Insights into the design of the two-phase delivery model within the design phase of infrastructure projects

MSc. thesis

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TUDelft

TwynstraGudde

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TU Delft

Preface

Hereby, I present my graduation thesis which marks the end of my journey at the Delft University of Technology. The challenge to fulfil the Master Construction Management and Engineering has been a great learning experience. I would like to take the opportunity to thank the people who supported me towards this accomplishment.

The development of this research would not have been possible without the guidance of my thesis committee. Firstly, I want to thank the chair of the committee, Marleen Hermans, for providing rigorous comments that helped to safeguard the scientific value of the research. Secondly, Maedeh Moleai for our almost weekly meetings during the first months of the research that helped me to start. Next, Marian Bosch-Rekveldt for the numerous comments you made on my report and for always helping me to move in the right direction. Also, I would like to thank TwynstraGudde for giving me the opportunity to conduct research on this interesting topic within the group of Risk and Contracting advisors. I have received the best welcome and guidance that I could have wished for. My gratitude goes to Leon Tammes, Ruud Schrauwen and especially Anne de Jager for guiding me through this journey. I really enjoyed spending time with the group of advisors at TwynstraGudde and learning from your vast experience. I also want to express my gratitude to all the interviewees who participated in this research for their enthusiasm and their interesting insights.

On a personal note, I would like to thank my friends and family who always cheered me on. I am very grateful for the encouragement I always felt from my parents, of which my mother in loving memory, to study and to pursue my goals. I also want to thank Ester, for her grammatical help on the report. Finally, I want to thank my girlfriend Emmy, for listening to my complaining, and for your unconditional support and encouragement.

Lastly, thank *you*, the reader. I hope you are as interested in the subject of the Two-phase model as I am, and I hope you will enjoy reading this thesis.

J.J. (Jillert Jan) Miedema
April, 2022

Summary

Introduction
Currently, the infrastructure industry is in transformation and moving towards new project delivery approaches. Aiming to improve the predictability of projects and due to a growing desire for collaboration between clients and contractors, the two-phase model has made its entrance in the industry and has been gaining popularity.

During the first phase of the two-phase model, client and contractor work together on the design. The first phase results in a detailed design including the price for execution. After a successful first phase, client and contractor come to an agreement for the execution phase. The price determination of the execution costs is delayed until after the first phase. The contractor therefore has a better grasp of the project risks and is in a better position to offer a more reliable price.

The two-phase model is relatively new on the market and therefore has not yet been standardized. The elements of a two-phase model have not been identified scientifically. This research contributes to making reasoned choices on how the elements of a two-phase model can be operationalized in infrastructure projects in a way that the two-phase model contributes to achieving the project's objectives.

The main research question of this study is:

What is the optimal operationalization of elements in designing the first phase of the two-phase model in infrastructure projects?

In order to find an answer to this question, research has been executed in four parts. The first and second part focus on the elements that are needed in designing a two-phase model. The third and the fourth part focus on how these elements can be applied. In part one, a literature study was conducted to determine the elements of a Project Delivery Method (PDM). In part two, six expert interviews were conducted which evaluated if the elements of a general PDM match the elements of a two-phase model. In the third part, a case study was conducted on three infrastructure projects to determine how the elements of the two-phase model are operationalized in practice. With the case studies as a basis, as set of statements has been formulated that describe lessons learned in the design of the two-phase model. Lastly, in part four, these lessons learned were evaluated by experts from the industry.

Research results
The literature study determined how the two-phase model relates to the other PDM's in the construction industry. A PDM is a method that describes how the tasks to be performed in a construction process, are distributed among the contracting authority and the other parties. The traditional model, the integrated model and the alliance are three major groups of PDM's in the Dutch construction industry. The two-phase model is a delivery model that cannot be captured under one of these groups. Early Contractor Involvement (ECI) is a broad term that describes a PDM that is mainly applied in Anglo-Saxon countries. ECI and the two-phase model have similarities since the contractor is early involved in both approaches. The advantages of ECI, like improved collaboration and better management of uncertainties, therefore are also expected to apply for the two-phase model. Secondly, the literature study determines the elements of a PDM. The elements that must be considered when designing a PDM are listed in Table 1.

