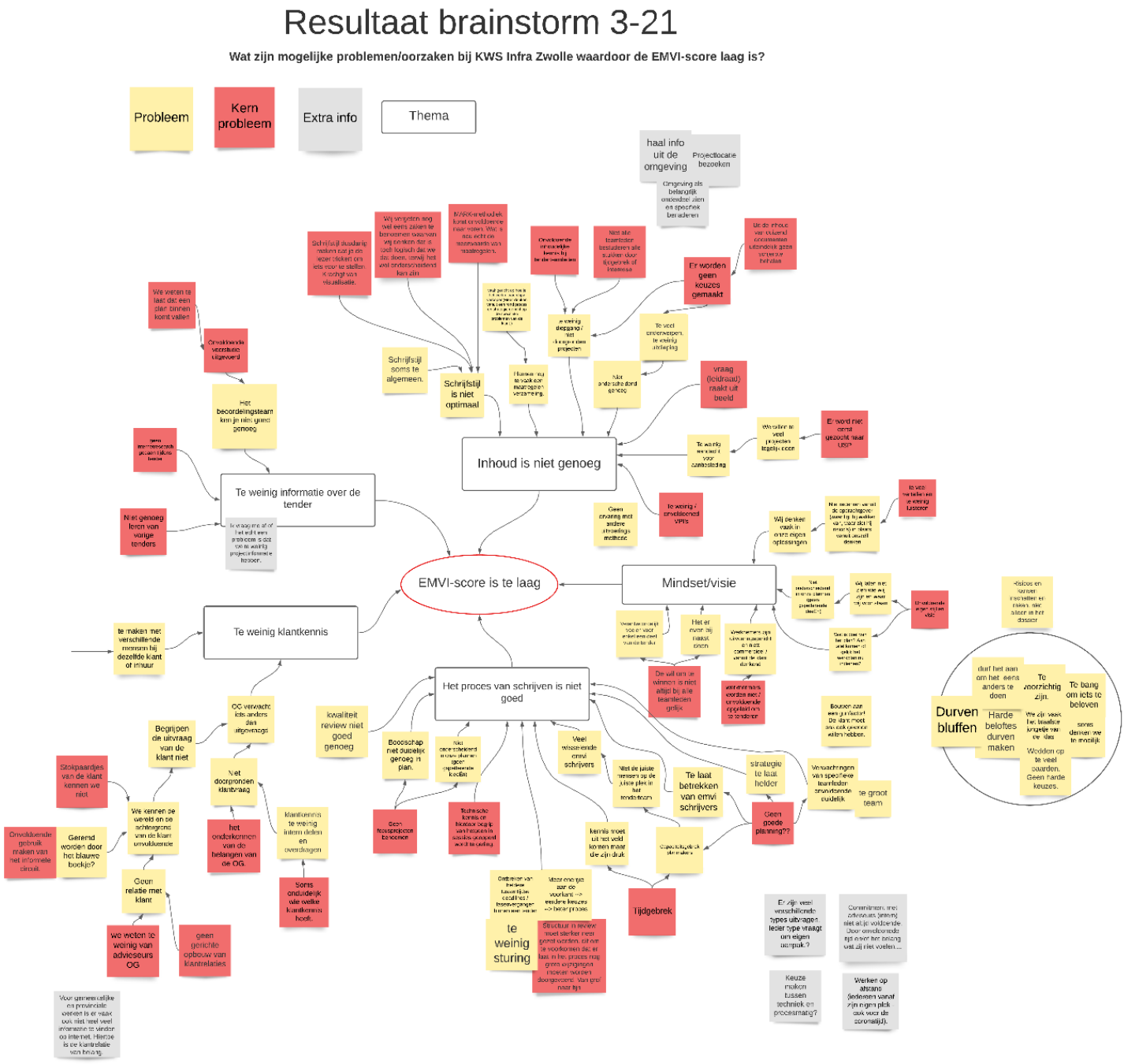

Figure A.1 Result brainstorming meeting

B. SYSTEMATIC LITERATURE REVIEW

INCLUSION/EXCLUSION CRITERIA

To improve the relevance of the search, inclusion and exclusion criteria are defined. First, the inclusion criteria determine the search terms that a study should have to be included in my review. The first one is 'Dashboard' because I want to design a dashboard. All articles that are not concerning a dashboard contain no relevant information for me. Another inclusion criterion is a term concerning 'design'. This does mean that 'design', one of its synonyms or alterations should be included. More details can be found in section 'search terms'. This is chosen to make sure we find papers on design instead of evaluation. Then the exclusion criteria. Before and during the search process there were not identified exclusion criteria.

