



# Minimizing deviations in projects regarding Infrastructure & Mobility at Witteveen+ Bos

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The Quality management system of Witteveen+Bos has been approved based on ISO 9001.

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## PREFACE

In front of you, you will find my thesis that concludes my bachelor's in the field of Industrial Engineering and Management at the University of Twente. For this research, I was fortunate to work at Witteveen+Bos to minimize deviations that occur in projects regarding infrastructure and mobility.

I would like to thank Eva Pieëte, my external supervisor at Witteveen+Bos, who was always willing to help me and provide feedback. Her insights, feedback and support were very helpful. Next to that, I would like to thank the employees of Witteveen+Bos. They were very welcoming and were always ready to help me and answer my questions.

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## ABSTRACT

This thesis is conducted at Witteveen+Bos under the group Project Control. They work on multidisciplinary projects where they collaborate with the client on matters regarding infrastructure. Here the project control group is responsible for the planning and structure of the project. They maintain and check whether the project is heading in the right direction. Currently, they are facing a problem where during the execution of a project, deviations occur that disrupt the progress of the project. These changes or adjustments in the project plan lead to delays, cost overruns and client dissatisfaction. Therefore, they asked what could be done to improve their current way of working and consequently minimize the emergence of deviations within their projects.

This resulted in the following research question: "How can deviations be minimized in the process of multidisciplinary projects regarding infrastructure and mobility in Witteveen+Bos?"

At first, the current situation of Witteveen+Bos was analyzed. Here the structure of the phases they go through during a project are mapped. This will show what they are currently using to streamline the project. Next, we measure the effect of the deviations currently on the project's time and money using case studies.

After that, the causes of the deviations were researched. For this, multiple qualitative data collection methods were applied. At first, a systematic literature review was conducted to find the most reoccurring causes in infrastructure projects. This result was used as input to set up the interview questions to determine what causes play a role within Witteveen+Bos. Next to that, a claim analysis was conducted where the VTWs from past projects were analyzed to see why it was required to be set up. This resulted in a list of root causes and their consequences, which are as follows:

- The process of delivering a product is unclear. It is often the case that more needs to be done than anticipated. This leads to an unclear plan of what activities need to be worked on, discussions with the client and decision-making will take longer, which is all unfavorable for the project.
- Scope changes or scope creeps might happen and go unnoticed until it becomes a bigger problem. Therefore, Witteveen+Bos loses the overview of the project.
- The internal communication within Witteveen+Bos is also a cause of deviations. Team members focus more on pleasing the client than on the project scope. Additionally, they do not mention problems until it is too late.

At last, solutions are presented, and an implementation plan is created to show how it can contribute to solving the problem. These solutions should help to resolve at least one of the causes determined in their current situation. This brings the following solutions:

1. Implement a process-oriented WBS next to the deliverable-oriented WBS during the project preparation.
2. Make use of a RACI matrix to improve internal communication.
3. Plot the progress of the project in a burn-up chart to detect scope changes sooner.
4. Document the success and failure factors to enhance continuous improvement.
5. Minimize people-pleasing behavior.

This should help to improve process mapping, create more clarity, detect scope changes sooner, lead to more transparency and increase internal communication, which contributes to fewer deviations within the projects of Witteveen+Bos.

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## LIST OF ABBREVIATIONS

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| Abbreviation | Meaning   |
|--------------|---|
| W+B          | Witteveen+Bos                                     |
| SDG          | Sustainable Development Goals                     |
| WBS          | Work Breakdown Structure                          |
| VTW          | Claim (Verzoek tot wijziging)                     |
| SLR          | Systematic Literature Review                      |
| PMP          | Project Management Plan                           |
| PMC          | Organizational Unit (Product-Market Combinations) |

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# 1

## INTRODUCTION

This chapter informs about the company Witteveen+Bos and the focus of this research. Sections 1.1 and 1.2 introduce the company. After that, Sections 1.3 and 1.4 describe the problem description and identification. In Section 1.5, the stakeholders will be identified. Furthermore, a more in-depth explanation is given about infrastructure project phases in Section 1.6. Then Section 1.7 explains the research questions and how they will be approached. At last, Sections 1.8 to 1.11 discuss the deliverables, scope, limitations and assessment of validity and reliability.

### 1.1 Introduction Witteveen+Bos

Witteveen+Bos (W+B) is a consulting and engineering firm that operates in 11 countries and yearly work on 4500 projects worldwide. In collaboration with clients such as energy and water companies, rail and harbor authorities, and governments they work on complex projects that focus on improving the living environment for society and helping to meet sustainable goals. Here, they mainly prioritize SDG 10 (reduced inequalities), SDG 13 (climate action), SDG 14 (life below water) and SDG 15 (life on land). Throughout the entire project chain, W+B has responsibilities that include establishing policies, designing, contracting, and supervising the execution of the project. Their projects are divided into four main categories: deltas, coasts, and rivers; infrastructure and mobility; energy, water, and environment; and build environment:

- Deltas, coasts, and rivers: As climate change is causing sea levels to rise, they work on innovative solutions at delta, coast, and river regions to protect the cities.
- Infrastructure and mobility: These projects are regarding roads, bridges, and tunnels. Here they help their clients to maintain and design infrastructure to increase accessibility and mobility.
- Energy, water, and environment: Since sustainability is an essential theme in the company, they work and advise clients to work towards a healthy ecological system and a circular economy.
- Build Environment: Cities are getting a higher population density, which means that cities need more resources to meet the needs of the residents. Hence, Witteveen+Bos helps transform cities to deal with these rapid changes.

### 1.2 Project Control

Based on the four main work fields, the company is divided into four different business lines. Every business line is divided into smaller organizational unit called PMCs. One of the PMC is Construction Management in the business line Infrastructure and Mobility. Another division of this PMC can be created called Project Control, where the research will take place. For an overview of the organizational structure, see Appendix I. Project Control focuses on seven main points: financial management, risk management, planning management, scope management, interface management, process management and information management. Hence, their main tasks are creating schedules, managing the scope, and maintaining an overview of the project.

### 1.3 Problem description

The department of Infrastructure and Mobility works on a wide range of projects. Examples of projects include creating a plan and providing advice to renovate a bridge or designing a new tunnel. These types of projects are often multidisciplinary, meaning that people from different disciplines and other areas of expertise are required. This has as downfall that a project quickly can become unclear if not properly managed as numerous deliverables are needed and they must work on it for a long time. Therefore, Witteveen+Bos has project managers and controllers to structure such projects better. Their responsibilities include defining and understanding the deliverables, creating a realistic time plan and making agreements with the client before the project officially starts. Mapping this out early in the project should ensure that the project will be successfully completed.

However, during the process of a project, deviations occur, indicating that things are not proceeding as expected. Witteveen+Bos makes a distinction between two types of deviations. The first deviation is minor and results in slight modifications to the project plan, which do not have consequences regarding time or money. The second deviation includes deviations from the contract, planning or process. The impact of these deviations is more severe and can potentially affect the originally agreed-upon time plan and money. These consequences will be elaborated in a claim (in Dutch: Verzoek tot Wijziging (VTW)). Besides the consequences for the planning and money, it also brings a lot of effort and discussions with the client, which causes a lot of disruption and unclarity within the project flow. Therefore, the main problem for Witteveen+Bos is the second form of deviation.

The impact of these deviations depends on how the client reimburses Witteveen+Bos. There are often two reimbursement options: *Regie* or *Lumpsum*. *Regie* entails that Witteveen+Bos is paid based on the number of working hours spent on the project, whereas *Lumpsum* involves a fixed price over the entire project. As Lumpsum projects, are required to be completed within the specified time frame, the number of deviations has a greater effect on these kinds of projects. Otherwise, a delay will lead to a decrease in the profit margin.

Therefore, this research focuses on minimizing the number of deviations during multidisciplinary Lumpsum projects of Witteveen+Bos within the group project control, which is part of the department of Infrastructure and Mobility. Solving this problem will positively affect the profit margin, minimize project delays, and increase stakeholders' satisfaction.

### 1.4 Problem Identification

Talking with the employees, we are able to confirm that there are unforeseen deviations from the original project plan regarding deliverables, planning and deadlines, which disrupt the projects. Therefore, the core problem of this research is that deviations occur during the project process.

A problem cluster is developed to show the effects of the main issue and how they are connected. This is shown in Figure 1. If a deviation occurs during the execution of the project, employees work on additional tasks that were not considered during the project preparation. Witteveen+Bos wants compensation for this additional work, which often translates into more time or money. For this, they will renegotiate and discuss the implications of the deviation with the client. Based on these discussions, it may be necessary to approve and rewrite the initial contract plan, which would take much time. This could lead to a lower profit margin, delays and dissatisfaction among the stakeholders.

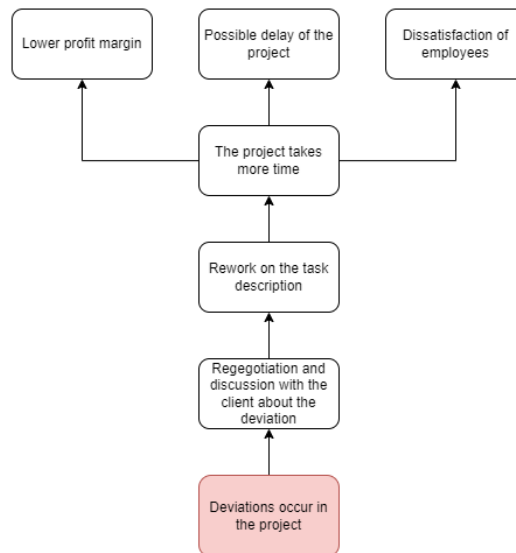


Figure 1 The Problem Cluster

## 1.5 Stakeholders

At the start of a multidisciplinary project, a project team is composed at Witteveen+Bos, where different functions are assigned. These teams often consist of a project director, project leader, sub-project leader, and project employees with different responsibilities. This is shown systematically in Figure 2. They collaborate to deliver and satisfy the requirements of the client's project. For this research, these are important stakeholders to consider.

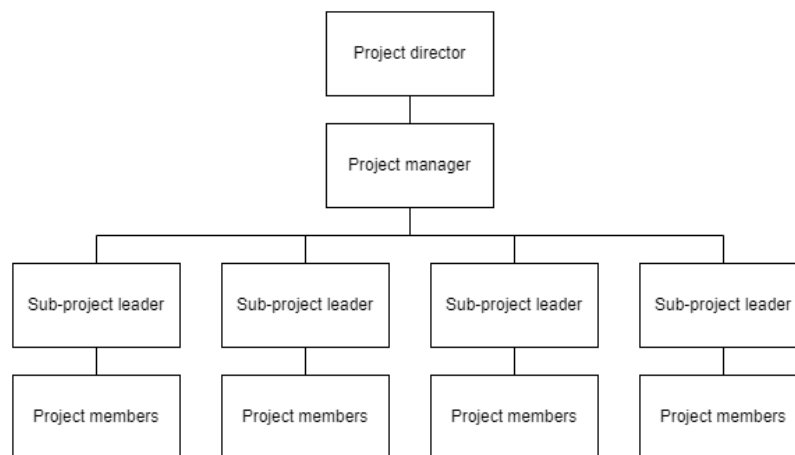


Figure 2 Team Structure

The project director is on top of the pyramid and is ultimately responsible for the project. The project's quality, organization, compliance, finances, time constraints, level of risk, and information requirements are all examined by the project director.

The project leader is responsible for ensuring that the tasks regarding quality, organization, finance, time, risks, and information are documented in the agreement with the client. This person shapes how the project should be executed and ensure that the project's quality is assured.

Each project requires a different number of sub-project directors. It depends on the scope of the project and the number of required disciplines. Each sub-project leader is responsible for the execution of the project products for a specific part of the project. They will then instruct their staff members on their tasks.

The employees will execute these tasks. To ensure the project goes successfully, they should notify it promptly if they anticipate encountering issues.

Furthermore, the client is also an important stakeholder. There should be a well-developed relationship with the client throughout the project. Witteveen+Bos must ensure that the final outcome meets the client's expectations and requirements. Therefore, it is important to keep the client involved in the project.

## 1.6 Theoretical Framework

Given the topic of the research, it is required to have sufficient knowledge about the infrastructure sector on how to approach a project. Therefore, we look at the steps that must be followed for Dutch infrastructure projects. Due to the significance of several of the phases for this research, they will be zoomed in on and explained in more detail.

### 1.6.1 Infrastructure Life Cycle

Because the research primarily focuses on large infrastructure projects, a thorough understanding of the full infrastructure life cycle is required, from early planning to project completion. Therefore, there will be explained how these types of projects are typically handled. Looking at major infrastructure corporations in the Netherlands, their projects can be divided into different phases (Rijkswaterstaat, 2022).

#### 1. Initiation phase

The initiation phase is set by the client that initiates a new infrastructure project. Starting an infrastructure project is a major investment that requires work over an extended period. Therefore, the client identifies the drawbacks and assesses whether the project will be beneficial and feasible to launch the project.

#### 2. Exploration phase

The problems that were identified at the initiation phase will be examined in further depth during the exploration phase by the client. Possible approaches to solve the problems will be considered. Furthermore, the client will determine whether to implement the project themselves or hire an external party.

#### 3. Development phase

If the client decides to outsource the job, they will send a request to potential organizations, such as Witteveen+Bos to assist them to work on the project. Consequently, Witteveen+Bos will begin to play a role during this phase. Looking from the perspective of W+B, the development phase can be subdivided into different phases. The first phase is the proposal phase, where they will decide whether they are interested in the project and wants to make an effort to win the project. If the project is awarded to them, the project preparation phase will start. Here, they discuss and determine what is needed to achieve the deliverables, as well as the resources and time required to complete each task. This will result in a detailed plan of approach as well as a time plan to help structure the project and increase efficiency during the project execution and the other subsequent phases. These phases will be elaborated in more detail in Sections 1.6.2, 1.6.3 and 1.6.4.

#### 4. Realization phase

During the realization phase, the design will be executed based on the plans that were made in the previous phase. The construction process can disrupt society and negatively affect the environment to fulfill the technical and functional requirements of the design. Therefore, in this phase, the construction approach should be considered that minimizes their inconvenience.

#### 5. Operation and maintenance phase

The infrastructure must be checked and maintained to ensure long service life. This will be carried out in the operation and maintenance phase. The design of the maintenance planning should minimize the number of

maintenance activities. Furthermore, it assesses how the final results performed in comparison to the initial strategy throughout this phase. This might help in enhancing project management for future plans.

As mentioned earlier, Witteveen+Bos is typically engaged during phase three, the development phase. This stage can be divided into three parts: the proposal phase, the preparation phase, and the execution phase, which will be described in more detail.

### 1.6.2 Proposal Phase

In the proposal phase, Witteveen+Bos competes with other engineering and consultant companies to win the project. Therefore, W+B must set up a project proposal which covers their interpretation of the project. It includes aspects such as the background of the project, the required expertise, the required resources, the description of the project deliverables, and possible expected risks and bottlenecks (Grit, 2019). Based on the quality of the project proposal, the project can be rewarded to Witteveen+Bos or not.

### 1.6.3 Preparation Phase

If Witteveen+Bos is granted the project, the first step is to map out the project in greater depth, as it may be ambiguous initially. Hence, the project outline is determined, which should sharpen the topics that need to be covered. This includes negotiations regarding the money distribution and the activities that need to happen. Everything will be documented in the project plan, resulting in more clarification and settlement of the project. Furthermore, the project content and organizational issues are addressed throughout the preparation phase. One of them is the team composition, which covers all the needed disciplines, as well as how the collaboration will be organized with the client. This could include regular working sessions and feedback rounds. Moreover, it is determined who has the authority to make decisions. These are frequently project managers at Witteveen+Bos. To ensure that all the important stakeholders are aware of the project procedure, a start-up meeting should be organized that covers the goals, project plan, activities, team agreements and competencies of the project team. The quality of this project plan is an important aspect of the project's success (Grit, 2019).

### 1.6.4 Execution Phase

Tasks will be completed if it is apparent what must be done. This could include in-depth research, collecting data, and creating prototypes to help steer the project's execution phase. To ensure that it is consistent with the agreed-upon deliverables, there are multiple occasions for the client or within the organization itself to provide feedback (Grit, 2019).

## 1.7 Research Approach

In order to solve the core problem, the research question is formulated as follows:

“How can deviations be minimized in the process of multidisciplinary projects regarding infrastructure and mobility in Witteveen+Bos?”

To address the research question, we have established the following sub-questions with their approach:

1. What is the current project management process in infrastructure and mobility projects?
  - a. How is the proposal phase currently designed in W+B's project process?
  - b. How is the preparation phase currently designed in W+B's project process?
  - c. How is the execution phase currently designed in W+B's project process?

Currently, W+B already has an approach for managing projects. This can be divided into phases, as previously stated. For this research, it is important to understand the development phase because it maps the project course and hence plays a role in whether it will be successfully completed. Therefore, to better understand their current way of operating and find the bottlenecks of the organization, these phases will be

mapped, which will consider the most important tasks as well as how they are linked to each other. This question will be addressed by conducting a descriptive study. According to Cooper & Schindler (2013), a descriptive study attempts to describe or define a subject. Therefore, this approach will help to describe the current situation at Witteveen+Bos. The primary data collection approach is through Witteveen+Bos's handbook, which guides projects. It explains how most of the projects should be structured and executed. Another way of collecting information is through communication with employees. They would go into greater detail regarding the structure of these projects and what every task entails. All this information will result in a BPMN model for each phase that will show more systematically how the process of a project flows and give us a better understanding of the current process.

2. What is the state of the deviations in infrastructure and mobility projects?
  - a. What is the effect of the deviations?
  - b. What is currently done against the deviations?

After it is clear how the project phases are organized, we can look at the occurrence of deviations within these processes. Deviations have an impact on time and money because they can increase the number of tasks that need to be executed and require more effort. This leads to delays and cost overruns. For RQ2a, the impact of these consequences will be measured to see how disruptive the deviations are to the progression of the projects. For each project, Witteveen+Bos stores information every time a deviation occurs, called claims. Hence, the extra number of expenditures required to execute the task will be summed up and the extra needed time will be stated to understand the effects of the deviations.

Next to that, Deviations are a reoccurring phenomenon, yet still an ongoing problem for many multidisciplinary projects. Therefore, it is anticipated that Witteveen+Bos considered measures to minimize the number of deviations. The methodologies used to optimize the project process are explained in the handbook of Witteveen+Bos. In RQ2b, these methods are analyzed in terms of how they are applied and utilized during the project process. This will help to understand what their current actions are against the deviations.

3. What are the causes of deviations in infrastructure & mobility projects?
  - a. According to the available literature, what are the possible causes of deviations?
  - b. Based on primary data available of the deviations, what are the possible causes?
  - c. Based on interviews, what do important stakeholders consider possible causes?

This research question will search for the causes of the occurrence of deviations. Here the research will be turned into explanatory research. An exploratory study tries to explain a particular event (D. R. Cooper & Schindler 2013). Currently, there is a vague understanding of what causes are of the problem. Hence an exploratory study will help to explore why these causes occur. This will show what needs to be tackled and solved. To find an answer to this question, three sub-research questions are formulated.