Table 1: Elements of the PDM

Elements of a Project Delivery Model	
Task & Responsibility allocation	Pre-project planning Design & Engineering Construction Project management
Form of specification	'Early' / 'late' phase transition Detailed / conceptual design or functional requirements
Risk measures	Allocation Sharing Mitigation Insurance
Contractual reinforcements	Price determination Incentives / penalties Rewards / saving sharing Losses sharing
Process operating systems	Decision making (integrated, linear) Dispute management Information management & ownership
Form of collaboration	Classical / relational contract Intensity of collaboration

The elements of a PDM in Table 1 have been evaluated by a group of experts to check if these elements also apply to the two-phase model. Some clarity in the structure of the table was lacking in the opinion of the experts. Interview sessions resulted in a model that includes all elements of a two-phase model that must be considered when a two-phase model is designed. The elements are captured in five groups:

- **Actor's behaviour and organization's qualifications** are requirements for the two-phase model to be successful. Actors must have understanding for the other parties interest and cultural differences. Open communication and mutual trust is also important for the actors. The organizations must show the qualifications: professionalism, technical and cost expertise and must be able to release control in the collaboration.
- **The motivation** to apply the two-phase model must consist of a desire to involve the contractor early and to delay the price determination. This can apply on the full, or a part of the project scope.
- **The result of the first phase and responsibility** describe the design assignment that can be wide or narrow and the responsibility allocation over the design.
- **The form of collaboration** can be integral or coordinated. This has influence on task and role division between the parties, separated or integrated management teams and decision making.
- **The contractual reinforcements** describe the subjects that can be implemented to motivate the contractor towards the project objectives. Price determination, risk measures, dispute management and incentives are elements that must be considered.

In a case study over three cases, the application of these elements in practice has been investigated. Based on the case analyses, two streams are indicated that apply the two-phase model differently. The 'risk reduction' stream applies the model to improve manageability of project risks. In this stream, tasks and roles are clearly divided and collaboration is mainly used to smoothen the process and share knowledge to prevent mistakes. The 'integral' stream intends to optimally benefit from the expertise of all parties in the design phase to improve the overall quality of the designs. The roles are less strictly defined and collaboration is applied to every task. Good collaboration between the parties is essential in the integral approach.

A set of observations was determined over the cases. These observations contained good practices and obstacles in the two-phase model in the cases. After evaluation by three experts, the observations resulted in thirteen 'lessons learned' that can help client parties in organizing their two-phase model in future projects.

1. early involvement of the contractor ensures an increased quality of the designs
2. early involvement of the contractor enables efficiency gain by scope optimization
3. there are two streams that apply the two-phase model for a different objective: one that applies the model integrally and one that is focused on risk reduction
4. two separate mirrored management teams are undesirable in a project
5. the degree of releasing control is an important consideration for the client
6. the design phase becomes increasingly extensive and expensive
7. clients should be hesitant to use unit prices for the execution price during the tender.
8. the exit option, open-book accounting, benchmarks and expert judgement combined provide sufficient tools to control the execution price
9. although cultural differences are difficult to handle, they provide added value
10. joint effort is required to determine working methods during the project start-up
11. contractor's traditional hour rates and percentages for general costs are not sufficient in an extensive design phase
12. joint responsibility for subsidy approval works for the contractors an incentive to make cost-oriented choices
13. the two-phase model provides opportunities to include innovation and sustainability in a project

To answer to the main research question: there is not one optimal combination of elements to design the two-phase model for every project. An optimal combination of elements form a two-phase model that stimulates a project organization in achieving the project objectives which are determined by the client. The right combination of elements depends on the content and context of the project. The client must consider the degree of releasing control the client is comfortable with.

Recommendations
For client parties, it is recommended to start considering why they would want to apply the two-phase model. The delayed price determination incurs a disadvantage for the client which must be compensated by the advantages of applying the model. Clients wishing to apply the two-phase model are recommended to consider all elements of the two-phase model that have been determined in this research. Reasoned choices must be made about the operationalization of the elements, by keeping the content and context of the project in mind. The thirteen lessons learned can help the client in making these choices. In projects with high complexity, the integral stream of the two-phase model is recommended. The collaboration between the parties in the integral stream should be based on equality. For the risk reduction stream, the client is recommended to clearly identify how the approach is intended. The contractor must know from the start, what is expected of him.