USE OF DATABASES

When choosing a database 4 criteria are taken into account. First, the focus of the database should be suitable for our research question. For this research, multidisciplinary databases, focused on science or computer science are preferred. Second, we should be able to use a wide range of Boolean operators and search parameters. This is because we want to make use of inclusion criteria and the asterisk. Third, the type of materials available. We want a database that provides us with scientific materials so no websites or non-peer-reviewed journals. Lastly the size of the database. It is nice to have a database that has a lot of material because then the chance is higher that you find all the material that is helpful for you. The databases that match these criteria best are Scopus, who owns a lot of material with a multidisciplinary focus, and Web of Science, who is focused on technical sciences.

However, after trying the first few search queries (see Table B.2) we found that the content in these databases is very specific. This is interesting, but the research question is general and requires more educational sources like books. Therefore, there is decided to search the UT library dashboard for books that generate that overview. Therefore, in the end Scopus and the UT Library are used.

SEARCH STRATEGY

Before starting the search, search terms are determined by writing down synonyms and boarder terms for each key concept. These search terms can be found in Table B.1.

Table B.1 Search terms

Key concepts	Synonyms	Broader
Design	Lay-out, architecture, setup, arrangement, construct, framework	Develop, create, design*,
Dashboard	Control panel, indicator panel	Tool, Dashboard*,
KPI	Key Performance Indicator, KPIs, KPIs,	"Performance, indicator", measurement, "performance indicator",

The search strategy is to start with a search query that is quite specific and includes all key concepts and some of their synonyms or broader terms. In Table B.2 the search log can be found with a reflection on the search results.

Table B.2 Search log

Date	Search query	Database	Hits	Comments/relevance
29-3-21	(design* OR layout OR develop OR create) AND	Scopus	148	This search yielded a lot of articles with as main topic KPI selection. Since I want to know more

	(dashboard) AND (KPI OR KPIs OR KPIs OR "key performance indicator")			about how to design a dashboard for the next search KPI is left out.
29-3-21	(design* OR lay-out OR develop OR create) AND (dashboard)	Scopus	1315	In this search, it was a lot about developing/creating a dashboard in a case study. Since I need to know more about how to design a dashboard in general, I need more educational sources or systematic reviews.
30-3-21	(design* OR framework) AND (dashboard*) + filter: search in article title	Scopus	**229**	This search is quite relevant, still a lot of case studies. However, some of them describe the design process of the dashboard. I would still like to get a bit more educational material therefore there is decided to switch to search UT library instead of Web of Science
30-3-21	(design* OR framework) AND (dashboard*) + filter: books	UT library	**113**	The first page of results seems relevant

The result of the search is a total of 342 sources found in Scopus and the UT Library. In the end, all the results are processed, this can be found in Table B.3. When the final articles were selected, we scanned through the references. The references used in that paper are looked at because they could provide us with additional relevant information. Before a final selection is made we wrote up a conceptual matrix. This matrix visualizes which sources address which topics. Table B.4 shows us that we have at least 2 sources per topic. Therefore, we can conclude that the sources we found are enabling us to answer the research question. The topics are based on the information we already read while assessing the relevant papers. In Table B.5 an overview of the selected articles can be found.