First, for RQ3a, literature research will be conducted to see the common causes of deviations in infrastructure projects. In databases such as Scopus, we search for academic journals that include key terms such as "causes", "deviations/ claims", "infrastructure projects", and "consultant". These will help to refine the search results to articles that cover common causes of deviations in infrastructure projects. The findings will be documented in a conceptual matrix that summarizes the primary causes of each source. These sources will draw a general conclusion, mentioning the causes that occurred the most. The outcome of this literature review will help structure and provide a foundation for the other data collection methods.

In addition, during a project, much data is acquired about the deviations. One form in which the data is collected is via claims. Claims are documents that are made when deviations occur that have consequences for either time or money. It states the context, reason, and consequences of the occurred deviation. Therefore, for RQ3b, the primary data sources will be analyzed as claims giving insight into which causes often reoccur in different projects. For this, a few representable projects will be collected where deviations affected the course of the project.

At last, for RQ3c, qualitative data will be collected through interviews. These will be held with relevant stakeholders, such as project leaders and project controllers. These interviews will follow a semi-structured interview procedure, which means that some questions are determined beforehand, but there are opportunities to dive deeper into the participant's answers. Here questions will be asked about their experience in a project, how they perceive a deviation and their opinions about why these deviations occur. This will provide qualitative data that give us a better understanding of the causes of the deviations.

Answering these will result in a list of causes that are most reoccurring and troublesome.

4. What are possible solutions to minimize the number of deviations in a project?
  - a. Based on interviews, what do important stakeholders assume would help to solve the problem?
  - b. According to the available literature, what are the possible methods to solve the problem?

Based on the causes of the problem, we can look for methods to solve them. Besides using the interviews to identify the possible causes of the deviations, they also can serve as a means to learn more about the stakeholders' requirements for improvement. This helps us focus our search query and gives us insight into the type of solutions we should seek. By using literature research, methods and theories will be searched that could help solve the causes and thus minimize the number of deviations in a project. Similar to the literature study approach for the causes, we will search in databases such as Scopus for concepts that could minimize the number of deviations. Examples of possible concepts are "lean", "agile" and "project management". After the possible methods are presented, we will consider which solution should be prioritized using an impact-effort matrix. It will show which solution will have the most effective outcomes compared to how much effort needs to be put in.

5. How can the solution be implemented?

At last, an implementation plan will be written. This will provide Witteveen+Bos with a guide for implementing the recommendations in their project workflow. We will outline the steps involved and what is required to reduce deviations in projects involving many disciplines.

## 1.8 Deliverables

The aim of this research is to minimize deviations in Infrastructure and Mobility projects at Witteveen+Bos. Therefore, the main deliverable of this research is to provide recommendations on how the effect of deviations can be minimized. To achieve this, it is important to identify the causes of deviations using qualitative data collection methods. This will ensure that the solutions are effective in suppressing the occurrence of deviations. In addition, the current project phases and processes are also mapped to understand the problem's context better. Their project management process is mapped and the effect of the deviation on the projects is measured. Furthermore, an implementation plan will be written that guides Witteveen+Bos on how the recommendations can be integrated into their current way of working.

## 1.9 Scope

Since the project only takes ten weeks, the scope of the research will be as follows. Witteveen+Bos focuses on four main categories: deltas, coasts and rivers, infrastructure and mobility, energy, water, and environment and build environment. Because the fulfillment of these projects can be diverse, we only focus on infrastructure and mobility-related projects in this research.

Also, Witteveen+Bos has facilities all over the world. Each country has different regulations and approaches to work on infrastructure projects resulting in different reasons for deviations. Therefore, this research only focuses on solving the problem in the Netherlands.

Next to that, Witteveen+Bos works on different projects that differ in scale. Since the problem has the most significant impact on multidisciplinary projects, the recommendations will focus on finding solutions within these projects.

At last, if we look at the Infrastructure Life Cycle in Section 1.6.1, Witteveen+Bos is mainly involved in the project in phase 3. However, in some projects, they also supervise the realization of the project. During the realization phase, deviations also occur, but these are different from the development phase. Therefore, we only focus on deviations related to project management in the development phase.

## 1.10 Limitations

There are some limitations to the research design. One of them has to do with generating solutions. The possible solutions will be based on information from previously conducted projects. Therefore, the assumption is made that future projects will behave similarly to previous projects. However, although the structure of each infrastructure and mobility project is similar, the projects are never identical. Thus, this could lead to solutions that are less effective in future projects due to this difference.

Furthermore, a lot of information about infrastructure and mobility is available from completed projects. However, there is chosen only to analyze a few of these projects that are representable due to the time constraints. This increases the risk of overlooking certain details or overgeneralization.

Next to that, since it is not possible in the given time plan to implement the solution, the result cannot be tested to see whether it provides the anticipated results.

## 1.11 Validity and Reliability

**Validity** refers to how well the research results represent what we want to measure (Cooper & Schindler 2013). To ensure the validity of the study, the data collected must align with what we are trying to achieve. Since a big part of the research solution should consider stakeholders' opinions, behaviour and experiences, interviews would be a more suitable data collection method as it brings more detailed and informative data. It is essential to conduct interviews with people who belong to the research population to acquire the right information that helps answer the research topic. Therefore, participants must work in the Infrastructure and Mobility department at Witteveen+Bos, have experience with deviations, have worked on multidisciplinary projects for three years or more and are acquainted with project management. Moreover, the questions asked must relate to the research questions. This should give us qualitative data that is consistent with the research and hence is valid.

Next to that, personal biases could unconsciously occur. This can appear in formulating the interview questions and interpreting the participants' responses, which influences the selection of solutions. In order to minimize this effect, a representative of the company should check and provide input on whether the statements are correct and represent reality.

Furthermore, different data collection methods are used to see whether the results are accurate. This, for example, occurred in the analysis of the causes, where we used interviews, primary data and literature. The acquired information will be compared and categorized into reoccurring themes, ensuring valid conclusions.

As the participants are expected to have similar experiences with deviations, it is common to encounter different opinions since everyone operates and manages a project differently. This creates inconsistencies within the answers, which needs to be considered as it affects the validity of the research. It is necessary to deal with the variations to reveal the interviewees' range of views. Often there are reasons behind their statements that can be traced from the experiences of the participant. Therefore, the possible reasons behind the variations can be explored to understand why there are differences. The different views can also enrich the research topic.



**Reliability** refers to whether the same results will be achieved when the research is conducted repeatedly (Cooper & Schindler 2013). Therefore, the research method will be thoroughly outlined to ensure that reliability is attained. Each step will describe and explain how we arrived at the results. This ensures that the research can be verified and reproduced by others.

Interviews will be held with different participants to collect qualitative data. Each interview will follow a standard procedure for asking the same questions. This should minimize the effect of random error and biases, ensuring reliable results.

## 1.12 Summary Chapter 1

Witteveen+Bos is an engineering and consultant company that works on a wide range of projects. As their projects are relatively large and multidisciplinary it is important to structure the projects well completed in within the budget and time frame. However, currently they are often faced with the problem that there occur quite some deviations during the execution of the project. Having consequences for time, money, and the client's satisfaction. Therefore, this research has set up the following research question: "How can deviations be minimized in the process of multidisciplinary projects regarding infrastructure and mobility in Witteveen+Bos?" The answer to this research question will be presented in actions and methods that Witteveen+Bos can apply.

# 2

## CURRENT PROJECT MANAGEMENT PROCESS

In Chapter 2, the research question “What is the current project management process in infrastructure and mobility projects?” will be answered. This was accomplished by reading their documents and asking employees, which aided in mapping the proposal phase (Section 2.2), preparation phase (Section 2.3), and implementation phase (Section 2.4) of Witteveen+Bos.

### 2.1 Project Process

The project management process can be divided into the following main phases:

- Proposal phase
- Project preparation
- Project execution and completion

The interpretation of these phases may vary from project to project. However, some components are similar, which will be discussed in the following sections.

### 2.2 Proposal phase

The beginning of the proposal phase is when a client submits a request for a project. When Witteveen+Bos is interested, they will begin writing an action plan. Here, Witteveen+Bos is trying to win the project and come to an agreement about the project activities and its budget. Thus, the action plan discusses the project, the expected products, the time plan, and cash flows. The client can then decide whether to reward the offer to Witteveen+Bos. In case it is rewarded, it still can occur that the offer must be changed in certain aspects. This process can be seen in Figure 3.

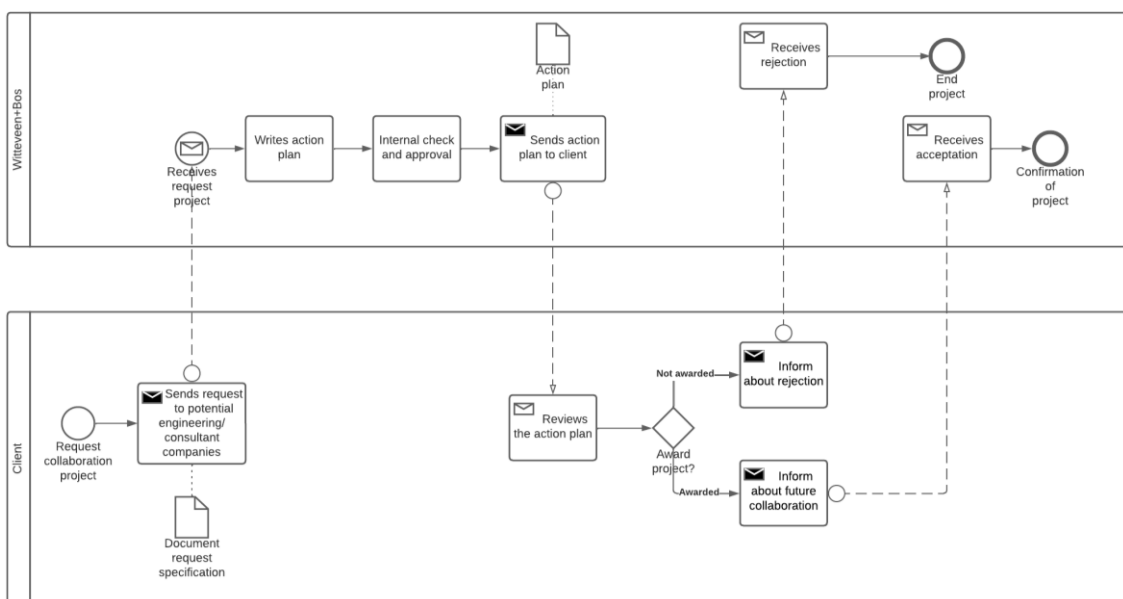


Figure 3 Process Model of the Proposal Phase

## 2.3 Project preparation

When the project is given to Witteveen+Bos, the project can be initiated. During the project preparation phase, all aspects, such as environment, management, and team, are considered. This often starts with composing the project team and a more in-depth discussion with the client about the project called the project start-up (PSU). Subsequent to this, a project management plan (PMP) will be created, where the work balance structure, work packages and time plan will be documented. This means that Witteveen+Bos will define how they plan to approach the project, the necessary steps that must be taken and the duration of each task. In addition, the potential opportunities, and risks that the project can pose and how they can manage them are examined. If the client approves the PMP, the project plan can be executed. This process is shown in Figure 4.

During this phase, it is important to be transparent with the customer regarding money, risks, organization, quality, information, time and safety. This could reduce the chance that discussions will arise about the project deliverables in the future.

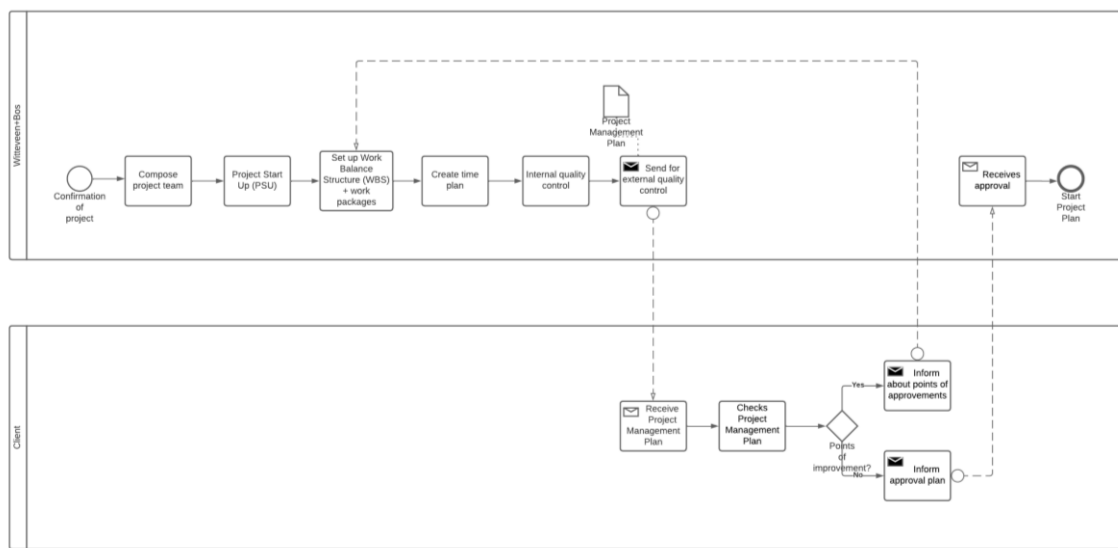


Figure 4 Process Model of the preparation phase

## 2.4 Project execution

In the project execution phase, the tasks are executed based on the time plan made during the project preparation. These tasks can widely differ from each other. However, regardless of the discipline or the context of the project objective, most of them are performed in the same manner. At first, data needed to perform the tasks must be collected. This may include reviewing project requirements, conducting preliminary research, obtaining permits, etc. After this, the execution will be prepared. Here, Witteveen+Bos will create a plan of approach and choose the needed people for the activity. When this is clear, the execution of the task can start. The result will receive internal as well as external quality control. The received feedback should be implemented in the final product, which will eventually be transferred to the client.

During this stage, progress reports are also written. A progress report lists every accomplishment completed over a given period as well as the tasks that are still in progress. These are often sent to the client every four weeks or a month. For these completed tasks Witteveen+Bos would like to be paid and therefore sends an invoice.

Furthermore, the progress report discusses the risks and deviations within the project. They indicate issues that could cause problems in the development of the project. Witteveen+Bos clarify what they are encountering as delay and how they will proceed. However, when the delay has negative consequences, such as missing critical deadlines or when additional work was required that was not included in the agreement, a claim (VTW) will be submitted. For this, representatives from Witteveen+Bos and the client will discuss the matter. Based on the outcome of the discussion, the claim will be written, including the reason,



# 3

## CURRENT STATE OF PROJECT DEVIATIONS

This chapter covers the effect of the deviation (Section 3.1) and their current project management approaches to see what they are currently doing to work efficiently (Section 3.2). This should answer the research question “What is the state of the deviations in infrastructure and mobility projects?”.

### 3.1 Effect deviations on projects

During the project preparation, the tender price and duration of the project will be determined. The tender price is the total sum of completing all project tasks outlined in the work packages. In contrast, the duration specifies the time frame in which the project must be completed, including the intermediate milestones. Witteveen+Bos strives to finish its work within these parameters. However, due to deviations, more time and money may be needed during the project execution, resulting in a smaller profit margin and project delays. In order to understand the impact of the emergence of deviations, a case study will be conducted. Three completed or ongoing projects will be examined, and the total sum of the claims will be compared to the tender price. These three were chosen because the deviations show major issues in these projects, making them representative and helpful for the research. This will help to understand why they occurred. Following that, the time a project has been delayed will be reviewed. Due to confidentiality, the names of the projects are excluded, and the prices are converted to percentages in this research.

The second project focused on redesigning an area and was expected to start in December 2021 and end in May 2022. However, this deadline was not met and was pushed back to May 2023, causing the project to be delayed for a year. This significant delay was not immediate but developed over time as some items required additional work. The deviations also caused the sum of the deviations to be nearly equal to the tender price, which doubled the price.

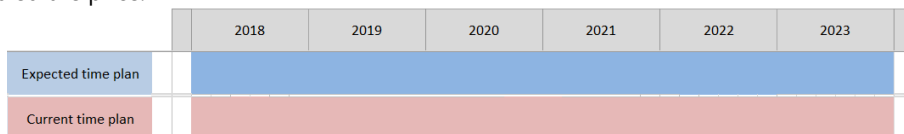


Figure 6 Delay in Project 1

The second project focuses on redesigning an area and is scheduled to begin in December 2021 and be completed in May 2022. However, this deadline was not met and was pushed back to May 2023, causing the project to be delayed for a year. This delay gradually altered over time as products needed to be worked on. The deviations also caused the sum of the deviations to be nearly equal to the tender price, which doubled the price.

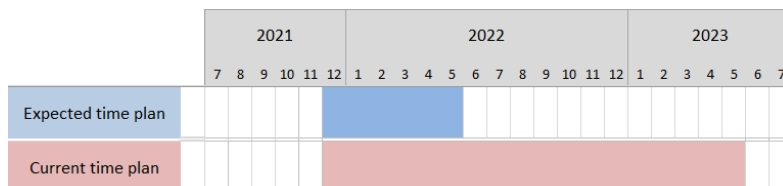


Figure 7 Delay in Project 2

The third and final project focuses on dike improvement. In order to reduce maintenance for at least the next ten years and to improve the safety of the sailing ships, it was requested that the sheet piles must be maintained. The project was originally scheduled to begin in July 2022. However, the launch was already

postponed until August 2022 due to several complications. Additionally, the project's original completion date of March 2023 was changed to November 2023, resulting in a delay of 9 months. Furthermore, the costs increased as extra work that was required but was not originally planned for the project was delivered. This sum of deviations was, in total, around a third of the tender price.

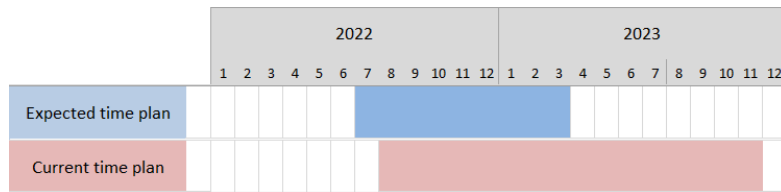


Figure 8 Delay in Project 3

## 3.2 Project Management Methods

Witteveen+Bos makes use of different project management methods that give guidance on how a project should be tackled. This could optimize the process flow of the project and hence minimize the impact of deviations on the project. In many cases, Witteveen+Bos does not adhere strictly to one methodology. Based on their preferences and experiences, they adopt some elements from the methodologies that work for the project. A few methods they apply are the following:

### 3.2.1 Systems Engineering

According to INCOSE (2015), "Systems Engineering (SE) is an interdisciplinary approach and means to enable the realization of successful systems. It considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs." The main principles of Systems Engineering:

- Systematic thinking: The entire project and the ultimate objective should be taken into consideration, involving the project's stakeholders during the whole process.
- Customer demand central: The project's development is dictated by the needs and demands that the project owner has laid out. These requirements are listed in a document that will be consulted when issues, confusion or chances present themselves.
- Optimization across the life cycle: There are different phases an infrastructure project undergoes, which include the initiation, planning, design, construction, and maintenance phase. System Engineering ensures that these phases are coherent with one another and are optimized.
- From abstract to concrete: The first version of the project's requirements is still conceptual. These specifications will be more detailed so that it is clearer what the intended outcome should look like.
- Explicitly working: There are often products that need to be verified and validated by different parties. Next to that, people can work from different locations. Therefore, it is necessary to make clear agreements about the collaboration.