For further research, it is recommended to study the competencies and organizational preconditions which are required from the actors and managers to stimulate the positive side of cultural differences. Secondly, future research could focus on actions that could be taken to preserve the collaborative relationship of the first phase in the execution phase. Thirdly, a study could be carried out to determine a calculation methodology to revalidate the reference prices that match the two-phase model. Finally, the evolution of the two-phase model is a recommended subject of future research to monitor the development of the model and to check if the two streams change or continue to exist.

Contents

1 Introduction

Two-phase delivery models have been gaining popularity over the last couple of years in the Dutch construction industry. Different choices can be made in how the two-phase model is applied on a specific project. This thesis provides insight into the considerations involved with those choices. The study was carried out with the support of the Procurement and Contracting department of TwynstraGudde, an organizational consultancy firm that advises both the business community and the public sector on many current urgent themes.

1.1. Context

There is over 20 years of experience with integrated contracts in the Dutch infrastructure industry, but the enthusiasm for this type of contract is degrading (Chao-Duivis, 2019).

The integrated model is besides the traditional model and the alliance model one of three general contract models that can be distinguished in Dutch construction industry (Bruggeman et al., 2010). The integrated contracts originated from the early 2000s, when there was a desire to reduce the involvement of the public client in construction projects. The aim was to decrease the lead time of traditional construction projects and to involve the constructor's knowledge in the design (Chao-Duivis, 2019). This was a response to the traditional model which was the predominant model until that time. In the traditional model, all building processes are outsourced separately on the market, on the basis of separate contracts. This means that the client outsourced the design task to an architect or engineering firm, and the execution task to a contractor. Although the client outsources the design task to an architect or a engineering firm, in principle the client remains legally responsible for the soundness of the design in relation to the contractor (Jansen, 2009). The term 'integrated contracts' refers to project delivery models in which the design and the execution are carried out by a single party in relation to the client (Bruggeman et al., 2010). There are several variants of integrated project delivery models available in the construction industry, in which additional tasks of financing, multi-year maintenance or even exploitation can be integrated in the contract (Jansen, 2009).

A report by Rijkswaterstaat (RWS) describes the experiences and results of the integrated contracts in The Netherlands over the last fifteen years (Koppenjan, 2020). The report concludes, among other, that although the projects gained positive results in terms of added value for the owner and user, there is criticism about the allocation of the project risks. The most heard criticism is that the project risks cannot be adequately foreseen during the tender stage before a detailed design is made. As a result, the unknown risks cannot be priced, which leaves the contractor at a disadvantage. Moreover, the tenderers are in a competitive situation to present the lowest tender price. This situation can stimulate opportunistic behaviour, in which the tenderer tends to underestimates risks (Chao-Duivis, 2019). As a result, construction parties have become increasingly critical about their participation in large infrastructure projects (250 million euros and more) and a decrease of the average registrations per tender is recognized (McKinsey&Company, 2019).

1.2. The Two-phase model

Currently, the construction industry is transforming and moving toward other project delivery approaches. RWS is starting to introduce the Portfolio approach for projects with a repetitive character and the expectation is that also the Alliance model will be applied in more projects (McKinsey&Company, 2019). With the

aim to improve the predictability of project performance and due to a growing desire for collaborations between clients and contractors, the two-phase model was introduced.

Figure 1.1 illustrates the differences between a regular tender for the traditional and integrated models and the tender of a two-phase model. The first and second part of the figure illustrates a regular tender process. During the regular tender, a contractor is selected for the (design and) execution work and the price for these tasks is determined simultaneously. The third illustration in the figure shows the procurement process of the two-phase model. During the tender of the two-phase model, the contractor is selected. The price for the execution work is only determined at the end of the first phase.