Table B.3 Selection process

Total #of hits	**342**
Removing duplicates	-26
Selecting based on the title	-214
Selecting based on abstract	-74
Removed after complete reading	-24
Added after screening references	+1
Added for more depth on a topic (while writing)	+3
Total selected of review	**8**

Books	4
Articles	4

Table B.4 Concept matrix

Nr.	Paper\Concept	Background			Data selection and collection	Screen layout
		Definition	Types of dashboards	Components of dashboard		
1.	Eckerson, W., 2006	x	x	x	x	x
2.	Few, S., 2006	x	x	x		x
3.	Treude, C., Storey, M., 2010	x		x		x
4.	Cahyadi, A., Prananto, A., 2015	x		x	x	x
5.	Lempinen, H., 2012	x			x	
6.	Cuesta, H., 2013				x	
7.	Heerkens, H., 2021				x	
8.	Cooper, D., Schindler, P., 2003				x	

Table B.5 Final selection of articles

Nr.	Title	Author(s)	Topic
1.	Performance dashboards: measuring, monitoring, and managing your business	(Eckerson, 2010)	More info on each type of dashboard and designing of the layout
2.	Information dashboard design: the effective visual communication of data	(Few, 2006)	A lot of info about types of dashboards, mistakes, design
3.	Awareness 2.0: staying aware of projects, developers and tasks using dashboards and feeds	(Treude & Storey, 2010)	About viewlets, about the number of viewlets and use of dashboard: a case study

4.	Reflecting design thinking a case study of the process of designing dashboards	(Cahyadi & Prananto, 2015)	The process of designing a dashboard
5.	Constructing a Design Framework for Performance Dashboards	(Lempinen, 2012)	KPIs, data collection and preparation
6.	Practical Data Analysis	(Cuesta, 2013)	Data quality
7.	Solving Managerial Problems Systematically	(Heerkens & van Winden, 2021)	Making KPIs measurable
8.	Business research methods	(Cooper & Schindler, 2003)	Data preparation and quality

C. LIST OF MEDIA DISPLAYS

Table C.1 Types of Media Displays

Category	Display media	Comments
Graphs	Bullet graph	Display key measure in comparison to a target
	Bar graph	Great for displaying measures associated with a category
	Stacked bar graph	Use only when you have to display multiple instances of a whole, with a focus on the whole
	Combination bar and line graphs	Use when you want to combine data that fits best with a bar chart, and a line
	Line graphs	Use when you want to reveal patterns or trends in data
	Sparklines	Simple graph meant to provide a quick sense of historical context
	Box plots	Use when you want to convey a rich picture of data distribution
	Scatterplots	Shows if two paired sets of measures are correlated
	Tree maps	Use when you want to display large sets of hierarchically or categorically structured data
Icons	Alert	Use to draw attention to particular information on the dashboard
	Up/down	To indicate if measures go up or down
	On/off	Use to identify some items different from others
Text		Use to report a single measure without comparing it to anything
Images		Is unnecessary for most typical business uses
Drawing objects		Useful to connect pieces of information
Organizers	Tables	Arrange data into columns and rows
	Spatial maps	Useful when data is tied to a physical space
	Small multiples	Displays a single row or column of related graphs

D. SURVEY CURRENT SITUATION

Intro:

I would like to have your opinion on how KWS Infra Zwolle currently handles evaluations and feedback on the EMVI plans so that I can map out the current situation. The questions apply to the internal evaluation, the external evaluation with the customer and the letter with the assessment of the tender. If you don't have enough information to answer the question, you can skip it. I would also like to point out that you can withdraw from the research at any time and that the data cannot be traced back to you as a person. Thank you very much for filling in. For questions you can always call or email me.

To which extend do you agree with the following statements on a scale from 1=totally disagree 3=neutral 5=totally agree.

There is not looked back enough at feedback/evaluations from the past

When I'm searching for feedback it takes long to find it

When I'm searching for feedback it is hard to find the right information

I can easily draw conclusions from several tenders, to improve the EMVI plans

The feedback we get on EMVI plans is useful

There is room for improvement on how we deal with feedback

There is room for improvement on how we process the feedback

Which grade do you give the internal evaluation? *Scale:1-10*

Which grade do you give the external evaluation? *Scale:1-10*

Do you have any other remarks? *Textbox*