The use of System Engineering at Witteveen+Bos can be seen in the project preparation phase when a project management plan is written. All the critical aspects of the project, such as the project's description, work packages, organization, and requirements, are compiled based on the customer's demands. Early in the project, this will give more clarity regarding the scope and the mutual expectations. Additionally, there are collaboration days where those participating in the project get together in one place to interact, collaborate, and give each other feedback on the ongoing activities to improve communication and produce products that are coherent. This is in line with the explicit working of SE and helps to detect problems earlier in the project.

### 3.2.2 Integral Project Management

Integral Project Management (IPM) divides the organization of the project into five main groups, each having its own role. Especially in large projects, IPM can be beneficial to make the best use of people's expertise. The groups include:

- The project manager is responsible for achieving the project's end result. Therefore, they manage the project appropriately and ensure the team cooperates.

- The project controller establishes the planning, budget, scope and risks. They are also in charge of managing reports, including progress reports.
- The environment manager focuses on the relationship with the local neighborhood and stakeholders during the project. They interact with key stakeholders to take them into consideration as the project develops.
- The technical manager oversees the technical aspects and content of the project. They manage the risks from a technical and organizational perspective.
- The contract manager is responsible for all the project contracts during the process for the different parties involved. They will provide the contract documents.

### 3.2.3 PMBOK

The Project Management Body of Knowledge (PMBOK) is a collection of techniques and methods to manage a project. They categorize it into the knowledge areas of integration, scope, time, cost, quality, personnel, communication, risk, and procurement. These should be addressed in order to complete a project. The areas are often discussed in the preparation phase during the set-up of the project management plan and the project start-up. Both ensure that there are explicit agreements made on how to communicate and behave with one another as well as that the practical aspects of the project are understood.

### 3.2.4 Scrum

Scrum is a method to work effectively and flexibly using smaller cycles. These short cycles should ensure that the value of the products is maximized in the end after all the iterations. This methodology is apparent when creating a design for the project. There are on average three design loops, where after each design loop the design is more refined due to the feedback that is provided after each iteration. Creating these design loops ensures that problems are detected earlier and that they will deliver the right product that meets the requirements.

## 3.3 Summary Chapter 3

In this chapter, we have looked at the effect of deviation on the time frame and tender price of a project. Three projects are analyzed that are completed or are almost finished. From these projects, we can conclude that deviations from the initial assessment have a major impact resulting in additional costs above the tender price. In two of the three projects, delays also occurred. Furthermore, we investigated what W+B is currently applying to structure the projects. There are various project management methodologies used, which include systems engineering, IPM, PMBOK and Scrum.

# 4

## ANALYSIS CAUSES DEVIATIONS

In this chapter, the causes of the deviations will be analyzed. This will be done via different methods starting with a literature review (Section 4.1). This will reveal which are common causes of deviations in projects, helping us to give more direction what needs to be paid attention to during the other data collection methods, a claim analysis (Section 4.2) and interviews (Section 4.3). After this, we will explain how the data collection approach complies with the grounded theory. This should answer the research question: "What are the causes of deviations in infrastructure & mobility projects?"

### 4.1 Literature Review

Many researchers have studied the causes of deviations in construction and infrastructure projects. Therefore, literature research will be conducted to identify potential causes that also could apply to Witteveen+Bos. The acquired information will be used as input to develop more insightful and detailed interview questions. The databases Scopus and Web of Science were used to discover various papers on this topic, which will be explored more below.

Hayati et al. (2019) identified the causes of claims during construction works. This was accomplished using questionnaires filled out by the owner, contractor, and consultant in construction projects. The main reasons for claims were changes in owner's requirements; changes in design from the owner; a project executed in a short period without proper planning on design, tender, and contract documents; inadequate scope definition, and specification and incomplete and uncoordinated design.

Gündüz et al. (2013) identified 83 delay factors that were categorized into nine major groups. These were based on a literature review and interviews with people working in the construction industry. One category was "consultant," whose primary causes for delays were delays in inspections and testing, and poor communication between parties. Other causes included design changes, design errors and lack of experience.

Odeh & Battaineh (2002) researched the causes of delays via questionnaires sent to contractors and consultants that work on large projects in Jordan. The delay factors of clients were that they interfered with and changed the project, made slow decisions, and had an unrealistic time plan. Consultants showed delays in the approval of designs, controls, and inspections. Other delays that were mentioned are contract changes, ambiguity in the interpretations of contract documents and lack of communication between the different parties.

Using a questionnaire survey, Prasad et al. (2018) examined the reasons for delays in India's project sectors of transportation, power, buildings, and water. For transportation projects, the primary causes included claims decision delays, inadequate construction sites, delays in payment for overwork, financial implications, and scope variation.

Based on a literature review, interviews and case studies, Abd El-Razek et al. (2017) found three leading causes for claims in Egyptian construction. These are variations from the original plan, inadequate design/drawings/ specifications, and delays in the approval of documents.



Matseke & Khatleli (2021) identified the causes of mega-construction projects in South Africa using a literature review study. The results revealed an inadequate time plan, unclear project specifications and schedule delays.

In the research of Lo et al. (2006), the causes of delays in civil engineering projects in Hong Kong are researched using a literature review and surveys. Here, they acknowledge the following causes: unclear scope, inadequate management and supervision, environmental problems and changes made by the client.

Shahsavand et al. (2018) distinguished 78 factors through a questionnaire for clients, consultants, and contractors in the Iranian construction industry. The main five causes were changes made by the client, shortage in time, shortage in costs, delay in managing the site and inadequate definition of deliverables.

Based on the various studies conducted in the literature, we inferred that several factors cause deviations within a project, resulting in delays or cost overruns. Nevertheless, the following were the most common causes mentioned in the papers. At first, clients adjusted the projects, requesting something different than what was originally envisioned. Even though the changes could be little, as the project is in progress, it could have a negative impact on the other project activities or require rework of what was already established interrupting the project. Moreover, delays in the approval of documents also played a factor. Documents are frequently subjected to several quality tests, either internally or by the client. When it is not stated adequately when documents are expected to be delivered, this also causes interruptions. Another cause of deviations is adopting an unrealistic time plan resulting in the inability to complete work on time, guaranteeing delays. At last, scope variations impact the deviations within projects. For example, the project scope is enlarged, which means that more tasks must be completed within the same time frame, putting the project at risk.

## 4.2 Claims Analysis

At Witteveen+Bos, deviations happen in every project, having an impact on both schedule and budget. These are described in VTWs, which explain the reason of the deviation and the impact on time and money. Because the claims contain the reasons for deviations, they are examined to see if reoccurring causes can be identified. In Section 4.2.1 the method to find the causes will be explained and the results will be presented in Section 4.2.2.

### 4.2.1 Method

For the claim analysis, the VTWs made by the three projects outlined in Chapter 3.1 will be investigated in this section. We scheduled a meeting with a project representative to review the list of VTWs and brainstorm about the deviations and their potential causes. This was done face-to-face and took about an hour to 1.5 hours. Using the data gathered from these sessions and the VTW document itself, each VTW was divided into topics, descriptions, consequences, and potential causes of the deviation. The impact of each VTW was also included. However, due to confidentiality reasons, the price is expressed as a percentage of the total sum of the tender price. It should be noted that not all VTWs from each project were included in this research, as some contained too little information to draw conclusions.

### 4.2.2 Results

#### Similarities in the project VTWs

Looking at the VTWs of each project, there was a difference in context as each project's products and needs are unique. This resulted in VTWs that discuss various topics, such as one project requires more hydrology research, while another does not request this. However, there were found similar underlying causes of the claims.

One of the reasons was the unanticipated need for additional meetings with the client. This could be for a variety of reasons, such as additional guidance, more work sessions, or an urgent concern. These meetings

would help in improving the collaboration with the client and in making decisions. However, since these meetings were not scheduled in advance and yet still require time to conduct, a request for a VTW is submitted.

Furthermore, additional duties, activities, or research were frequently required to deliver a product. One of the reasons was that as time progressed, more information became available, making it more apparent what exactly needed to be done. Some extra activities, on the other hand, appeared only when executing the work. As a result, critical aspects to deliver the desired product may have been overlooked. In such cases, W+B must adapt their work and adjust the project plan accordingly, which can lead to additional costs and delays.

Another cause for the emergence of VTWs is that products were not defined and thus fell beyond the scope of the project. Extra deliverables were requested as outputs for the work packages, while this was not specified. However, they were nonetheless needed for the project's success. This led that W+B must work on extra deliverables pressuring the time plan of the project.

#### Differences in the project's VTWs

However, there were also some differences between the projects where one category was only apparent in one project. For example, for Project 1, there was a lack of capacity in terms of the number of employees, which had a substantial financial impact. The client made a wrong assessment, which resulted that more employees from W+B were acquired than earlier anticipated.

Moreover, several VTWs were created for Project 2 due to inaccurate input data. As preliminary research for the project, the client had already hired a technical manager who created designs and computations that Witteveen+Bos used as input data. However, after some time, they discovered that the data provided was inaccurate and contained numerous errors. As a result, the requirement to check the legitimacy of the input data accounted for half of the additional work, leading to much additional research, re-work, and meetings.

### 4.3 Interviews

Interviews with Witteveen+Bos employees were done in addition to a claim analysis to learn more about their perspectives on deviations. In Section 4.3.1, we explain how participants for the interviews were selected. After that, in Section 4.3.2, we describe the interviewing process. The interview results are finally provided in Section 4.3.3.

#### 4.3.1 Participants

The last research collection method applied is conducting interviews. In order to collect the right participants to interview, purposive sampling has been used. Purposive sampling entails that participants are selected that have expertise and experience regarding the research topic (Gill, 2020). As a result, criteria were established, narrowing it down to suitable candidates to interview. This results to the following criteria:

- The participant is active in the department of Infrastructure and Mobility.
- The participant must be acquainted with project management.
- The participant has at least three years of project management experience.
- The participant is knowledgeable regarding deviations in multidisciplinary projects.

In the end, seven participants were interviewed for the research, where all of them had a professional work background in project management. Their positions entail "project leader", "project controller" or "contract manager". They have shared their knowledge and experiences, which gave valuable information in determining the causes of the deviations.

### 4.3.2 Method

The interviews were conducted in a semi-structured format with open-ended questions. This method was chosen because semi-structured interviews allow one to ask questions regarding the topics that need to be addressed while also having the flexibility to ask follow-up questions on their responses to understand their views, opinions, and statements better (Barclay, 2018). Before the interviews, an interview protocol was designed in accordance with the practical recommendations of Jacob & Furgerson (2015), which helps in planning and structuring the interviews. Furthermore, to determine which topics and questions must be covered during the interview, the results are used from the literature review. We will analyze whether the causes mentioned in the literature also plays a role in the occurrence of deviations at W+B. The list of interview questions can be found in Appendix II.

During the interviews, participants will be given an introduction outlining the objective and goal of the research. Following that, the interview's structure will be described. After they have a better understanding of the research and interview, the participant is informed about how their privacy will be protected and for what purpose the data will be used. The interview can start once informed consent is acquired. The first questions are designed to get to know the participant better. This includes asking about their position, responsibilities, and the amount of work experience within Witteveen+Bos. After that, questions about process management are posed, including planning, work packages, and internal and external communication. Finally, more detailed questions about the occurrence, reasons, and solutions to the deviations were asked. The interview lasted 45 to 60 minutes and was conducted in person or via Teams.

If the interviewee consents, the interviews will be recorded and transcribed. Because the interviews were conducted in Dutch, the transcripts were also written in Dutch. However, the findings are reported in English. The key points of the interview transcriptions can be found in Appendix IV. However, three interviews were combined with the claims analysis because similar issues were covered, one of the only differences was that the answers from the claim analysis were more project specific. As these interviews contain confidential information, they were not transcribed. The interview answers will be evaluated and interpreted to identify recurring themes and the causes of the deviations. This helps to comprehend the problem from the employees' perspective and acquire more information about the deviations to discover what needs to be tackled and solved.

### 4.3.3 Grounded theory and Saturation

As the data collection of this research follows a qualitative research approach, the grounded theory is used. The grounded theory is a methodology to formulate methods that are based on acquired data. This data is often qualitative data obtained from interviews, case studies, etc. and it attempts to discover relationships between the data following the approach seen in Figure 9. (Glaser & Strauss, 1967; Strauss & Corbin, 1994)



Figure 9 Grounded Theory Approach (Qualtrics, 2022)

In this study, grounded theory was used to draw conclusions using qualitative data. This gives us a better idea of what causes solutions should be found. The grounded theory consists of multiple steps to reach a valid answer. As in this chapter, we address the sub-research question "What are the causes of deviations in infrastructure & mobility projects?", data is collected via SLR, claim studies and interviews. For the SLR this implies that the main findings will be summarized, for the claim studies the VTWs will be listed along with the explanations for the VTWs and for the interviews, a transcript will be made. It occurred, during the data analysis, that we found out that some information was not clear or that we forgot to ask. Therefore, the employees were again contacted after the meetings to get more clarification about the data or answers

provided. This could be the case for either the claim analysis or the interviews, which allowed us to get better data.

After the data collection, we broke down the data and assigned it a label of possible causes. This was done on an individual level, such as by participant or by each project. This is often referred to as open coding. After that, axial coding was conducted in which connections are made with codes that are related to each other and can be clustered together in the same category. The final type of coding is selective coding, which identifies and addresses the root causes when looking for solutions. This continued until saturation was reached (Delve & Limpaecher, 2021). According to Glaser & Straus (1967), saturation occurs when new data does not provide additional information to the research, which ensures that the right causes will be tackled. In other words, saturation is reached when no new categories are discovered, which was the case after 7 interviews in this research.

#### 4.3.4 Results

Analyzing the answers of the employees, various causes were mentioned. One of the main findings of the interviews regarding the causes of the deviations is the process to deliver a product of the project. A Work Breakdown Structure (WBS), which divides each work package into smaller deliverables, is used to determine the project's structure at the beginning. However, participants state that more work is often required to complete the deliverable than was anticipated. Although, it is an undeniable truth that such changes occur in the project, the additional activities could have a huge impact on the course of the project. It leads to negative consequences for the project in terms of time and money for which Witteveen+Bos would like to be compensated. However, the client is primarily concerned with the products and pays little attention to how Witteveen+Bos will accomplish this. Therefore, the discussions about the process will take longer and if it is a major issue on which not everyone agrees, the problem may reoccur. This causes the deviation to become an even bigger issue.

Another cause mentioned is concerning disagreements about the scope. As previously stated, Witteveen+Bos captures the deliverables and the scope with the help of the WBS and the PMP. This should ensure that the project's expectations are aligned and that both parties have the same expected outcome. However, it still occurs that during the project the scope changes or expands. For example, due to interpretation differences with the client of what is included, or team members unknowingly work on topics that are not within the scope.

This brings us to another cause. While external communication with the client is an important aspect of leading the project to a success, the internal communication between the team members within Witteveen+Bos is equally critical. Employees' people-pleasing tendency is a big issue that currently creates deviations in many projects. So, if the client asks a specific employee to do something extra to the product or design, they will try to incorporate it without thinking about whether it is in the scope or not because they want to please the client and are willing to help. This does not become apparent to the project manager, until after the task has been finished making negotiating with the client about the deviation more challenging. The employees do not always mention changes immediately, which is also a cause. Instead of reporting it, they will first put in the hours to complete the work and think of alternatives to keep up. When they bring it up later, the problem has usually become more prominent, which has a greater impact on the project's progress.

There were also a couple fewer common factors mentioned. One issue mentioned is that the customer provides comments or information later than expected, preventing Witteveen+Bos from working on their duties and, in the worst-case situation, causing the entire project to be delayed.

In addition, while the action points and decisions discussed in important meetings are documented, this does not always happen for smaller, more informal meetings. Consequently, if a decision was made in such meetings, disagreements about the plan occur if the statement is drawn back. Since it is not documented, it makes it more difficult to discuss and set up a claim. To ensure that everyone is aware of the decisions made during even small informal meetings regarding the project, the minutes should be sent through email.

Finally, in large projects, the members of the project team may change. As a result, knowledge is lost, and it takes time to work with a new person who must get acquainted to the new project. This contributes to the project's inefficiency. Although it is meant well for the employee itself, it is preferable to have as little change in the team as possible in order to maintain knowledge.

#### 4.4 Main Findings

We identified the causes of the deviations in the projects of Witteveen+Bos. This was accomplished through the use of data from SLR, case studies, and interviews. A summary of the major causes will be provided, as well as what the respondents believe must be considered for the solutions. For the overview of the causes, see Figure 10.

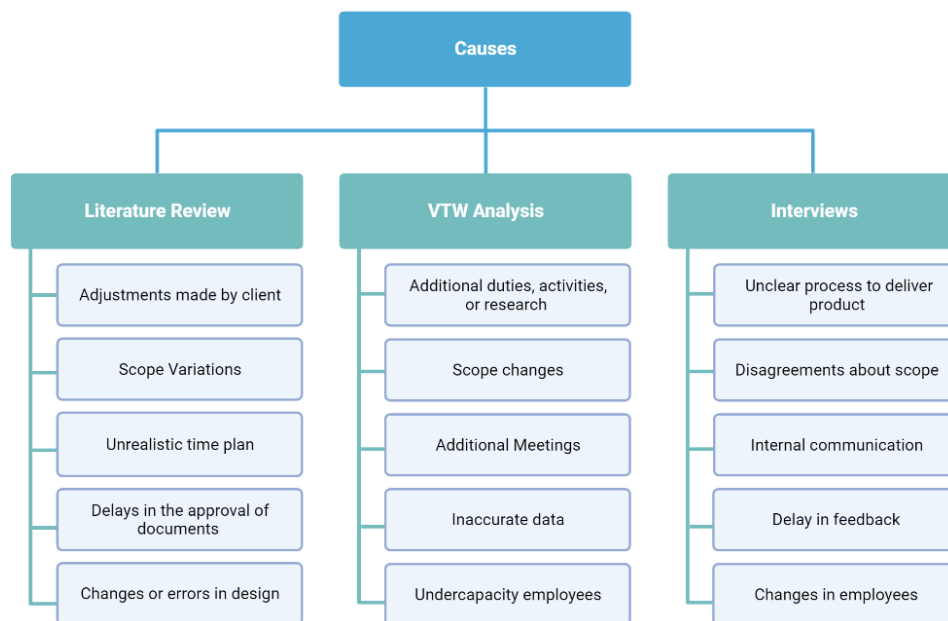


Figure 10 Overview Causes

#### Process

From the data collection, the respondents stated that the process to achieve a deliverable involved more than was stated in the project plan. These additional activities have several reasons. One of the reasons is that the activities were not specified well enough in the contract. Next to that, it occurs that they were overly optimistic in assuming that they would only need to do a set of activities. In addition, changes need to be made as a request from the client. This is also apparent from the case studies since there were VTWs composed regarding the process. For example, new data or information is available leading to further research, extra design loops, etc.