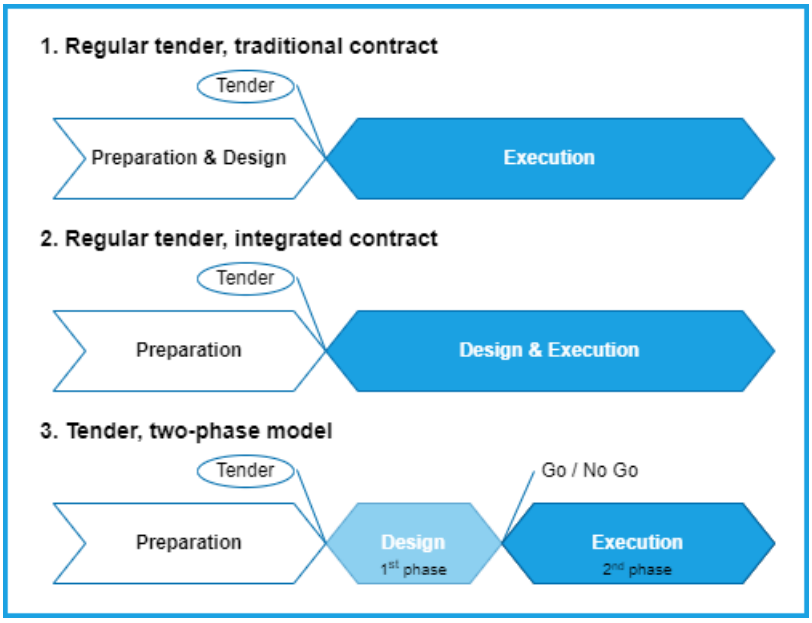

Figure 1.1: Tender for traditional and integrated contracts and the two-phase process (CROW, 2020)

During the first phase of the two-phase model, after the tender, the client and the contractor work together on the project design. The first phase results in a detailed design including the realizations costs. After a successful first phase, an agreement is made between the client and contractor for the realization phase. In other words, the pricing of the realization costs is extended until after the first phase. This causes the contractor to have a better grasp of the project risks and is, therefore, in a better position to offer a more reliable price. Although the two-phase model is relatively new in the Dutch construction industry, in an international context, the two-phase model has similarities with the Early Contractor Involvement (ECI) delivery model. Within ECI the contractor is involved in the design phase to share his knowledge of the costs of the realization and the execution of the design (Bruggeman et al., 2010). ECI can be seen as an umbrella term which includes, in addition to the two-phase model, more project delivery models (PDM's), in which there is a certain degree of collaboration between the client and the contractor in the design phase of a project (Van Wijck, 2018). Within the two-phase model, this is also the case, and therefore the two-phase model can also be grouped under the term ECI. Eventhough, within the ECI it is not necessary to include two phases in the contract, the ECI is a broader model than the two-phase model.
The definition of the two-phase model, provided by the institute for construction law (Wijk-van Gilst, 2020) is:

> *In the two-phase model, pricing for the construction phase follows at the end of the design or engineering phase. Hence, more information is known, which leads to fewer uncertainties and financial risk and thus offers perspectives for better risk distribution.*

RWS uses the term 'two-phase contract', instead of 'two-phase model' (McKinsey&Company, 2019), this term is also regularly mentioned in construction news articles like Cobouw (Cobouw, 2019). However, in this thesis, the term two-phase model will be used. A contract form is defined by Jansen (2009) as "A standardized legal binding agreement as made between the participants in a construction process, based on the chosen

Project Delivery Model". The traditional Bouwteam agreement, which is a form of the two-phase model, originated already in 1952. However, during the last couple of years the two-phase model has been reinvented and applied more often. Due to the two-phase model being relatively new and not having been standardized, it would be inaccurate to speak of a two-phase contract: the term two-phase model is therefore more appropriate.

The Dutch Waterboards reinvented the two-phase model in the High Water Flood Defence program (HWFD). Several dike reinforcement projects, as part of the HWFD program, have been put out for tender with a two-phase model. Besides the waterboards, RWS has also gained experience with the two-phase model. RWS experimented with the two-phase model on projects such as the: Nijkerkerbrug, Krib- en Oeververlaging Pannerdensch Kanaal en Zuid-Willemsvaart.