A recommendation that the respondents have given is mapping the process of the project more explicitly at the beginning of the project. The project outline created during the preparation phase is critical to the project's success. Most project and contract managers acknowledge this and believe that improved documentation of the process would be beneficial. As a result, Witteveen+Bos can arrange their activities better and the client knows what to expect. Also, if a deviation occurs, the discussion with the client will become easier and will assist in determining whether W+B is entitled to reimbursement as it is pre-determined what falls within the project. Thus, clarity about the activities of the project should increase.

#### Scope:

Another cause for deviations that are found in all the data collection methods is the changes that are made in the project's scope. These were not taken into account in the PMP, which means that they will not be paid

for the additional tasks. Although such changes are inevitable within a project, it does bring disruption within the project and hence need to be detected.

Therefore, scope changes should be detected quickly and monitored well so that everyone, especially the project manager, is aware of the situation and can act accordingly to prevent major problems in the future. These changes must be communicated to the project team to keep everyone up to date about the new scope ensuring they work on the right tasks. This needs to ensure that there is a better overview of the project and help detect scope changes earlier.

#### Internal Communication:

There are a few improvement points in internal communication that can reduce the impact of deviations. Currently, people at W+B have a strong tendency to work on extra tasks that are often asked on an individual level, which the project manager is not aware of. If the request was outside the scope, it could lead to major deviations. Next to that, if a deviation occurs, it will not always be mentioned immediately. It is only mentioned later in the project when the problem has become more prominent. This makes it difficult to find a simple solution and incorporate it into the current planning without delaying milestones.

As a result, personnel working on the projects should be encouraged to express their concerns. There should be more transparency and communication within a project, so problems can be addressed and solved promptly. This should help to complete the work effectively.

## 4.5 Summary Chapter 4

In this chapter, we were trying to find the causes to the deviations. At first a literature review was conducted to get familiar with common causes in the infrastructure sector that provided us information of which needs to be looked out for when analyzing the causes for Witteveen+Bos. This has been done with interviews and a claim analysis. After conducting 7 interviews and 3 projects, saturation was reached. From this, we can conclude that the main causes W+B is facing are an unclear process to deliver the products, unclear scope of the project, and lack of internal communication.

# 5

## SOLUTIONS AND IMPLEMENTATION PLAN

In this chapter, the solutions and implementation plan are introduced. Section 5.1 discusses how the solution will be found. The solutions will then be described in Section 5.2, along with how they work and how Witteveen+Bos can use them in their projects. These will be summarized in Section 5.3. At last, in Section 5.4, we determine which solution is best to implement at first with the use of an impact-effort matrix. This will answer the research questions “What are possible solutions to minimize the number of deviations in a project?” and “How can the solution be implemented?”

### 5.1 Evaluation Method

As noted in Section 4.4, there are a few causes to address in order to minimize the emergence of deviations. These causes need to be reflected in the solutions, which means:

- It needs to improve the process structure of the project.
- It increases the clarity of the scope of the project.
- It benefits the internal and external communication.

In order to find solutions to these causes, a literature search will be conducted. In databases such as Scopus, Web of Science, and Google Scholar, articles that provide approaches or methods to help limit the number of deviations in infrastructure/construction projects will be searched. Because there are numerous ways to solve the problem, not all of them are applicable in this study. As a result, the following are the inclusion criteria when looking for solutions:

- It should address at least one of the causes. In other words, it should make the process for the products more explicit, create a clear scope or improve the communication.
- The methods are applicable in the field of construction and infrastructure. There are techniques for various industries, like the software sector. If they emphasize and address comparable issues, they will be investigated to see if they are plausible in resolving our causes.
- There is evidence that the method is effective in multidisciplinary projects. This increases the probability that it benefits Witteveen+Bos.
- It should be suitable and applicable in the current process at Witteveen+Bos, meaning that there is no need to restructure their whole process.

### 5.2 Solutions and Implementation Plan

We will discuss potential solutions that reduce the deviations in Witteveen+Bos’s projects. Therefore, a description of the method or approach will be provided along with its core principles. Following that, we explain how the solution will address one of the causes of data collection and how it benefits the company. Finally, we will explain how the solution would be integrated into Witteveen+Bos’ current working environment.

#### 5.2.1 Process-oriented work breakdown structure

When it comes to project preparation, one of the first things that will be undertaken, is to construct a work breakdown structure (WBS). This entails that the project’s scope is divided into smaller parts, resulting in a

list of all the deliverables for the project. Thus, each work package that is assigned by the client is broken into smaller, more manageable outputs. As a result, a WBS provides a structure for what must be accomplished and delivered. According to the interviews, the respondents had a positive experience incorporating a WBS in the project. Setting this up at the start reduces the likelihood of something being overlooked.

During the interviews, several employees stated that establishing a clear and well-defined scope at the start of the project is crucial. The WBS creates better coordination between Witteveen+Bos and the client. In case there are any disagreements regarding additional products throughout the project execution, having a WBS would make discussions easier as everything is documented, and it can be reviewed whether it was requested or not. Thus, the project will run more smoothly when setting up the work breakdown structure. It also contributes to a better relationship with the client. As they know what to expect from the beginning, there will be more understanding of why, for example, extra funds were required to execute the additional product.

While the client's intended deliverables are clear, the process to deliver the deliverables is not always apparent. It frequently occurs that more work or rework needs to be done, which leads to deviations in the project. The participants stated that it would help if the procedure for achieving a deliverable would be more explicit. The most suitable time for arranging this is during the preparation phase. As it was mentioned that it helps to work out the deliverables into smaller parts, it is recommended that the process for the products also will be specified. A way to structure this is using a process-oriented WBS (also called verb-oriented WBS), which follows a similar approach as the deliverable-oriented WBS. By using this method, the smaller deliverables established in the deliverable-oriented WBS will be further subdivided into the specific action and activities needed to complete the product (Taylor, 2015). If the customer wants W+B to look into additional requirements for a deliverable, they can notify it sooner rather than later throughout the project's execution. This will result in fewer repairs in the future. Another benefit is that the design of the process-oriented WBS is similar to their current method of operating. Therefore, there is no need to learn anything new as the main principles are comparable to the current WBS, which the project managers found to be effective (Android, 2017).

Implementation Plan for the process-oriented WBS:

Witteveen+Bos is now using Excel to develop a deliverable-oriented work breakdown structure. Here it is categorized per work package requested by the client, each divided into smaller deliverables. Figure 11 shows an example of how the WBS is currently structured.

To elaborate more on the deliverables, a process-oriented WBS should be embedded in the deliverable-oriented WBS. It is advisable to keep the process- and deliverable-oriented WBS in the same document to maintain integrity. For projects with a few deliverables, another section can be introduced and added to the current WBS to clarify more of the activities that W+B must complete. This can be done as follows:



Figure 11 Example of Work Breakdown Structure

- 1. Name Work package 1
  - 1.1 Product
    - 1.1.1 Sub-product
      - 1.1.1.1 Activity 1
      - 1.1.1.2 Activity 2

However, in bigger projects that require more deliverables, using such a structure will be at the expense of the overview that the WBS should provide. Therefore, it is preferable to separate the process- and deliverable-oriented WBS onto separate sheets but keep them in the same document for easy retrieval. By



giving each activity and deliverable a unique number, it is still possible to link the activities and deliverables while maintaining integrity across the various WBS.

Just as it is arranged currently with the deliverable-oriented WBS, the client must also look at the process-oriented WBS to determine whether they approve the approach to achieve the product and whether there are any additional aspects they would like to include. This will ensure that the client agrees with the deliverables but also the process to provide the deliverables. As a result, the likelihood of things requiring to be repaired at the end of the project will be minimized. As everything is properly defined, there will be less of a problem if something changes, or the customer decides to add more throughout the project that was not originally included in the scope.

Although it is ideal to have all of the activities planned out before the project begins, it is not always possible to describe all of the project's activities that must be executed. This is especially the case for projects that are complex and last for a long time. As we look further into the future, it becomes less and less obvious what needs to be done. To deal with the uncertainty while maintaining the structure, the process-oriented WBS should be combined with Scrum. Scrum divides a project into sprints, which is a fixed time frame where certain elements of the project are worked on. The interval between each spring is based on the type and the size of the project. Larger projects frequently require longer intervals between sprints because there are not any new results or activities to be report. Before a sprint starts, Witteveen+Bos informs the client of how it will work and what its planned activities are. As a result, splitting the process-oriented WBS over numerous sprints will help structure larger projects better.

## 5.2.2 Responsibility assignment matrix

According to Fewings and Henjewe (2019), the WBS is frequently paired with a responsibility assignment matrix (RACI). RACI is an acronym for Responsible, Accountable, Consulted, and Informed, where each letter signifies a role that contributes to completing a task in the WBS. Hence, it deduces more explicitly the responsibilities and expectations of each team member. "R" are the people that execute the task, "A" are the people checking whether the task is correctly executed and meets the requirements of the deliverable, "C" provide subject-matter advice to help with the activity and "I" people need to be informed about the work so that they can communicate it to the rest of the team. Project managers often occupy the "I" roles.

The main purpose of the RACI matrix is that it will assist in clarifying the project in terms of what is expected of everyone involved in the project. This makes it clearer to team members what they need to work on and ensures that every task is assigned to someone, preventing anything from being missed. Having a well-developed RACI matrix will help to solve the cause regarding internal communication. RACI concentrates on improving communication to ensure effective information exchange. As the roles of the project are clearly divided, it makes it easier to reach the right people when an issue arises. Additionally, if changes occur, it takes less effort to find out whom to contact and update about the changed plans.

The RACI matrix will also make people feel more accountable for their assigned work. As a result, the team members are more driven to provide a high-quality product and understand that their efforts contribute to the success of the project. This will improve the project's workflow, and less rework will be required. (Good, 2023)

Another benefit of the RACI matrix is that it monitors the workload of the team members and helps to prevent them from experiencing a work overload. A few interview participants reported that member changes occasionally occur during projects. This is unfavorable because this means knowledge about the project would be lost. Keeping track of the tasks each team member is working on can help reduce the number of member changes. (Haworth, n.d.)

The RACI matrix will generally increase the clarity of the project, improve internal communication, and reduce team shifts, all of which should lead to fewer deviations during projects.

### Implementation Plan for the RACI Matrix

As internal communication was a cause of deviations in the project, a RACI matrix helps to strengthen the communication. The RACI matrix can be configured as shown below in Figure 12. In the rows, all the deliverables are listed from the work breakdown structure. This will be used as input to see what needs to be done for the project. Following that, the columns list the team members involved in the project as well as their areas of expertise. The RACI matrix can designate who is responsible for what for each deliverable. For smaller projects, it is possible to mention each individual team member in the RACI model. However, this would be less comprehensive for larger projects since a large number of people are participating. Therefore, such projects should develop a RACI matrix per discipline that takes part in the project. If the people involved in the project are clear, people will then be assigned to execute (R), check (A), help (C) or be informed (I) about the task.

**Example of RACI Matrix**

| Action Item | A | B | C | D |
|-------------|---|---|---|---|
| Work Item 1 | C | R | I | A |
| Work Item 2 | A | C | R | I |
| Work Item 3 | A | C | R | I |
| Work Item 4 | C | R | A | C |

Figure 12 Example of RACI Matrix (Abdollazadeh, 2021)

Although Witteveen+Bos implicitly divide the work, they do not structure and document it according to a RACI matrix. The division of tasks is often discussed verbally among themselves. However, the RACI matrix would be beneficial for Witteveen+Bos as it improves internal communication and the overall clarity of the project. The RACI matrix is not only useful for team members since it informs them of the tasks they must complete, it is also useful for project managers. In case changes occur in the project or information needs to be relayed about a specific task, they can check the RACI matrix and see whom they need to contact. Including an additional column to explain what is required of the client for a task, it might also help strengthen external communication. As a result, the communication will run more smoothly, and it can avoid confusion.

### 5.2.3 Burn-Up Chart

At the start of a project, a schedule is created based on how long they expect each task will take. This will be displayed in a Gantt chart, which is a bar chart that shows the project schedule. Efforts are made to follow the schedule. For this, a burn-up chart helps to visualize whether the project is still on schedule. This ascending line graph compares the project's achievements and progress to the actual schedule.

There are two lines in the graph where one shows the expected process and the other the actual progress. The advantage of creating a burn-up chart is that it allows you to monitor whether the task is being completed on time or if revisions are required. If development is slower than expected, the graph will illustrate this since the line of actual progress will slip under the line of the schedule. If there is a large gap between the lines, it is necessary to identify where the bottleneck is and try to resolve it. As a result, it provides a benchmark and shows whether the process is proceeding as expected.

The whole scope of the project is also included on the burn-up chart, which is mostly represented by a constant horizontal line. If something is added to the scope, the burn-up chart is adaptable and will depict it

since the line that measures the entire scope of the project will increase. This benefits Witteveen+Bos as it tracks the development of the scope over time. Currently, they do not have a tool that visualizes the scope in this manner, while it has useful properties. In large projects, the scope changes are not detected on time, which has an impact on the work that comes after the change. Therefore, developing a burn-up chart helps Witteveen+Bos to get a better overview of the scope over time and help detect scope creep sooner in the project. In other words, it regulates controlled and uncontrolled additions to the scope of the project. (Chappell, 2022)

#### Implementation Plan for the Burn-Up Chart

A burn-up chart is plotted as follows (see Figure 13). On the x-axis, a time unit or number of sprints is given and, on the y-axis, the number of products that need to be delivered. In this graph, there are often three lines. At first, there is a line that shows the total scope of the project, meaning showing all the products that need to be delivered. In principle, it is a horizontal line over the whole graph. However, if a scope change requires additional activities for the project, the line will increment. Next to that, a second line contains data on the project's planning. It sets out how many products need to be finished at a certain date based on what was planned. At last, there is a line showcasing the actual progress of the project. Plotting the lines will reveal whether they are behind schedule (see Figure 13). If the distance between the lines becomes too big, Witteveen+Bos should try to find out why this delay is caused and see how the schedule needs to be adjusted.

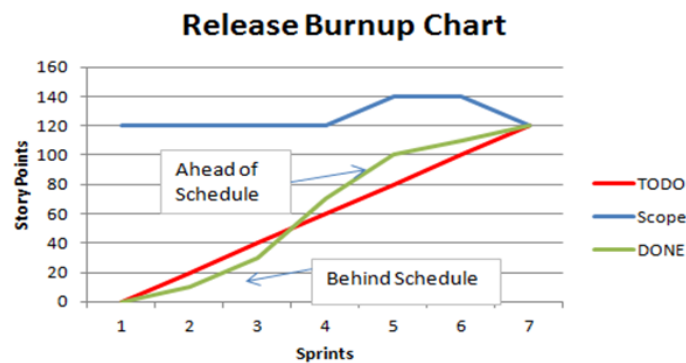


Figure 13 Example of a Burn-Up chart (Kulkarni, 2019)

The Burn Up Chart would work well with another chart Witteveen+Bos uses as it has similarities in approach. However, this graph looks at the spendings over time, while the burn-up chart looks at the finished products over time. If the spendings are still as expected, but the number of finished products is lower than expected, the budget has already been used to finish fewer products. This indicates that the project might go over budget if this continues. Therefore, combining these two graphs will help detect and signal deviations within the anticipated plan faster. Currently, the graph regarding the spending is already implemented in an application that monitors the project status. This is called "projecten monitor". As the graphs are similar and only requires the data regarding the planning, it should be possible to implement the burn-up chart in this application.

## 5.2.4 Lessons Learned

Agile is an upcoming project management methodology. It originates from the software industry, which is like the construction industry, often complex and variable. Agile places a strong emphasis on addressing these risks within these uncertain and complex projects. The main principles are divided into 12 parts that should help make the project process more efficient and effective. One of these 12 principles is continuous improvement. Continuous improvement is often referred as Kaizen. This entails that the projects should be evaluated to see where there is room for improvement (The Agile Manifesto, 2001).

Witteveen+Bos currently does not utilize or document information from previous projects to support cross-project learning. It has been done to a few projects in the past, but not actively and is not easily accessible to others. This is a loss for the company as much can be learned from past projects experiences and can

stimulate continuous learning. Documenting these past projects experiences in a lessons learned document helps to mitigate them in future projects. For example, common mistakes can be identified to ensure they will not be repeated again, or in counterpart, good approaches that were used in the project can be applied in future projects. Over time, it will create a list of insightful information and experiences from past projects that will optimize the project management process for Witteveen+Bos and enhance the effectiveness and efficiency of a project life cycle for future projects.

Another advantage is that other project managers will learn from each other. Every project manager has their own way to structure and approach a project. Therefore, the lessons learned help give insight into other project managers' methods that enlighten and empower other project managers in their way of working. (Miles, 2022)

Although setting up a lessons learned does not provide an immediate solution to one of the causes, it would still be a beneficial step to tackling the problem. It presents an overview of the best practices of project management and uses the knowledge to provides a better workflow, reducing the number of deviations occurring and hence reduce the likelihood of delays and cost overruns.

#### Implementation Plan for the lessons learned

As said before Witteveen+Bos had set up a lessons learned document that contained the following topics:

- Analysis of the deviations: They looked at the deviations that occurred in the project and divided them into categories.
- A timeline of the deviations: A timeline was sketched where the biggest deviations were placed in the phases of the project.
- Success factors and improvement points: The top 3 success factors and improvement points were mentioned based on the findings of the analysis of the project.

Although how it was documented brings much insightful information, it is very time-consuming to keep track of this after every project. This has as a consequence that project managers are not stimulated to compose the lessons learned after a project. According to Julian (2008), there are a few things that need to be considered to enhance continuous learning from past projects:

- Understanding and trust need to be established within the company. Every project manager has a different approach to addressing a project. That does not necessarily mean that certain methods are wrong. The lessons learned should be seen as a learning approach to show what best can be done under certain circumstances. This can be best shared in an environment where there is a mutual understanding of the importance of continuous learning and trust.
- The focus should be on both the successful projects as well as in the troubling projects. Often project managers focus on what must be improved to avoid the same mistake again. Although this is indeed important to consider, successes are also important to document. These methods can then also be applied to future projects.
- Establishing the lessons learned at the end of the project is not required. As some projects run for a long time, it will be more difficult to recall the problems or successes the project has encountered. Therefore, it is recommended to create, for example, a template that project managers occasionally fill out to highlights the key points of the project.

The template should lower the threshold and the effort for people to write their main learning points of a project. This can be presented, for example, in a table as shown in Figure 14. Once the project is over the template needs to be uploaded where it is easily accessible. Currently, the best place to store these documents is via Teams. Many documents are already shared in different Teams groups, making it easier to retrieve the information wherever and whenever possible.


| Lessons Learned Template   |  |  |  |  |
|--|--|--|--|--|
| Today's Date: 1/2/2023<br>Project Name: My Project<br>Project Manager: George Washington<br>Notes: (add any extra info here) |  |  |  |  |
|   |  |  |  |  |
| WIN or ISSUE   | Describe What Happened   | What Was the Impact?   | How Does This Change Future Projects?  | Action Items   |
| WIN  | time tracking system with the team to test whether or not productivity would improve                 | We saved 200 hours of time and delivered the work 2 weeks early                                      | We will roll out time tracking to all teams in the company                                     | 1. Purchase software licenses for all employees<br>2. Send email explaining why time tracking is necessary |
| ISSUE  | project was out sick for 2 weeks and there was no available replacement, so we had to wait for her   | The project was delayed 4 weeks and the client was upset. A \$25,000 credit was issued to the client | We need to have redundancy in the IT department to ensure there is always someone available    | Chat with CEO and HR about hiring additional IT help   |
| WIN  | The client was so happy with the final presentation that she offered us a 2 year exclusive contract! | This contract is going to double our revenue growth over the next 2 years                            | The new style of in-person client presentation should be used on more projects, when possible. | Share the new client presentation format with other teams  |

Figure 14 Lessons Learned Template (Project Manager, n.d.)

### 5.2.5 Minimize People-Pleasing Behavior

A problem mentioned in almost every interview is people-pleasing behavior. During the project, the client asks rather informally whether someone from Witteveen+Bos could add something extra to the product. Often the employee of Witteveen+Bos will be pleased to help the client and try to incorporate it into the project without wondering whether it is in the scope. If the project managers do not locate this quickly, unintentional extra work will be executed which will not be paid for.

Therefore, this people-pleasing behavior has a dangerous impact on the number of deviations occurring in a project, and although this is one of the main causes, there is no easy solution to this problem. This is because this behavior is embedded in how people in life operate. The answer to this problem could be found in research regarding psychology in the workplace. However, this is outside the scope of the research.

Nonetheless, there are a few practices that aid in minimizing this people-pleasing behavior, which will be discussed in the implementation plan. Decreasing the possibility of this behavior occurring has the benefit of fewer disruptions within the course of the project and minimizing scope changes. Also, less time is needed to have conversations with the client asking for compensation.

#### Implementation Plan for people-pleasing behavior

As said before, people-pleasing behavior is difficult to change as it relates to behavior of people. This is not simply changeable with a method regarding project management. However, some things can still be done to minimize people-pleasing behavior. One approach is to inform the employees during the project set-up. During this meeting, some time can be reserved to explain how they should deal when such a situation arises. For example, when additional activities are requested, instead of immediately confirming and accepting them, inquire the project managers first to confirm whether it is in the project's scope.

Next to that, highlight the importance of the project as a whole, rather than what the team member itself thinks is important. They should be made aware of what the consequence is on the course of the project, if they deviate from the project scope, which will increase their accountability and aid to minimize the scope changes.

### 5.3 Summary Solutions

In this chapter, several methods were mentioned that could help W+B to solve their problem. In Table 1, these solutions are summarized, which explains the method and its advantages.

| Nr | Method               | Description   | Advantages  |
|----|----------------------|---|---|
| 1  | Process-oriented WBS | At the start of the project, explain for each small deliverable established with the delivery-oriented WBS what the process and activities include. | <ul style="list-style-type: none"> <li>- Better overview of what needs to be done</li> <li>- More clarity about the activities</li> <li>- Increase effective working</li> </ul> |

|   |                                   |   |   |
|---|-----------------------------------|---|---|
|   |                                   |   | <ul style="list-style-type: none"> <li>- Create same expectations between W+B and the client.</li> </ul>  |
| 2 | Responsibility assignment matrix  | A matrix that will show what the responsibilities are for each team member.                                   | <ul style="list-style-type: none"> <li>- Better communication</li> <li>- More clarity</li> <li>- Reduce team shifts</li> </ul>                                    |
| 3 | Burn-up chart                     | A linear graph showing the progress against the schedule. This helps to keep track of the project's planning. | <ul style="list-style-type: none"> <li>- Detect scope creep and changes sooner</li> <li>- Visual representation of progress</li> <li>- Better overview</li> </ul> |
| 4 | Lessons Learned                   | A document mentioning what went well and what went wrong that can be used in future projects.                 | <ul style="list-style-type: none"> <li>- Avoid same mistakes twice</li> <li>- In the long term, will result in more effective working</li> </ul>                  |
| 5 | Minimize people pleasing behavior | Learn how team members should deal with people-pleasing behavior.   | <ul style="list-style-type: none"> <li>- Better communication</li> </ul>  |

Table 1 Summary Solutions

## 5.4 Impact-Effort Matrix

Although multiple solutions have been drawn, it does not mean that each method will be as effective and minimize the number of deviations occurring at a similar rate. There are two main factors which determine if the method could successfully be implemented at the company. One of them is the impact that the solution has. It answers the question of how well the solution can solve the deviations occurring in projects. On the other hand, there is also the amount of effort needed to implement the solution and make it work effectively. An impact-effort matrix is created to visualize how the components are set up against one another. An impact-effort matrix is a 2x2 matrix with on the x-axis the level of effort and on the y-axis the level of impact. As a result, the following four quadrants are formed:

- *Fill-Ins* refer to low effort and impact. These show the activities that take little effort and will give little in return. Hence, these are less likely to bring something meaningful.
- *Quick Wins* refer to low effort and high impact. When comparing the activities here to the effort required, they offer the highest return. These bring the most valuable and effective solutions for the company.
- *Major Projects* refer to high effort and impact. This means that the activity takes time to implement, but will provide effective results.
- *Thankless Tasks* refer to high effort and low impact. These activities are highly time-consuming and give little in return (Helmke, 2022; GroupMap, n.d).



Figure 15 Impact-Effort Matrix (productfolio, n.d.)

The impact-effort matrix can be filled up with the solutions provided in Section 5.2. As the research had a qualitative approach, it was difficult to determine the exact position of each solution. It was difficult to pinpoint, for example, how much one solution will effectively impact the problem in numerical data while the retrieved data is qualitative. Therefore, it is only possible to make an estimation of where the solutions will

be located in the matrix. An attempt was made to do this as objectively as possible, but the analysis could still have a margin of error.

For the level of impact, we determine the position based on how many causes the solution addresses. The more causes it covers, the more likely it will help to solve the problem. Also, the solutions were presented to the people working in the group "project control" for whom this research is being conducted. We asked what their opinions were on the solutions and brainstormed their feasibility. Based on this, the position of the solution was determined.

For the level of effort, we determine the position based on the number of hours it would take for the project to implement. One of them is the quantity of hours a worker must put in if it is used in projects. If the solution requires many working hours to establish, it will increase the level of effort in the impact-effort matrix. In addition, the time they spent learning how the solutions function also plays a role. It will be simpler to communicate the solution to the staff if, for instance, W+B already employs something comparable to the new solution.

How the solutions have been mapped in the impact-effort matrix can be seen in Figure 16. The solutions that are in the quadrant "Quick Wins" first needs to be tackled. Consequently, it is best to start by implementing the burn-up chart and the RACI matrix. These will bring the most impactful changes in comparison with the effort required. If more time is available, the solutions from the quadrant "major projects" can be established, which would be the process-oriented WBS.

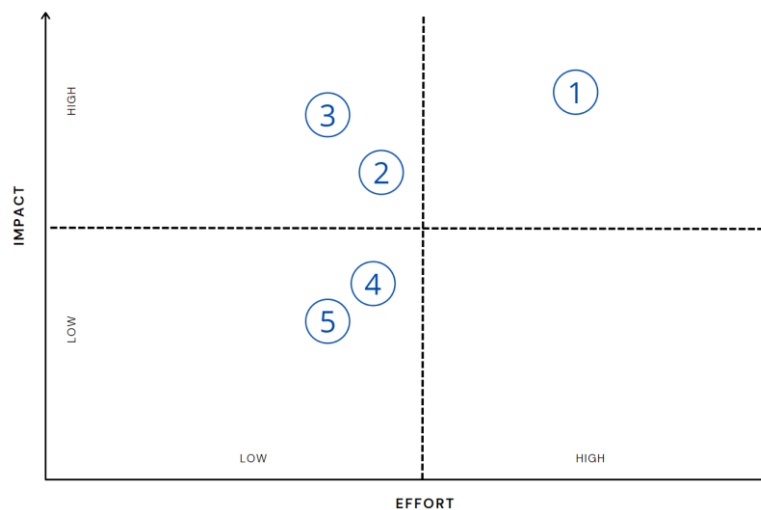


Figure 16 Impact-Effort Matrix for the solutions

## 5.5 Summary Chapter 5

Using a literature review, we found solutions for Witteveen+Bos that tackle the causes mentioned in Chapter 4 and hence minimize the deviations in multidisciplinary projects. A total of five solutions were presented: set up a process-oriented work breakdown structure, create a RACI Matrix, plot a burn-up chart, write lessons learned, and minimize people-pleasing behavior. How the solutions relate to the causes can be found in Figure 17.

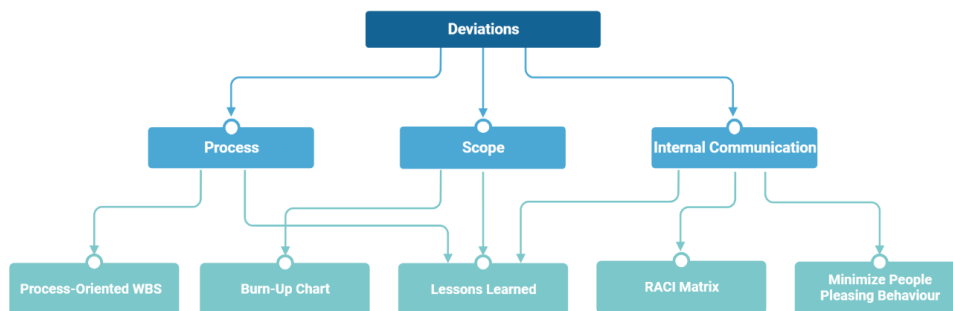


Figure 17 Relation Causes to Solutions

# 6

## DISCUSSION, CONCLUSION, LIMITATIONS

The last chapter summarizes the main findings of this research, and the research question will be answered. In Section 6.1, the discussion can be found where we address the validity, reliability and relevance of the results. After that, the limitations and recommendations for future research were given in Section 6.2. In the last section, the conclusion of the research has been written.

### 6.1 Discussion

In this Section, we will interpret the solutions presented in Chapter 5. We will defend why the solutions are valid and reliable in Section 6.1.1. Moreover, in Section 6.1.2, the relevancy of the findings will be discussed.

#### 6.1.1 Validity and Reliability

In this research, recommendations were given to Witteveen+Bos to reduce deviations in multidisciplinary projects by examining their causes. Various research methods have been used, such as a systematic literature review, interviews and claim analysis to assure validity and identify the right causes. For the interviews, this meant that employees were selected that have knowledge about deviations. For the VTWs, this entailed that representative projects were analysed where the deviations had a major impact on the project. Hence, it guarantees that the causes correspond to the real issue the organization is experiencing.

Also, using multiple data collection methods ensures that the results are reliable. If the same causes emerge from the different methods, it means that these causes are indeed the bottlenecks in the company. It reduces the possibility of having random errors. Next to that, we continued our research until saturation was reached, meaning no new categories were found. Hence, if the research would be conducted again the results are likely to be similar.

For the solutions, we investigated studies that applied methods in situations where deviations were attempted to be avoided. Therefore, we especially looked at project management methodologies that are applicable in the infrastructure sector. This ensures the effectiveness of the methods since it has been tested in other similar situations. Next to that, it increases the probability to improve the situation as they attack the main causes of the company.

#### 6.1.2 Relevance of research

The results given in this research for Witteveen+Bos are relevant to the company as it analyzes the bottlenecks of the deviations. Next to that, it explained how the methods presented could be implemented in their current way of working. This would help Witteveen+Bos improve its current project process for a project regarding infrastructure & mobility. In case the solutions show effectiveness in the workflow, the ideas can be spread to the other departments of Witteveen+Bos under the condition that they face the same problems. In the end, it helps benefit the overall performance of Witteveen+Bos.

Besides that, it could also contribute to other companies that face the same problems and work in the same work field as W+B. However, as this research was tailored to the problems and challenges of Witteveen+Bos, there cannot be said with certainty that the same solutions are as effective to other companies as they have a different organizational structure. Nonetheless, other companies can still learn from these practices and adjust them to their work environment. It will provide insight and inspiration on how it can be shaped in their business setting.



## 6.2 Limitations and Future Research

In this research, some shortcomings impact the validity and reliability of the findings. At first, there was a limited number of interviews and project cases that were analyzed. Due to the time limitation of 10 weeks, there was only room for a few weeks of data collection, where all the interviews and case studies had to be conducted and completed. As a result, due to the small sample size, it raises concerns about the generalizability of the research findings. It is possible that some issues have been overlooked and neglected while they form a problem for the company. This means that the findings might not be directly applicable to other departments within Witteveen+Bos unless they have the same causes. For future research, more interviews and case studies are recommended to increase validity and reliability even if saturation was reached from the received replies. This shall ensure that the causes identified in this research are, in fact, the primary causes that the organization is facing.

As for the respondents interviewed, their main positions were often project managers and project controllers. Although they play an important role to minimize deviations other people could be interviewed. In this research, only a few contract managers were interviewed. However, because they are involved in developing the set-up of the project during the preparation phase, their comments and views would also provide an intriguing viewpoint on the subject of this research. Therefore, it will bring more insight into the problem when more contract managers are interviewed. In addition, the client also plays a role in the emergence of deviations. This study has mainly concentrated on what Witteveen+Bos could do to lessen the impact of project deviations. Thus, for future research, the client's involvement in deviations should also be investigated.

Furthermore, the interview questions were created based on the literature review to obtain more insightful responses. However, this brings biases from the perspective of the respondent and the researcher. Since the researcher draws the interview questions on what was found in the literature, this might have impacted and guided the interview in a particular manner to check whether Witteveen+Bos's circumstances mirrored those discussed in the literature. In other words, the researcher tends to verify this information, leading to confirmation bias. On the other hand, the respondents would feel the need to comply with what the researcher would expect, which will influence their answers and introduce biases. Additionally, since we have based the interview questions on the literature review, it is possible that certain problems were overlooked, which leaves room for additional potential causes to have gone unnoticed.

The research that is conducted follows a qualitative approach. Due to the non-statistical nature of the data, it is challenging to guarantee reliable outcomes free of bias. Even though the validity and reliability have been tried to be guaranteed, as described in Section 1.11, quantitative research would help strengthen the research findings. A way to apply a quantitative research approach is to implement the findings in projects to see the impact on delays and costs. This will provide more statistical information on the effectiveness of the solutions. For example, Section 5.2.3 discusses how the Burn-Up Chart could be utilized in a software application that is used for projects, called "projecten monitor". Future studies can examine how this will be incorporated into the projecten monitor. In order to create the chart, data regarding the planning needs to be available in the application. Next, there must be thought of how to visualize the chart, so it is understandable for everyone at the company and to the client. Moreover, it should be able to integrate well with the expense graph to take full advantage of the method and detect deviations sooner. If this is applied to a few projects, we can determine how effective this method is.

Finally, due to time limitations, not all the potential strategies described in the literature were examined. The methods were chosen based on their likelihood to function inside Witteveen+Bos's current organizational structure. Hence, this means that the selection of methods was chosen subjectively and could include biases. This also holds when deciding on the position of the solution on the impact-effort matrix. Its major objective is to indicate how effective each technique is. However, it does not guarantee that the values are an accurate reflection of how it would play out in practice. It is advisable to continuously search for additional methods and approaches that could bring new and interesting insights to improve the current process even further. For example, W+B can learn more about Agile Project Management as they increasingly apply lean and agile principles in their projects. This can help deal with complexity and uncertainty in projects. Another suggestion is that it would be beneficial to look more closely at the project's people-pleasing behavior. It

involves psychological issues that were not considered in this study. However, it is still interesting to see from a psychological perspective how it can help minimize deviations.

### 6.3 Conclusion

This thesis was conducted at the company Witteveen+Bos, where they are dealing with the problem that there are deviations within the project causing negative consequences for time, costs, and customer satisfaction. Therefore, we answer the following research question to solve this problem:

“How can deviations be minimized in the process of multidisciplinary projects regarding infrastructure and mobility in Witteveen+Bos?”

To find an answer to this research question, the causes were first analyzed. This has been done by conducting a systematic literature review, interviews with project and contract managers and a claim analysis. From this analysis, we found that the main causes that enhance the occurrence of deviations were the following:

- In the preparation phase of a project, W+B determines what needs to be done to deliver a product. However, it occurs that this does not cover all the activities that needed to be performed, meaning extra research, steps, and meetings are required, translating to more time and money for the project.
- There occur scope changes during the execution of the project. This can be caused due to interpretation differences between the client and Witteveen+Bos about what is within the scope. As a result, the clarity of the project worsens.
- Internal communication also plays a role in the problem. Employees work on tasks that are not explicitly mentioned in the scope. They will still help to satisfy the client while not receiving compensation for it. Next to that, if a deviation occurs, they will not immediately notify the project managers, causing the deviation to be noticed too late.

Based on the determined causes, solutions were searched in the literature that could tackle these causes and hence will give an answer to the research question. In the literature search, five possible methods were selected that help the problem.

At first, using a process-oriented work breakdown structure ensures that all the activities are included to deliver the product. This should be established at the beginning of a project closely after developing the deliverable-oriented Work Breakdown Structure. A smaller process-oriented WBS combined with a scrum sprint will also assist structure the project better and guarantee that all the activities are included if the project is too complex to map the process entirely during the planning phase. This also benefits that the objective of W+B aligns with the client.

Furthermore, a RACI matrix helps improve internal communication as the roles of every team member are defined. This will help create a better overview of what everyone's responsibilities are and stimulates information exchange within Witteveen+Bos. Next to that, it is easier to contact and update the appropriate team members if the scope changes.

Also, a burn-up chart aids in graphing the planning process over time to determine whether it is being followed appropriately. In case fewer products are finished in comparison with what was planned, W+B can intervene and rework their planning to meet the deadlines. This would work well in combination with the growth of expenses of the project over time, which will keep both the planning and the expenses in check.

In addition, to promote continuous improvement that suits the Agile principles, the success factors and the improvement points should be captured, so people learn from each other and prior projects to avoid them in upcoming projects and, in the long term, have an effective project management approach.

At last, people-pleasing behavior is a danger for the scope since more is done than was mentioned in the scope. Therefore, people need to be informed about how to deal with certain situations and emphasize the importance of working as one team to minimize the effect of this type of behavior. For a full overview of the solutions and their implementation plan, see Section 5.2.

An impact-effort matrix has been built to assist Witteveen+Bos in determining which option should be implemented first. This shows that it is recommended to set up the burn-up chart and the RACI matrix first. Meanwhile, setting up a process-oriented WBS will take more effort, but it will have the biggest impact on how to deal with deviations.