1.3. Structure of a Project Delivery Model

A PDM defines the task distribution between actors in all phases of a project life cycle. The definition of a PDM is given by Jansen (2009) as:

A method that describes how the tasks to be performed in a construction process, are distributed among the contracting authority and the other parties.

Several PDM's that are used in the industry, like the traditional and the integrated delivery model, describe how roles and responsibilities in the construction process are distributed across the participants of a construction process. This provides structure in the way how tasks are decomposed and coordinated (Mintzberg, 1989), which significantly contributes to the organization of the collaboration between client and contractor and the success of the project (Caniëls et al., 2019; Dietrich et al., 2010).

In a report by Klessova et al. (2020), a comparison is made between the terms 'structure', 'organizational design' and 'architecture'. Structure significantly contributes to the success of the collaboration in multi-actor projects (Dietrich et al., 2010). Along with the term 'structure', the terms 'organizational design' or ' architecture' are largely synonymously used in literature (Aubry and Lavoie-Tremblay, 2018). Architecture can be defined as the way in which a system is arranged (Fjeldstad et al., 2012) in an organizational setting and the focus often is on the patterns of interdependencies (Capaldo, 2007). Organizational design explains "what should be the design, structure, or architecture of the organization" (Burton and Obel, 2011), to both the thing , i.e. the resulting organization, and the process to perform the design (Aubry and Lavoie-Tremblay, 2018).

Klessova et al. (2020) describe the importance of structure in a project for collaboration and project success. Well organized structure within a project delivery model can be seen as a requirement to enable a well functioning PDM. Because "structure stabilizes patterns of interaction between participants in projects, reduces uncertainty for actors, supports governance mechanisms helps to organize the integration of outcomes of different activities and influences organizational efficiency and performance" (Klessova et al., 2020). Since the two-phase model is new and clients do not yet know how they can apply the model successfully, the structure is missing in the two-phase model.

1.4. Problem Statement

The two-phase model is gaining popularity and it is expected that it will be increasingly applied in the infrastructure industry in the coming years. The delivery model has not been standardized and it is not yet clear what choices can be made in designing the two-phase model to use the model effectively. The demand for structure in a PDM (Muller, 2009), and how this can be organized within the different delivery models in the industry, is described in literature (Klakegg, 2017). Research has however not focused on the two-phase model. Scientific interpretation on how the two-phase model should be designed is therefore missing. TwynstraGudde has recognized that public clients sometimes struggle with making deliberate choices on how to organize their two-phase model. TwynstraGudde, as a consultant for public clients in infrastructure projects, could contribute by helping their public clients to enable their ability to make carefully considerated choices. This research contributes to making reasoned choices on how the two-phase model can be designed in infrastructure projects.

1.5. Scope

This section describes the choices that define the research scope.

Perspective

The client is in the lead when it comes to the design choices of a PDM. TwynstraGudde advises mostly clients in the infrastructure sector on their project delivery strategies. Because the client is in the lead for designing the PDM, the client perspective has been the focal point of this research. However, the contractor's perspective is essential in designing a PDM because a delivery model can only succeed when the collaboration contains advantages for all parties. The contractors perspective is therefore also included in this research.

Projects

TwynstraGudde has gained experience in advising on the two-phase model in several infrastructure projects. Besides some road projects, a large part of the projects are dike or bridge renovations. In most projects, RWS or the waterboards are the clients. Since the waterboards are best represented in TwynstraGudde's network, the focus of this research has been on dike reinforcement projects as part of the High Water Flood Defence (HWFD) program.

The projects this research aimed to focus on, are projects with high complexity and where (a part of) the scope is not yet fully defined or specified. Secondly, there should be a desire from the client to collaborate intensively with the contractor to incorporate the contractor's knowledge in the design. In such collaboration the two-phase model must be carefully designed.

Project phase

Many projects that are using the two-phase model are still in their preparation or design phase. Therefore, it will be difficult to gather information on how two-phase models are applied in practice from finalized projects. Also, the design phase of the two-phase model is the stage where the most collaboration occurs between the client and the contractor. Therefore, this research focuses on the first phase of the two-phase model.