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# Appendices

## APPENDIX: ORGANIZATION STRUCTURE

| Directie Witteveen+Bos N.V.<br>ir. W.B.G. Bijman (Wouter)<br>ir. S.C. van der Biezen (Stephan)<br>ir. E. Buter (Eveline) |   | BUSINESS LINES   |  |  |   | AFDELINGEN  |                                    |
|--|---|--|--|--|---|---|------------------------------------|
| BUSINESS LINE MANAGER  |   | Infrastructure and Mobility  | Built Environment  | Deltas, Coasts and Rivers  | Energy, Water and Environment   |   |                                    |
| MANAGEMENT TEAM  |   | dr.ir. L.S.W. Koops (Leonie)   | drs.ing. E.J.N. Rijdsijk (Edgar)   | ir. H.J.M.A. Mols (Harry)  | ir. M.J.T. Scheres (Marc)   |   |                                    |
|  |   | ir. M.C. van Breukelen (Maarten-Kees)<br>ir. R.P. Herrema (Rinze)<br>ir. F.J. Kaalberg (Frank)<br>ir. H.B. Laboyrie (Polite) | ing. J.M.W. Akkerman (Martijn)<br>ir. S. Delfgaauw (Steven)<br>ing. M.T. Marshall (Matthew)<br>J. Smits MSc (Jair) | ir. R.M. van den Boomen (Rob)<br>ir. C.H. Clemens (Rina)<br>ir. E.D.P. Eijnthoven (Evert)<br>ir. D.J. Jaspers Focks (Dirk-Jan)<br>ir. A.J.G. Kops (Arno) | ir. F. de Bruijn (Fred)<br>dr.ir. S. Van Herreweghe (Samuel)<br>ing. J.A. Lijftogt (Johan)<br>ir. P.V. Tienhooven (Peter) |   |                                    |
| THUISMARKT   |   | SECTORHOOFD  | dr.ir. L.S.W. Koops (Leonie)   | drs.ing. E.J.N. Rijdsijk (Edgar)   | ir. H.J.M.A. Mols (Harry)   | ir. M.J.T. Scheres (Marc)                         |                                    |
| Nederland  |   | PMc Construction Management  | ir. I. van den Berg (Inge)   | PMc Energietransitie   | PMc Ecologie  | PMc Afvalwater                                    | Communicatie                       |
| KANTOREN   | Directie  | PMc Infra constructies   | ir. R.P. Herrema (Rinze)   | K.A. Haans MSc (Koen)  | drs. L.G. Turlings (Lennart)  | P.P. Puttkammer MSc (Peter)                       | drs. N. Eimers (Nathalie)          |
| Amsterdam  | ir. W.B.G. Bijman (Wouter)<br>ir. S.C. van der Biezen (Stephan)<br>ir. E. Buter (Eveline) | PMc Gebiedsontwikkeling  | ir. F.J. Kaalberg (Frank)  | ing. M.T. Marshall (Matthew)   | PMc Havenconstructies en ontwerp  | PMc Bodem, ondergrond en omgeving                 | Facilitaire zaken                  |
| ir. P. Hoogvorst (Paulien)   |   | PMc Life Cycle Management  | ir. A.C. de Wit (Auke)   | ing. M.T. Marshall (Matthew)   | ir. G. Hamoen (Gert)  | ing. M. Kraneveld (Maarten)                       | E. Jager BSc (Emile)               |
| Breda  | ir. I. Bolier (Ingrid)  | PMc Ondergrondse infrastructuur  | ir. F.J. Kaalberg (Frank)  | PMc Gebouwen   | PMc Havenontwikkeling, scheepvaartwegen en baggeren   | PMc Circular and net zero Solutions               | Financiën                          |
| Den Haag   | drs. E. Weerman (Ellen)   | PMc Relational Contracting   | ir. J. Kooij (Jelmer)  | ir. S. Delfgaauw (Steven)  | ir. P. Quist (Peter)  | ir. J.F. Kramer (Freek)                           | H. Heuker MBA (Hendrik)            |
| Deventer   | ir. W.B.G. Bijman (Wouter)  | PMc Smart Infra Systems  | ir. M.C. van Breukelen (Maarten-Kees)  | PMc Omgevingsrecht en vergunningen   | PMc Kusten, rivieren en landaanwinning  | PMc Drinkwater en proceswater                     | ICT                                |
| Heerenveen   | drs. H.J.W. Albers-Schouten (Rianne)  | PMc Verkeer en wegen   | dr.ir. A.S. van Beinum (Aries)   | drs. M.J. Schilt (Maurits)   | ir. R.Bouw (Ruud)   | ir. J.C. Schut (Jochem)                           | ing. G.J. Werler (Gerrit Jan)      |
| Rotterdam  | ir. M.L. Aalberts (Marinus)   | PMc Vervanging en renovatie van kunstwerken  | ir. S.C. van der Biezen (Stephan)  | PMc Planstudies en procesmanagement  | PMc Waterbouw en geotechniek  | PMc Elektrische en proces-automatiseringssystemen | Juridische zaken en kwaliteit      |
| Utrecht  | ir. W.F. van den Berg (Wim)   | PMc Digital engineering experiences  | ir. O.G. Schepers (Otto)   | dr. A.M. Springer-Rouwette MSc (Anke)  | ir. D.J. Jaspers Focks (Dirk-Jan)   | ir. E. Twigt (Edwin)                              | mr. J.J.M. van Gessel (Jeroen)     |
| Wageningen   | C. Koot MSc (Corinne)<br>dr. ir. A. van Nieuwenhuijzen (Arjen)                            |  |  | PMc Stedelijke infrastructuur  | PMc Waterbouwkundige constructies en dynamica   | PMc Energiesystemen                               | HR                                 |
| Groningen (pop-up)   | J.A. Zoete MSc (Jimme)  |  |  | ir. R.P.N. Pater (Richard)   | ir. R.A. de Heij (Robert)   | ir. R.T. van der Velde (Raphaël)                  | ir. drs. M. Stadler (Minke)        |
|  |   |  |  | PMc Digital engineering experiences  | PMc Watermanagement en ruimtelijke adaptatie  | PMc International Technical Assistance            | Digital Support                    |
|  |   |  |  | ir. O.G. Schepers (Otto)   | ir. H.J. Mondeel (Herman)   | ir. P.V. Tienhooven (Peter)                       | drs. A. van Kolthoorn (Antoinette) |
|  |   |  |  |  | PMc Hoogwaterbescherming en landinrichting  | PMc Milieu, gezondheid en leefomgeving            |                                    |
|  |   |  |  |  | ir. H.J.M.A. Mols (Harry)   | ir. J.L. Dierx (Hannie)                           |                                    |





## APPENDIX: SYSTEMATIC LITERATURE RESEARCH

In this systematic literature review, we try to find an answer to the following research question: "According to the available literature, what are the possible causes of deviations in infrastructure projects?"

### II.1 Inclusion and exclusion criteria

|                    |
|--------------------|
| Inclusion Criteria |
| See key terms      |

| Exclusion Criteria                                      | Motivation   |
|---|--|
| The source language is other than English.              | Sources that are not written in English cannot be understood due to the language barrier.  |
| The publication data of the source is from before 2000. | Only this century's sources are considered to ensure the information is still relevant.  |
| The complete source is inaccessible.                    | If the sources are inaccessible via UT access or it has no open access, the study's findings cannot be reviewed. Hence, it will not be included. |
| The source is not relevant to the research question.    | If the search results present data that does not add value to answering the research question, it will not be taken into account.                |

### II.2 Used Databases

The databases Scopus and Web of Science have been chosen to retrieve the sources. Both are multidisciplinary databases, meaning they cover various academic fields. This will increase the likelihood that relevant information is found for the research question. Next to that, it provides different types of sources, such as journal articles and conference proceedings, that are often peer-reviewed. This will ensure that the information is reliable.

### II.3 Search Results

| Date   | Search String  | Number of search results | Number of duplicates |
|--|--|--------------------------|----------------------|
| Scopus                                       |  |                          |                      |
| 10-04-2023                                   | ( TITLE-ABS-KEY ( claim* OR deviation ) AND TITLE-ABS-KEY ( construction OR infrastructure ) AND TITLE-ABS-KEY ( cause OR factor OR reason ) AND TITLE-ABS-KEY ( management ) AND TITLE-ABS-KEY ( consultan* ) ) | 55                       | 1                    |
| Web of Science                               |  |                          |                      |
| 11-04-2023                                   | ( TITLE-ABS-KEY ( claim* OR deviation ) AND TITLE-ABS-KEY ( construction OR infrastructure ) AND TITLE-ABS-KEY ( cause OR factor OR reason ) AND TITLE-ABS-KEY ( management ) AND TITLE-ABS-KEY ( consultan* ) ) | 49                       | 0                    |
| Total  |  | 103                      |                      |
| Duplicates between Scopus and Web of Science |  | -22                      |                      |
| Exclusion Criteria                           |  | -6                       |                      |

|                                     |     |
|-------------------------------------|-----|
| Excluded after reading the abstract | -58 |
| Excluded after reading the paper    | -8  |
| Total sources used for SLR          | 9   |

To find relevant sources for the research, it should include key terms similar to causes, deviations and infrastructure projects. The results obtained from both databases were exported into Excel to remove the duplicate sources. After that, the title and abstract were scanned to determine whether the article was relevant to the research question. Keywords that were often used in the articles were delays and cost overruns. Although these were not in the search query, the sources were considered since deviations are closely related to these consequences. This revealed that there were 17 relevant sources. In reviewing the sources, some causes are more related to the implementation phase, while this search focuses more on the management and preparation beforehand. Therefore, in the end, 9 sources are used for the systematic literature review.

## II.4 Findings Systematic Literature Review

| Source   | Key Findings  |
|--|---|
| Hayati, K., Latief, Y., & Rarasati, A. D. (2019). Causes and Problem Identification in Construction Claim Management. IOP Conference Series, 469, 012082. <a href="https://doi.org/10.1088/1757-899x/469/1/012082">https://doi.org/10.1088/1757-899x/469/1/012082</a>  | <p>Top 5 reasons for claims in construction projects</p> <ul style="list-style-type: none"> <li>- Changes in owner's requirements</li> <li>- Changes of design from the owner after the tender</li> <li>- Project executed in a short time period without proper planning on design, tender and contract documents.</li> <li>- Inadequate scope definition and specification.</li> <li>- Incomplete and uncoordinated design.</li> </ul>  |
| Gündüz, M., Nielsen, Y., & Özdemir, M. (2013). Quantification of Delay Factors Using the Relative Importance Index Method for Construction Projects in Turkey. Journal of Management in Engineering, 29(2), 133–139. <a href="https://doi.org/10.1061/(asce)me.1943-5479.0000129">https://doi.org/10.1061/(asce)me.1943-5479.0000129</a> | <p>Common causes of delays by category</p> <p>Contractor</p> <ul style="list-style-type: none"> <li>- Lack of experience</li> <li>- Ineffective project planning</li> <li>- Inadequate management and supervision</li> </ul> <p>Consultant</p> <ul style="list-style-type: none"> <li>- Delay in inspection and testing</li> <li>- Poor communication and conflicts between parties</li> </ul> <p>Design</p> <ul style="list-style-type: none"> <li>- Design changes</li> <li>- Design errors</li> <li>- Lack of experience</li> </ul>  |
| Ren, Z. L., Atout, M., & Jones, J. R. (2008). ROOT CAUSES OF CONSTRUCTION PROJECT DELAYS IN DUBAI. Procs 24th Annual ARCOM Conference.   | <p>The study divides the causes into the three key participants in a construction project: client, consultant and contractor. According to their survey, the main causes per participant are:</p> <p>Causes from the client</p> <ul style="list-style-type: none"> <li>- Unrealistic time plan</li> <li>- Inadequate explanation of the bill of quantities</li> <li>- Mismatch sub-contractor with the contract terms</li> <li>- Irregular payment</li> </ul> <p>Causes from the consultant</p> <ul style="list-style-type: none"> <li>- Incomplete drawings/ designs</li> <li>- Approving documents takes a long time</li> </ul> |

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|  | <ul style="list-style-type: none"> <li>- Inspecting quality takes a long time</li> <li>- Mention discrepancies in the contract document too late</li> <li>- Changes of drawings/ design and Specifications</li> </ul> <p>Causes from the contractor</p> <ul style="list-style-type: none"> <li>- Incomplete method statement</li> <li>- Inconsistencies payments</li> <li>- Lack of expertise and workmanship</li> <li>- Miscommunications</li> </ul>  |
| <p>Odeh, A. M., &amp; Battaineh, H. T. (2002). Causes of construction delay: traditional contracts. <i>International Journal of Project Management</i>, 20(1), 67–73.<br/> <a href="https://doi.org/10.1016/s0263-7863(00)00037-5">https://doi.org/10.1016/s0263-7863(00)00037-5</a></p>   | <p>The study grouped the delay causes into 8 major groups where the most critical groups for this research are client, consultant and contractual relationships.</p> <p>Delay factors of clients</p> <ul style="list-style-type: none"> <li>- Delay in payment</li> <li>- Interfere and change in the project</li> <li>- Slow decision making</li> <li>- Unrealistic time plan</li> </ul> <p>The delay factors of consultants were not prominent in comparison with others. However, factors that were mentioned are delays in the approval of designs, controls and inspections.</p> <p>The contract can change during the project process, and ambiguity could occur in interpreting the contract documents.</p> <p>At last, there could be a lack of communication between the different parties.</p> |
| <p>Prasad, K. V., Vasugi, V., Venkatesan, R., &amp; Bhat, N. S. (2019). Analysis of causes of delay in Indian construction projects and mitigation measures. <i>Journal of Financial Management of Property and Construction</i>, 24(1), 58–78.<br/> <a href="https://doi.org/10.1108/jfmpc-04-2018-0020">https://doi.org/10.1108/jfmpc-04-2018-0020</a></p> | <p>The source ranks the causes of delays based on the project topic. For transport projects, the main causes are:</p> <ul style="list-style-type: none"> <li>- Delay in decision-making of claims</li> <li>- Inadequate required construction site</li> <li>- Delay in payment for overwork</li> <li>- Financial implications</li> <li>- Scope variation</li> </ul>  |
| <p>Abd El-Razek, M E, Bassioni, H and Abd El-Salam, W (2007) Investigation into the causes of claims in Egyptian building construction. In: Boyd, D (Ed) Procs 23rd Annual ARCOM Conference, 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management, 147-156.</p>  | <p>The most common causes mentioned are</p> <ul style="list-style-type: none"> <li>- Variations from the original plan</li> <li>- Inadequate design/ drawings/ specifications</li> <li>- Delay of approval of documents</li> </ul>   |
| <p>Matseke, D. A., &amp; Khatleli, N. (2021). CLAIMS MANAGEMENT: UNDERLYING CAUSES IN MEGA-CONSTRUCTION PROJECTS. <i>Proceedings of International Structural Engineering and Construction</i>, 8(1).<br/> <a href="https://doi.org/10.14455/isec.2021.8(1).con-27">https://doi.org/10.14455/isec.2021.8(1).con-27</a></p>                                    | <ul style="list-style-type: none"> <li>- Inadequate time plan</li> <li>- Unclear project specifications</li> <li>- Schedule delays</li> </ul>  |
| <p>Lo, T. Y., Fung, I. W. H., &amp; Tung, K. C. F.</p>   | <p>Based on their survey, they found the following causes:</p>   |

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|--|--|
| <p>(2006). Construction Delays in Hong Kong Civil Engineering Projects. <i>Journal of the Construction Division and Management</i>, 132(6), 636–649.<br/> <a href="https://doi.org/10.1061/(asce)0733-9364(2006)132:6(636">https://doi.org/10.1061/(asce)0733-9364(2006)132:6(636</a></p>  | <ul style="list-style-type: none"> <li>- Unclear scope</li> <li>- Inadequate management and supervision</li> <li>- Environmental problems</li> <li>- Changes made by the client</li> </ul>   |
| <p>Shahsavand, P., Marefat, A., &amp; Parchamijalal, M. (2018). Causes of delays in construction industry and comparative delay analysis techniques with SCL protocol. <i>Engineering, Construction and Architectural Management</i>, 25(4), 497–533.<br/> <a href="https://doi.org/10.1108/ecam-10-2016-0220">https://doi.org/10.1108/ecam-10-2016-0220</a></p> | <p>The source found 78 different factors. The top 5 causes are:</p> <ul style="list-style-type: none"> <li>- Changes made by the client</li> <li>- Shortage in time</li> <li>- Shortage in costs</li> <li>- Delay in managing the site</li> <li>- Inadequate definition of deliverables</li> </ul> |

The research question can be answered from the systematic literature review results. We can conclude that many different causes can occur during an infrastructure project. However, the leading causes that most sources mention are changes made by clients, changes or errors in design, delays in approvals of documents, unrealistic time plans and scope variations.



## APPENDIX: INTERVIEW QUESTIONS

|   |  |
|---|--|
| <b>Introduction</b>   |  |
| I am Cheng Qi and I am currently working on my bachelor's assignment for the University of Twente. My topic is about reducing the deviations in projects related to infrastructure and mobility. The interview is intended to gather information about how employees think about the deviations and their experiences with them. I will ask questions about yourself, your experiences with deviations, causes and possible improvement points. This will take about 1 hour. This interview will be confidential and all the data will be anonymized in the report. Before the interview starts, are there any remaining questions? |  |
| <b>Personal Questions</b>   |  |
| What is your role/function?   |  |
| How long have you held this position?   |  |
| What are your responsibilities?   |  |
| What kind of projects have you worked on?   |  |
| What is often the working method/ procedure?  |  |
| <b>Process (planning and management)</b>  |  |
| What is used to manage the project? (Gantt charts, critical path planning, dashboards and reporting)  |  |
| How do you maintain an overview of the entire project with the different stakeholders?  |  |
| What should be agreed upon beforehand in order to have a smooth project process?  |  |
| How are the plannings made?   |  |
| How do you experience the scheduling? (High workload? Feasible?)  |  |
| How do you set up the work packages? How do you know you have included the most important tasks?  |  |
| <b>Communication</b>  |  |
| <b>Communication with Client</b>  |  |
| How is the communication with the client?   |  |
| How often do you meet with the client?  |  |
| How can people indirectly related to the project be involved?   |  |
| Is the 2nd and 3rd layer included? How do you ensure that they are also well informed?  |  |
| How is ensured that the client and its requirements are kept in the loop?   |  |
| Is feedback delivered on time?  |  |
| How do you handle disagreements about what needs to be delivered?   |  |
| <b>Communication Internally</b>   |  |
| How is the communication internally?  |  |

|   |  |
|---|--|
| How often do you meet internally?   |  |
| Is it clear for the employees what their tasks and responsibilities are?  |  |
| Is there coherence within the tasks that the different employees work on? |  |
| How do you align the different disciplines and their delivered products?  |  |

|   |  |
|---|--|
| <b>Deviations</b>   |  |
| What are your experiences with deviations in a project?                                 |  |
| What are examples of reoccurring deviations within a project?                           |  |
| Are there disagreements about what is considered additional work?                       |  |
| What are the most common deviations?  |  |
| What are the most impactful deviations?   |  |
| What are in your opinions the causes of the deviations?                                 |  |
| Are the deviations reported on time?  |  |
| What do you think could help minimize the number of deviations?                         |  |
| Have you tried anything yourself to reduce changes?                                     |  |
| What aspects should I include when thinking of methods to reduce the number of changes? |  |

# IV

## APPENDIX: SUMMARY TRANSCRIPTS INTERVIEWS

### IV.1 Interview 1

|   |
|---|
| <p><b>Wat moet vooraf worden afgesproken voor een soepel projectproces?</b></p> <p>In een project wat we doen is vaak een resultaat van een uitvraag die de opdrachtgever heeft geschreven en onze aanbieding daarop. Die aanbieding komt tot stand onder druk van marktwerking, want je wilt die opdracht winnen, dus je moet vooral niet te duur zijn en je moet een plan schrijven wat gescoord kan worden door de opdrachtgever in punten. Maar dit wilt niet altijd zeggen dat wat er daarna moet gebeuren precies is wat is uitgevraagd, want tussen het moment dat de uitvraag geschreven werd en het moment dat je het echt gaat doen zit tijd. Van alles kan gebeuren of niet alle aspecten waren meegenomen en voorzien. Dus het moet heel helder zijn. Soms verwacht de opdrachtgever bij de uitvraag iets anders dan wat ze aangeboden kregen. Dus het goed vaststellen van je vertrekpunt met elkaar van "dit is wat jullie aangeboden heeft gekregen en dit voldoet helemaal aan uw uitvraag, maar dit is niet precies wat jullie bedoelden." Dit gesprek moet je dus heel snel voeren na het starten van je project, omdat je daarmee voorkomt dat er verschillende verwachtingen zijn en pas als het geleverd is te horen krijgt "dit hadden we niet voorzien" – "nee maar dat is wel wat we aangeboden"</p> <p>Meestal weet je zelf al wel waar je de uitvraag optimaal hebt zitten en integreren, maar je wilt de opdracht ook winnen en de andere partij gaat dat ook doen. Tijdens de uitvraag procedure krijg je soms nog wel eens de mogelijkheid om in gesprek te gaan met de opdrachtgever en kan je daarop wijzen "als je dit zo laat staan, krijgt u dit en als je dat niet wilt dan moeten we de vraag aanpassen." Maar dus echt duidelijkheid over wat je van plan bent te gaan doen en als je verwacht dat dat anders is dan wat de opdrachtgever eigenlijk verwacht dat je dat ook boven tafel krijgt. Dit zorgt ervoor dat je hetzelfde vertrekpunt hebt over wat er in de scope zit.</p> <p>Om effectief en efficiënt om te gaan met afwijkingen dan gaat het ook over dat de scope heel duidelijk hebt, maar ook dat, ook al is het niet overal het geval, de doelstellingen en bedoelingen dat je dat heel goed met elkaar doorneemt. Dat is wat anders dan de scope, maar dat je goed snapt wat de klant nou echt wil met het project en welke dingen belangrijk zijn. Eigenlijk in prioritering al, want tijd, geld, kwaliteit en duurzaamheid is nooit altijd even belangrijk.</p> |
| <p><b>Komt het voor dat de stukken niet op elkaar aansluiten? Hoe wordt daar mee omgegaan?</b></p> <p>Het betekent dat mensen heel inefficiënt gaan werken en dat kost je allemaal meer uren. Dat is vooral vervelend. Dan kijk je of je de afgesproken deadlines nog haalt. Of dat je ze wel haalt maar een notitie bijlegt dat deze raakvlakken nog niet helemaal kloppen en dat trekken we de volgende fase recht. Daar zit een hoop inefficiëntie in, dat kan niet anders. De planning is vaak leidend en heel beperkt en hoe verder je het einde nadert, hoe meer iedereen al opgesnoept heeft van alle buffers. Dus hoe meer druk er komt op de planning en dus hoe meer dingen parallel geschoven worden die eigenlijk na elkaar ontmoeten.</p>  |
| <p><b>Wat zijn de meest kritische afwijkingen die voorkomen?</b></p> <p>In de basis heb je de afwijking waarbij wat ze hadden uitgevraagd niet helemaal is wat ze bedoelden. Doordat je al meer hebt van de aanbieding dan verwacht.</p> <p>Dan heb je nog een type van dat we het zelf heel optimistisch ingeschat. Dus we dachten er met 4 interviews wel uit te zijn en het blijkt dat we 30 stakeholders moesten interviewen. Dan heb je een inschattingfoutje.</p>   |
| <p><b>We hadden het erover dat de juistheid in het begin belangrijk is, gebeurd het dan nu toch nog niet</b></p>  |

**goed genoeg?**

Je kunt er tijdens het gesprek erachter komen dat de opdrachtgever iets verwachtte dat niet zo letterlijk in de uitvraag stond en dus ook niet is uitgevraagd. Je kon het ook anders interpreteren. Omdat je in een tender met andere partijen zit ga je van uit van datgene dat het minste geld kost, want dat doet de rest ook. Dus dan nemen we bepaalde interpretaties over.

Het hangt er ook vanaf als het bijvoorbeeld een op een uitvraag is of je hebt de kans om met de klant te spreken van "Ik denk dat je dit bedoeld maar het staat er niet" (voor kleinere specifieke opdrachten kan je naar de klant bellen) Maar we zitten ook vaak in formele procedures waar je helemaal niet met de klant mag bellen en waar je met 3 andere partijen op basis van 40 pagina's uitvraag en 16 bijlages de aanbidding schrijven. Dan ga je jezelf niet uit te markt prijzen door aan te bieden van wat je denkt dat ze bedoelen en gewoon wat er letterlijk staat. Dat is de aanbidding en dan ga je het gesprek aan van "dit is wat u heeft gevraagd en krijgt, maar het kan dat u meer nodig heeft." Dan heb je al van begin af aan een aanvulling.

**Wat zijn grote afwijkingen die je hebt ervaren?**

De technisch manager bij de opdrachtgever valt uit en het project ligt daardoor voor een tijdje langer stil. Daar konden wij ook niks aan doen. Of we zijn daardoor gaan bijschakelen en dan doen we iets dat de opdrachtgever niet meer kan invullen. Dan heb je hele grote afwijkingen.

**Worden wijzigen op tijd gedetecteerd?**

Dit soort dingen denk ik niet. Een type wijziging dat te laat gedetecteerd wordt is als er op werkpakket niveau gewoon net meer dingen gedaan moest worden dan om gevraagd was. En dat iemand op werkpakket niveau bepaalde ontwerpnota maakt en we hadden 2 varianten aangeboden, maar er worden 3 of 4 uitgewerkt. Degene heeft dan niet heel strikt in de gaten of de klant vraagt van, vaak gebeurd dat in de interactie met de counterpart, kan je dit ook nog even uitwerken. Dan ga je in de service modus om de klant te helpen en dat gebeurd op werkpakket niveau. De deelprojectleider ziet het misschien wel of niet. Dus voordat je dat op project management niveau in de gaten hebt en het geadresseerd is als meerwerk, dan is het werk al gedaan en dat zijn de meest vervelende, want het werk is al gedaan.

Meerwerk hoeft niet een probleem te zijn, maar wel als het al gedaan is en dan om geld te vragen. We proberen dit soort dingen te ondervangen door van begin af aan alle eisen en resultaten verplicht in een digitaal systeem te zetten, relaties, zodat iedereen in principe de database zou kunnen opzoeken. Maar niet iedereen zit er met zijn neus in daarin van ohja dit zou ik eigenlijk moeten doen.



## IV.2 Interview 2

|   |
|---|
| <b>Kan het voorkomen dat je wat mist in taken die je moet doen voor een bepaalde werkpakket, van dit is al aangeleverd maar intern moet er nog een taak gebeuren en dat was voorheen misschien nu niet voorzien.</b>  |
| Gebeurt altijd. Of dat de klant denkt dat het bij ons ligt en wij zeggen dat het bij hun ligt. Bijvoorbeeld de aansturing van de planning, dan kan het in het contract staan dat de opdrachtgever dat doet, en zij denken dat wij het doen en dus dat het net niet scherp genoeg staat en dan blijft het in het midden hangen en dan doet niemand het.  |
| <b>Dus jullie hebben best wel wat manieren om dat op elkaar af te laten stemmen, maar wanneer zou het kunnen dat het mis zou kunnen gaan. Heb je een voorbeeld hoe dit mis kan gaan?</b>  |
| Het kan zo zijn dat je zelf een besluit in je hoofd hebt dat iemand anders het gaat doen. Dus dan zit je in een overleg met 5 mensen. We hebben het over die doet de raakvlakken met elektro, die doet de raakvlakken met civiel, die doet omgevingsmanagement, maar dat er toch ergens gaat liggen dat niet genoemd wordt op tafel. De een denkt dat doe jij wel en dan ga je het samenvoegen en blijkt het niet te passen. Dus er kan best wel wat misgaan ook al doe je al deze stappen wel. Uiteindelijk als je het steeds meer in elkaar zet, steeds meer gedefinieerd, dan wordt de afwijking vaak minder.  |
| <b>Kunnen afwijkingen belastend zijn voor de flow van het project?</b>  |
| We hebben een project over een brug die we nu doen. We hadden extra budget nodig en daar was hij ook mee eens maar er was maar een beperkt budget op het project. Je mag maar 50% van je initiële opdracht mag je nog meer erbij doen. Dus het heeft best veel tijd gekost om te kijken of er toch nog meer geld mogelijk was of dat we het werk op maat konden maken voor de ton. Zeker 6 of 7 weken gekost terwijl het project ondertussen doorliep. Maar er was wel afhankelijkheden op die producten die we opstellen. Dus alles liep een beetje uit en werd nog steeds geen duidelijk antwoord gegeven. Dus we hebben zelf een voorstel gedaan van, doe dan het werk op regie en laat ons dan de producten die echt het belangrijkste zijn. In plaats van 10 vraag naar 4. Zo werd het opgelost, maar dat heeft best veel tijd gekost, met de klant en ons om het uit te zoeken met allemaal mensen van contract management erbij. Dus meestal wordt het steeds groter en steeds mensen die ermee bemoeien. En we moeten aan alle kanten van de overheid, de aanbesteding. Dat is aan de ene kant wel goed maar het kost wel tijd als de tijd eigenlijk niet meer hebt in het project om daar nog aan te denken. |
| <b>Dus het wordt wel eerlijk aangegeven van als deze keuze wordt gemaakt dan kan het leiden tot iets goeds?</b>   |
| Ik doe het wel, maar er zijn project managers die het per ongeluk niet doen of het moeilijker vinden. Maar als je het niet doet dan kom je jezelf weer tegen op het moment dat het afgerond moet worden. Dan is de kwaliteit misschien niet goed of je hebt het product niet geleverd dat ze hadden verwacht. Dan kan je het beter aan de voorkant zetten. En niks is makkelijker als je vraagt krijgt van je kan ja en nee zeggen. Je kan ook nee zeggen en zeggen dat je kan het niet halen. Soms zijn ze heel blij met dat antwoord, want dan geef je de meest eerlijke antwoord en dan zijn zij ook geholpen, want dan hebben zij nog niet het product maar dan kunnen ze wel zeggen van hoe we het wel voor elkaar kunnen krijgen. In plaats van dat ze ja zeggen en dan over 3 maanden geld vragen en al het geld besteed hebben.   |
| <b>Het werd vaak benoemd dat mensen al wat werk hebben gedaan terwijl dat niet hoorde. Heb je misschien mogelijk oorzaak hoe dat voor is gekomen?</b>   |
| Ik heb zelf wel eens meegemaakt dat medewerkers die niet bevoegd zijn om iets erbij te doen, een akkoord te geven of een wijziging, dat ze van de klant te horen krijgen dat het er gewoon bij hoort en je moet het erin doen. Het komt van goede bedoelingen want van het moet vanuit mijn specialistische ervaring. Maar als dat niet op tijd gemeld worden intern of dat wij het niet gevraagd hebben en niet weten wat er loopt. Dan kan het zo zijn dat in kleine bedragen of soms wel groot, veel budget besteed is. Daar moeten we zelf ook vaak achteraan als project managers, zijn we de juiste dingen aan het doen. We zeggen dan ook altijd, echte scope wijzigingen mogen alleen maar overeengekomen zijn door de projectmanager of de contractmanager (op dat niveau) anders niet.  |
| <b>Zijn er oorzaken die je ziet die mogelijk leiden tot afwijkingen / wijzigingen in een project?</b>   |
| Kwaliteitsniveau. Dat wij denken dat we een 7 of 8 leveren, maar de klant het een 6 vindt. Dan heb je het netjes afgerond, budget op, maar dan zegt de klant dat dit niet goed is meegenomen en de kwaliteit is gewoon niet goed.   |

Het is heel moeilijk om te zeggen of het een 6 of een 8 is en dat is een beetje op gevoel. Stel dat het wel goed is dan zijn wij klaar en hoeven we niks meer te doen. Is er wat extra dan maken we er een VTW van met uren of budget. Stel het is niet goed en dat we echt iets vergeten zijn, dan moeten we op onze eigen kosten inhalen en verbeteren. (situaties waar je niet in wilt komen en toch om tafel te komen met de klant)

Ze krijgen bijvoorbeeld de eerste 4 producten van ons en zijn niet helemaal tevreden, van ja het staat er wel maar het is moeilijk leesbaar. Dan gaan ze de andere producten met dezelfde bril lezen. En als de communicatie door de eerste 4 producten al een beetje lastig is geworden tussen ons en hun, dat je het moeilijk met elkaar vind. Dan kun je wel in de situatie komen dat ze alles zwaar gaan beoordelen.

**Wat denk jij misschien dat beter kan in een project zodat zulke wijzigingen of afwijkingen minder voorkomen?**

Een hele belangrijke is dat we maken een plan van aanpak bij een offerte. Er staat bijvoorbeeld in we maken 100 uur met 2 medewerkers in een jaar tijd. Maar ik vind persoonlijk dat als we opdracht hebben dat we daar zelf niet daar even strak op zitten. Er wordt gezegd dat die ene medewerker die gaat met vakantie, we zetten iemand er naast die het kan oppakken wat je doet als goede bedoelingen. Waardoor we in het begin met de klant het al moet bespreken dat het net iets anders loopt dan in het plan van aanpak staat. Dus dan zeggen ze je hebt bijvoorbeeld 4 mensen gezegd die erop staan bij de project start up, maar we willen jullie hele team zien met 10 man. En daar denk ik dat we met z'n allen scherper op kunnen zitten en meteen al zeggen dat het anders dan in de aanpak staat. Maar je weet het domino effect, als je in het begin een steentje omgooit dan kan het aan het eind van een project heel groot worden en een hele grote wijziging zijn zonder dat je in het begin met z'n allen door hebt en communiceert.

Vooraf in communicatie, als in budget, als in planning. Het komt dat wij in het begin soms ook nog wel eens zeggen, 1 of 2 medewerkers of een dag extra dat verdien je toch wel terug als we het intern minder moeten doen. Maar ik denk dat het nog best wel een goede manier is om het met de klant erover te hebben, want zij kunnen ons dan al heel vervelend vinden, van ze hebben nog maar de week de opdracht en komen nu al mee dat het niet in de opdracht zit. Aan de ene kant wil je heel transparant zijn naar hun, anderzijds wil je ook voorkomen dat er meteen de persoon bent die komt met extra's. Ik denk dat we daarin moeten leren dat we goed moeten bijhouden wat is extra en wat is er minder in het project en niet doet.

**Gebeurt het vaak dat dat er iets extra's of minder wordt gedaan?**

Ik denk dat in de algemeenheid dat we daar iets voor moeten hebben waardoor we het strakker bijhouden. Strakker bedoel ik net zoals met uren invullen in BST10, dat je het hiervoor ook iets hebt. Alleen het probleem is vaak wel weer, we vullen al heel veel in. We moeten op een of andere manier voorkomen dat het nog meer is wat je invult. Anderzijds denk ik wel dat we hierop ons proces beter kunnen sturen. Dus aan de voorkant wel goed weten wat was de opdracht naar de klant, dat goed uiten in de project uiting en daar ook goed aan houden. En twee, als er een afwijking komt dat doe je dan zo strak mogelijk aan de voorkant in beeld hebben (zodat je het eerder kan signaleren.) Bij de opdrachtgever kan dit ook gebeuren dat zij ook dingen veranderen waar wij niet blij mee zijn, dat doe je nu wel maar let op zo was de opdracht niet naar ons uitgezet.

Dus ik denk dat die 2 dingen aan de voorkant dat nog beter inregelen en concreter maken van wat houdt een wijziging in. Dan zou het mooi zijn als je een overzicht zou hebben van dat je dit wijzigt op dit product, dan heeft het raakvlakken met die en die producten. Als dit 2 weken langer duurt dan zou het lijken dat dit ook langer gaat duren. En we doen het allemaal wel, maar het is meer van hoe kan je het beter aan de voorkant nog beter vastleggen en het overzichtelijk houden.

### IV.3 Interview 3

**Als we kijken naar best zo'n groot project, je hebt best veel mensen die aan zo'n project werken. Wat moet er dan volgens jouw vooraf al besproken worden, zodat het tijdens het project soepel of efficiënt gaat verlopen.**

Wat ik heel belangrijk vindt is dat je goede vragen moet stellen aan de voorkant. We moeten met elkaar de heel goed doorgronden. Dit is zowel voor intern als met de klant. Ik moet met de klant afstemmen heel goed afstemmen op hoe gaan we, wat is precies de vraag en wanneer is het project een succes? Dus wat zijn uw ambities, dus dat zit hoger dan het project, wat zijn de project doelstellingen en wat is dan eigenlijk de vraag in het project dat we moeten oplossen. Dus hetzelfde geldt ook naar onze collega's toe. Deze vraag heb ik, hoe gaan we het oplossen, zo gaan we het oplossen en deze stappen gaan we doorlopen en ik vind het heel belangrijk om ook met elkaar allemaal, ik naar de klant toe, maar eigenlijk we naar de klant toe, maar ook vooral intern de vraag heel goed hebben. Als je een slechte vraag stelt dan krijg je geen goed antwoord. Dus je kan beter zorgen dat je van voren de vraag scherp stelt met elkaar en weet wat er moet gebeuren en dan gaat iedereen los.

**Je vindt het belangrijk dat je elk project het in het begin concreet maakt?**

In een project, voor elk product gaan we een werkpakketje maken en helemaal uitschrijven van dit gaan we doen en in het structuur versie van ons document, dat noemen we de 10% versie, daar geven we aan dit is het structuur van hoe we het gaan maken. Dit is het werkpakket en zo hebben we het vertaald. Zijn we het met elkaar eens dat we dit gaan maken? Het klinkt misschien een beetje gek, maar als je dat vroegtijdig al hebt en vroegtijdig een structuur hebt staan, dan zegt de klant ook dit bedoel ik niet, want dit ontbreekt. Maar dan zeggen ze het voordat we onze uren hebben besteed en al onze werkzaamheden hebben gedaan theoretisch, want in de praktijk gaat het nog wel eens anders. Dan denken ze vroegtijdig al mee over van dit bedoelen we, u snapt wat we bedoelen. Dus de validatie heel vroeg doen, om te voorkomen dat je later alle kanten op gaat.

Wat wel een nadeel is, je bent er druk mee, het kost ontzettend veel tijd want je moet heel veel energie in de voorkant stoppen om iedereen mee te krijgen, maar de kwaliteit is wel beter geborgd aan de voorkant dan dat je anders zou hebben en dat je aan de achterkant veel moet repareren als het budget al besteed is en ontzettend onder tijdsdruk staat want dan moet het allemaal af en ingediend worden en dan komt er een moment van oh ja we hadden dat beloofd we moeten nog iets aanpassen en oh ja van hoe zat het ook alweer. Dat is niet zo handig.