Design of the two-phase model

The projects that will be studied in this research, already chosen for a two-phase model. Therefore it is not the question íf the two-phase model should be applied but rather hów the two-phase model could be applied in a specific project to achieve the project's objectives. The research focuses on the design of the two-phase model. In other words, which considerations are there to organize the two-phase model, bringing structure to the project's organization with the goal to enable a good design process.
Not included in scope of this research are the attitude and behaviour needed in a project team to enable smooth running collaboration, which is often subject to social or relational sciences.

1.6. Structure of the report

The structure of the report is as follows. In the introduction in Chapter 1, the context is provided about the main project delivery methods in the Dutch infrastructure industry and an introduction is given on the two-phase model. Next, the problem statement and the scope of the research are described. The objective of the research, the research questions and the methodology have been described in Chapter 2. Chapter 3 forms the literature study, in which project delivery models are discussed and the elements of a project delivery model are provided. The expert interviews, in which elements of a PDM are matched to the two-phase model are reported in Chapter 4. Chapter 5 provides the setup for the case studies and the description of the case study projects. The results of the case studies are presented in Chapter 6. In Chapter 7, the cross-case synthesis is described together with the expert session on the case transcending statements. Chapter 8 provides the research discussion and the limitations. In Chapter 9, the answers to the research question are provided together with the conclusion and recommendations.

2

Research Design

This chapter describes the research design, which consists of the research objective, questions, and methodology.

2.1. Research objective

Better risk allocation and improvement of client contractor collaboration have been named as the two main motives to introduce the two-phase model (Chao-Duivis, 2019). For the two-phase model to succeed, a carefully considered design of the model is essential. The objective of this research is to identify how a two-phase model can be designed in a way that fits the objective and context of a certain project.
The outcomes of this research provide guidelines that can be used by public clients and strategic consultants to help them designing their two-phase model.

2.2. Research questions

To fulfil the objective of this research, the main research question is defined as follows:

What is the optimal operationalization of elements in designing the first phase of the two-phase model in infrastructure projects?

To support an answer to the main research question, the following research sub-questions are formulated:

1. *Which design elements can be identified from literature for organizing the PDM where the contractor is involved in an early stage?*
2. *What are the design elements for the first phase of the two-phase model in practice and what activities are done differently in the two-phase model compared to other contract forms?*
3. *How are the elements of the two-phase model operationalized in practice?*
4. *What are the lessons learned in designing the two-phase model in practice?*

2.3. Research methodology

The research is divided into two parts. The first part is exploratory research, containing a literature study and an expert meeting. In the second part of the research, the implementation of the two-phase model in infrastructure projects is studied. In order to do so, case studies are conducted and an expert evaluation is held. Thereby, the findings from both the literature- and the case study are evaluated by experts from the industry. For each research question, the applied methodology is described in more detail below.