**We hadden het er al even over dat jij best vaak de klant meeneemt tijdens het project. Hoe zorg je daarvoor dat ze echt in het project worden meegenomen. Overleggen is er één, zijn er verder misschien nog andere dingen die je doet, zodat de klant echt wordt meegenomen en het product wordt geleverd waarnaar ze vragen?**

We werken met verschillende versies van documenten. Dus we hebben een werkpakket die we aanbieden, we hebben een 10, 50, 90 en een 100% versie en al die documenten en versies worden ingediend naar de klant als gelegenheid om het te toetsen. De 10% versie is de structuur versie, dus daarin staat wat ik wil maken, de 50% versie is heel vaak de versie waarop we valideren. We zijn dan ongeveer halverwege en hebben soms inhoudelijke vragen, wat wil de klant nou hier precies mee? Daarbij hebben we ook wel specifiek overdrachtsmomenten voor gehad, ofwel overleggen. En we dienen het document in halverwege de toetsing en koppelen het vaak met overleggen. Bijvoorbeeld vooral met ontwerp, hun techneuten vooral en hun toetsers en onze technici gaan samen aan tafel om te bespreken hoe het ontwerp vordert, welke knelpunten er zijn en hoe we die gaan oplossen. Dat doen we bewust halverwege en niet aan het eind, want op het eind heb je geen budget en tijd over om dingen te repareren en halverwege is daar meer ruimte voor en als we halverwege erachter komen dat er iets mis is met de koers, dan hoef je niet heel veel meer aan te passen. Maar als je de koers doorvoert tot aan de 90% conceptversie dan kan je niks veranderen en je geld en budget is op.

Het mooie vaak is dat als je halverwege bent is er ook nog ruimte, tijd en geld om daar of koerswijzigingen te doen of te bedenken van wat we wel gaan doen. Als er onenigheid is en niet met elkaar eens zijn, dan kunnen we wel kijken van, wat is er wel nodig om wel eens te zijn of wat moeten we nog uitzoeken. Dan hebben we nog tijd en budget beschikbaar om het uit te zoeken. Of we kunnen het besluit nemen om een andere koers te varen of er moet een extra product bij komen of er moet iets

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| <p>bijkomen. Hoewel de discussies best stevig zijn, je kunt ze makkelijker voeren als je nog niet helemaal klaar bent, omdat je elkaar beter begrijpt en het werkt 2 kanten op. Soms moeten we meer doen omdat de klant meer verwacht. Maar ook wel eens dat ze zeggen doe niet zo moeilijk, prima rond het maar af. Om het gesprek gewoon aan te gaan en het proces eigenlijk om het te organiseren van jongens ga het gesprek met elkaar aan als vakbroeders onderling.</p>  |
| <p><b>Zijn er misschien nog andere voorbeelden van afwijkingen die in jouw beeld heel vervelend/belastend of voorkomend waren?</b></p>   |
| <p>Wat je vaak ziet bij de 10, 50, 90% versie is dat de klant echt gaat toetsen op een hele late versie. Dus was op de 90% versie gaat er inhoudelijk goed gekeken worden. Bijvoorbeeld bij het contract hebben we gehad dat het niet goed was, we hebben een 95% versie gehad en ook nog een tussenversie en eigenlijk heeft het proces te lang geduurd. Wat er ook nog speelde is dat we een teamwijziging hebben gehad in het contractenteam. En die combinatie is wat giftig. Dus en een proces hebben die te lang duurt en een wijziging in het contractenteam.</p>   |
| <p><b>Jullie team wordt tijdens het project anders?</b></p>  |
| <p>Met name bij teamwijzigingen, wat je toch wel ziet, bijvoorbeeld bij contract/ ontwerp is dat iedereen toch wel zijn eigen manier van werken heeft en voordat je het helemaal eigen hebt gemaakt dat is gewoon lastig. Dus de continuïteit in zo'n team is heel belangrijk. Ook voor de afspraken die je 1.5 jaar geleden hebt gemaakt vol te houden.</p>   |
| <p><b>Een project kan best wel lang doorlopen dus dan is het fijn dat je een constante team hebt, die weet waar het project over gaat in plaats van het steeds opnieuw uitleggen van hier zijn we mee bezig.</b></p>   |
| <p>Wat wij hebben bij het contract gehad, maar de klant heeft het gehad bij alle IPM rollen. We hebben een 5<sup>e</sup> omgevingsmanager, een 3<sup>e</sup> technisch manager, contract manager is 1 keer gewisseld. Er zijn heel veel personen gewisseld bij de klant en wat je dan krijgt is dat de besluitvorming heel lastig is, want een half jaar geleden kozen ze A en nu kiezen ze B en dat wijzigt dan ook weer.</p>   |
| <p><b>Als we kijken naar de afwijkingen die voorkomen, zijn er dan mogelijke oorzaken waarvan je denkt dat hierdoor de afwijkingen ontstonden?</b></p>   |
| <p>Dus de wijzigingen van de personen in ons team. Collega's die gingen weg en een wijziging in een team is echt vervelend omdat je kennis kwijt bent. Dat is een oorzaak. En vooral andere verwachtingen is een andere belangrijke. Maar de andere verwachtingen hebben we met de 10, 50, 90% versie proberen te tackelen. (tussen W+B en de klant) en ook verwachtingen binnen de klant, want sommige IPM rolhouders die hebben gezegd we hebben interne adviseurs en die weten het ook niet altijd. Dus de verwachtingen zijn niet altijd even helder. Dat is een oorzaak van wijzigingen. En wat ik ook een oorzaak van wijzigingen vind is dat sommige processen te lang duren. Als het te lang duurt dan gaat de scherpste eruit en blijf je het voor je uitschuiven.</p>  |
| <p><b>Heeft u misschien een idee van hoe je zulke oorzaken het best kan verhelpen of misschien ideeën hoe je de wijzigingen kan verminderen in een project? Wat denk jij misschien dat beter kan in een project zodat zulke wijzigingen of afwijkingen minder voorkomen?</b></p>   |
| <p>De wijzigingen in het team dat is lastig en kan je niet altijd voorkomen. De boel klein houden en opknippen en heel expliciet werken werkt altijd wel en goed. Het expliciet omgaan met toetsingen en terugkoppelingen gaat goed. De doorlooptijd van een aantal zaken verkorten kan geen kwaad. Alleen een contract is een heel groot dossier. Die kan je niet in 1 dag opstellen en afronden. Wat ook heel belangrijk is de regelmaat van 10, 50 en 90%, dat werkt heel goed. Ook met de klant samen werkt het heel goed. Alleen de klant heeft vaak wel de nijing om te zeggen, alle voorversies interesseert me niet, ik wil een product hebben waar ik naar kan kijken. Maar die afstemming is heel goed en ook de korte lijnen houden met de klant doe je ook samen als teamwerk, dat werkt heel goed. Ook in het begrip en ook als er een wijziging is. Dus als er iets bij de klant gebeurt wat dreigend is dat eventueel impact op ons kan hebben als wijziging, zoals als er iets nieuws is. Als je daar korte lijnen met elkaar hebt en je werkt gewoon letterlijk met elkaar samen, dan is er geen drempel om dat te delen. Dus bepaalde transparantie hebben we nu eigenlijk nu niet over gehad (in het interview), met de klant wordt er behoorlijk open en eerlijk gewerkt. Dus als wij wat hadden dat ons in de weg zat dan deelde we dat en andersom ook. Dat heeft er heel erg bijgedragen dat er een wijziging was, hadden we er begrip voor, want we snapte wat er speelde. En dat is dan ook een beetje een persoonlijke samenwerking denk ik dat ons heeft geholpen, zowel intern in W+B als naar de klant toe. En ook zeg maar tussen de specialisten bij ons en de klant.</p> |

Als iets niet lekker loopt, dan vooral roepen dat het niet lekker loopt en daar ook actief naar vragen. (transparant samenwerken) Als de klant zegt jullie vragen een besluit beste W+B maar dat kunnen we nog niet want we weten niet wat we moeten doen. Dat is prima, maar dan zeggen wij tegen de klant als het uitblijft dan is dit de consequentie. Of we moeten deze ontwerp aannemen en gaan we daarmee door. Enige wat we weten is als het ontwerp anders wordt, dan hebben we een probleem, maar dan kan je wel het gesprek met elkaar aan en dat is wel belangrijk.

**Als we kijken, heeft u misschien nog ideeën voor mij waarvan je denkt van dit moet aangepakt of verbeterd worden, zodat de wijzigingen minder worden? Heeft u tips/ideeën of wensen van het onderzoek om mee te nemen?**

Wat ik heel erg merk is dat iedereen snoei en snoei hard werkt om het zo goed mogelijk te doen, maar ook wel eens en dat is bijna op sociaal veiligheidsvlak het spannend vind om aan te geven dat iets niet goed gaat of dat er iets anders loopt dan we hadden bedacht.

**Dus wel meer voor je zelf houden en alleen de goede punten benoemen?**

Ja, wat je heel veel ziet is, we werken heel veel met ingenieus en je wilt altijd een oplossing bedenken en als er iets niet helemaal lekker loopt, gaan ze eerst nog keiharder werken om een oplossing te bedenken in plaats van melden van hey er gaat iets anders. Alleen de interventie doen van hey, er is iets anders is nog geen probleem. Je doet niks verkeerd, ze zegt alleen let op er loopt nu iets anders. Als je dat tijdig meld en deelt, dan kan je het gesprek al voeren. Als je het niet deelt en er gaat iets mis, dan zijn we te laat.

**Heeft dat ook te maken met de relatie ook hoe het loopt binnen het project? Stel dat het een stroef project is, dat mensen het helemaal niet willen benoemen?**

Dat kan ook zijn of mensen willen per definitie het gewoon goed doen. Of mensen hebben zelf heel erg een visie van ik vind dat het zo moet, maar ik mag het niet zo doen. Waar ik ook mee te maken had en ook belangrijk is, is we hebben specialisten die willen het onderzoeken tot het laatste millimeter en als dat niet is onderzocht dan zijn ze niet zeker of het kan, maar we hebben niet altijd de tijd om het op de laatste millimeter uit te zoeken. Weetje, ik heb het globaal uitgezocht, deze risico's zitten er nog in, maar ik weet het niet zeker. Dus benoem de risico's. Je moet na een bepaald detailniveau stoppen dat is wel lastig, want er zit heel erg de communicatie van de samenwerking in. Zeker bij een groot project waar heel veel mensen aan werken heb je er niet altijd de gelegenheid ervoor. Dus we moeten een soort, bijna een safe space creëren, waar mensen wel kunnen aangeven van hey dat is niet helemaal wat het moet zijn.

#### IV.4 Interview 4

**Zijn er problemen die jij ziet in mogelijke planningen dat mogelijk niet haalbaar is of dat werkpakken niet gespecificeerd genoeg zijn dat misschien kan leiden later tot eventuele wijzigingen?**

Ik merk in veel gevallen en dan heb ik het specifiek over het project over planproducten. Je weet dat het proces bij een planfase aan veranderingen onderhevig is, dat stakeholders dingen gaan inbrengen, dat er nog wijzigingen zijn ook van de klant zelf, dat weet je allemaal. Maar toch vragen ze altijd een soort product resultaat. Dus dan vragen ze een project besluit als eindproduct (ik noem maar iets) En er zitten best wel vaak onderhandelingen van wat zit er nou wel en niet binnen onze scope, want uiteindelijk staat er vaak een zinnetje van jullie moeten komen tot een goed project besluit en alles wat eronder valt dat zit dus in de scope. Je hebt een aanbieding op een bepaald proces gemaakt. We hebben een WBS opgesteld, werkpakketten gedefinieerd, ook op basis van het contract en vervolgens gaan we per product per werkpakket wat we hebben een werkpakketformulier invullen van dat vinden wij dat wij gaan doen op basis van onze aanbieding, op basis van het contract. Aan deze eisen gaan we voldoen, dit proces gaan we doorlopen, dit zit wel binnen onze scope en dit zit niet binnen onze scope en dit stellen we aan het begin op.

In de projecten die ik probeer te begeleiden probeer ik dit proces erin te zetten, zodat je een helder startpunt hebt van wat we wel en wat we niet gaan doen. Wat vaak ondersneeuwt is de afstemming van het productformulier met de klant. Het gebeurt wel, maar vaak is de eerste discussie al van dat dingen meer in de scope vallen. Die discussie wordt niet altijd in het begin al gevoerd. Dan wordt er toch gezegd, we kijken wel waar het heengaat en als het loopt zoals het moet lopen dan valt het onder de scope en als het toch anders loopt dan kijken we dan wel. En vaak is dat toch wel een waarschuwing dat we scherper vooraf moeten zijn.

Het is allemaal meerwerk op proces en niet op de daadwerkelijke product. De eisen van de klant blijft hetzelfde etc. Alleen het hele proces waarin beperkte eisen waren opgesteld en waar we via de scope formulier helderheid over willen krijgen dat is helemaal over de kop gegooid. Dan krijg je een discussie we moeten gewoon een project besluit maken, jullie hadden aangeboden dat het in 12 integraal overleggen kan, uiteindelijk bleek het niet reëel, dat is dan jullie probleem.

**Kan je een voorbeeld geven waar het project helemaal over de kop is gegaan?**

Een project had hetzelfde probleem, waar we ook een resultaatsverplichting hebben. Daar hebben we iedere 2 weken een contractoverleg waarbij we alle afwijkingen, VTWs bespreken. Daar is het proces ook echt gigantisch door allerlei redenen, ook deels door ons dat we ook hebben toegegeven. Maar sommige dingen zitten echt niet bij ons en dan kun je wel zeggen van jullie hebben een resultaatsverplichting en je moet het product leveren, maar als we bepaalde stukken zoveel later krijgen of input eerst krijgen en vervolgens aanvullende input krijgen dat verstoord dan gewoon het proces. Dan kun je wel zeggen dat we nog steeds een resultaat hebben, maar het proces moet gewoon betaald worden. Voor de logische dingen kunnen ze het nog wel intern verkopen, zoals de aanvullende scope of een scopewijziging. Maar de minder logische dingen, zoals uitloop van review commentaar, maar dan zijn ze van ja jullie leveren ook alles tegelijk in, dan kunnen jullie ook weten dat we vertraging oplopen of we vinden een paar producten toch onder maat dus jullie leveren slechte kwaliteit dus daarom vertragen we. Dan wordt het een steekspel van wie gaat wat betalen. Dit heeft niet met directe scope creep te maken want hier is het vrij helder wat er gebeurd is.

Meer over scope creep gesproken, als je de productformulieren dus niet goed hebt afgestemd aan het begin dan ga je dus krijgen dat we kregen bij een dijk project ook is dat we een x aantal dingen hebben aangeboden. Dus dat we het oude alternatief gingen bekijken en op een gegeven moment zagen we gewoon dat er zoveel niet klopt, we gaan het anders inrichten. We gaan factsheets maken om gewoon voor ons zelf scherp te hebben wat we doen. Maar dat is een hele andere wijziging van onze aanpak met de gedachte van ja we moeten dit gewoon scherp krijgen van onszelf, maar dat leek in het begin een goed idee, toen gingen we dat in de review leggen van dit hebben wij gedaan en in plaats van dat hun het gingen aanvullen wat ons idee was, kregen we heel veel commentaar op, van dit klopt niet en hier is dit nog etc. Wat er uiteindelijk voor gezorgd heeft dat alleen de factsheets opstellen veel gekost voor het

hele proces erom heen. Terwijl het een ideetje was om het te versnellen en het was een afwijking van ons proces dus we hadden niet echt door dat het die kant op ging en op een gegeven moment explodeerde het tot een gigantische post en dan ben je al te laat om daarna nog te zeggen wij zijn afgeweken van ons proces en we willen graag geld hebben.

**Als we nu kijken naar alle VTW's die je hebt benoemd. Heb je dan een idee wat de oorzaken kunnen zijn buiten de scope wijziging die we in het begin zeiden dat dan misschien beter kon zijn. Zijn er misschien andere oorzaken waarbij je denkt van waardoor deze VTW's tot stand zijn gekomen en wat zijn de meest voorkomende?**

Er zijn heel veel scopewijzigingen zijn knippen en klaar, product X erbij, dat is heel makkelijk. We gaan kijken wat voor effect het heeft op allerlei andere producten, bedrag eronder. Daar krijgen we vrij snel goedkeuring voor en dat is allemaal prima. Maar wat ik met al deze VTWs benoemde wat de rode draad inzit is proces. Er is product technisch veranderd, ja de ene is dan opgeknipt, maar waar ging het geld en tijd naartoe ging is het proces om het af te handelen. De factsheets, het idee om onze aanpak te verbeteren in eerste instantie was eerst een kleine proces wijziging om nog steeds tot een basis order product (?) te komen, want het product basis order rapport bleef hetzelfde. Alleen we dachten slim te doen om het anders te doen, maar daar is zoveel procesmatig wijzigingen in gebeurd, het is uitgedijd kwa niveau omdat we hadden nog steeds meer informatie nodig hadden en er is gigantisch opgegroot op de klant, terwijl we eigenlijk een rapport zouden krijgen en nu kreeg die al die factsheets en dat heeft dus veel meer commentaar opgeleverd etc.

**Hoe denk je dan dat je dit proces kan aanscherpen zodat zulke WTV's minder snel voorkomen in een project?**

En dat ik toch stiekem wat ik in het begin al zei, in een scopeformulier vooraf echt afspraken maken met de klant over, bij mij part over een kortere periode per keer, bijvoorbeeld voor de komende ontwerploop, misschien 4 maanden, voorzien we het volgende proces om daar te komen. Alles wat het proces kan verstoren daar moeten we wat mee.

Dus eigenlijk per fase een mini plan van aanpak waarin je je proces omschrijft en als je van het proces afwijkt dan kan je daar rustig een afwijking van maken, maar op het moment dat het significant tot meerwerk leidt, dat je daar makkelijker het gesprek over kan voeren van hey, we hadden dit plan en we moeten gezamenlijk overeenkomen en gedeeld worden. Het is niet ons plan, want anders krijg je weer zoals die factsheets.

**Nog andere op-aanmerkingen om mee te nemen in het onderzoek, die jullie kunnen helpen?**

Communicatie is sowieso belangrijk en ik denk dat we niet altijd even sterk zijn om na toets commentaar/ na een bespreking om meteen een mail te schrijven van dit hebben we besproken zodat je je dossier opbouwt. Daar zijn we niet altijd even sterk in. We hebben dan een overleg gehad, we gaan dan met goed vertrouwen uit elkaar en dan gaan we verder met ons project en dan kom je later terug van we zeiden het toen wel maar dat willen we toch nu anders zien. En omdat je de afspraken niet op papier hebben, wordt het voor de escalatie eens stuk moeilijker, want dan wordt het van het was een half-afpraak.

Niet alleen bij overleggen maar na alle afspraken, niet alleen mondeling overeenkomen, maar ook vastleggen en met elkaar delen zodat het helder is van besluiten goed vastleggen, waarom is een besluit genomen, wat is de impact van het besluit, impact goed vastleggen zodat je weet als de impact groter is dan gedacht en dat je daar op terug kan vallen.

Bij standaard overleggen gebeurd het wel, format erbij met een actielijst. Maar ook bij wat informele afspraken moeten we zorgen dat dit goed vastgelegd wordt. Ook als het in een werkspoor zit en er wordt een vraag gesteld, dan wordt er telefonisch gezegd ik weet niet of dit binnen ons contract zit dat je dat ook direct op de mail zet en dat je dat ook goed vastlegt van we gaan eerst contractueel uitzoeken voordat ik ja of nee ga zeggen op jou vraag. Dan ligt de bal bij de juiste partij voordat wij aan het nadenken zijn. Ook dat soort dingen doen wij te weinig.