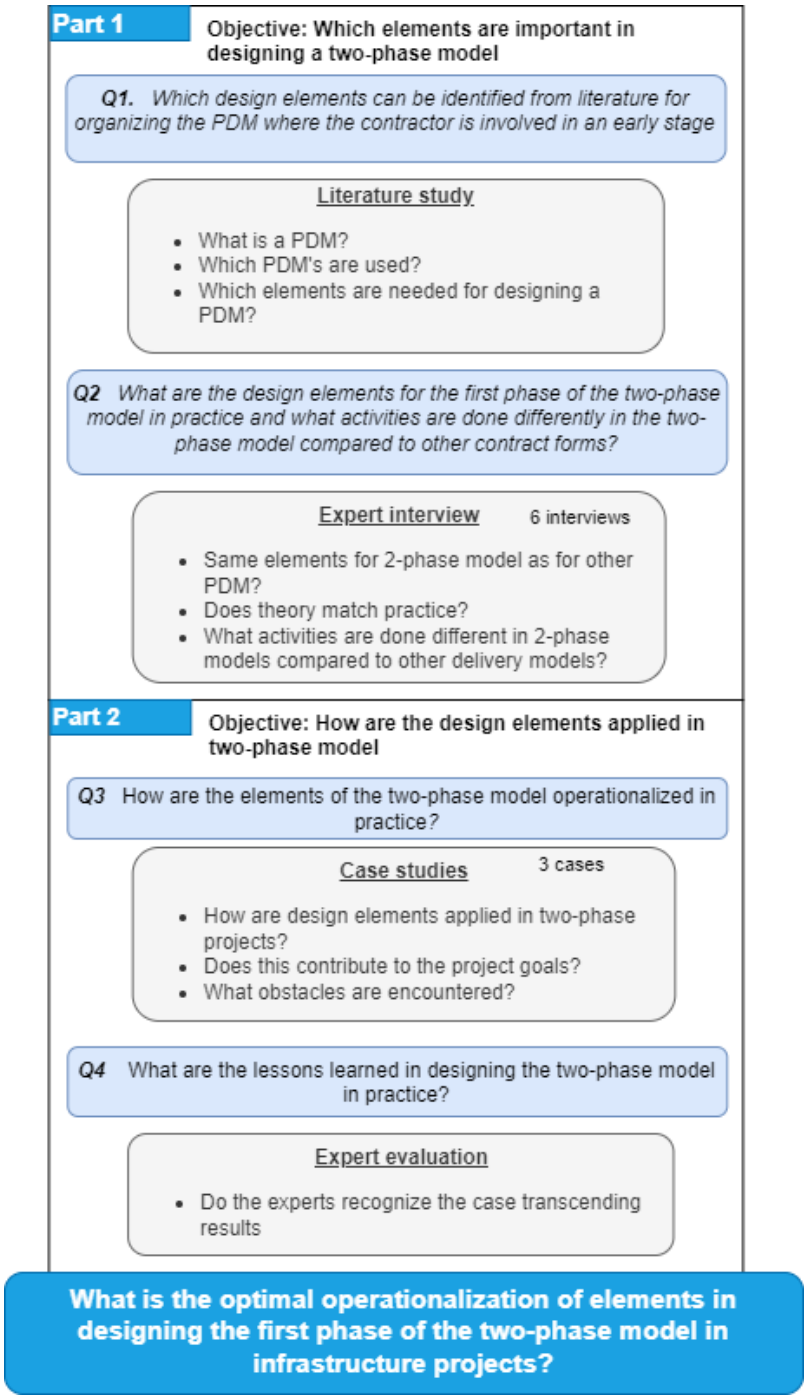

Figure 2.1: Research design

Q1 - Which design elements can be identified from literature for organizing the PDM where the contractor is involved in an early stage?
To answer the first research question (Q1), a literature study is conducted on the subject of project delivery models. The delivery models that are mainly used in the Dutch construction sector are described and the definition of a project delivery model is investigated. Secondly, the elements that a PDM consist of, are studied. In other words, this literature study provides the ingredients that are needed for designing a PDM.

Q2 - What are the design elements for the first phase of the two-phase model in practice and what activities are done differently in the two-phase model compared to other contract forms?
The purpose of the second research question (Q2) is to check if the design elements found in literature match with the findings of field experts. Secondly, this part should validate if the design elements for PDM's in general also apply to the two-phase model. Which activities done differently in a two-phase model compared to other contract forms is also a subject during the interviews. The answer to Q2 is found by conducting six expert interviews. Six interviews provide a wide enough picture on the elements of the two-phase model and is at the same time an executable number of interviews. All six experts are procurement and contracting managers or advisors who oversee multiple projects. The experts have experience with the two-phase model and work for a variety of public clients. The experts will be interviewed in a semi-structured way. The choice for a semi-structured method was made to stay in control of the expert interview and to assure a good validation of the elements found in Q1. Secondly, the semi-structured approach provides room for the interviewees to add additional elements that might not have been during from the literature study.

Q3 - How are the elements of the two-phase model operationalized in practice?
To gain insight into how the two-phase model is implemented in infrastructure projects, three cases are studied. How the design components are applied in the two-phase model, to realize the projects' objectives, is extracted from project documents. In interviews, the actors from the case study projects have been asked how they experience the two-phase model in the way that it is organized. The project actors have been asked which obstacles were encountered during the project design phase and how they think the elements of the two-phase model could be arranged differently in a future project to prevent reoccurrence of those obstacles.

Q4 - What are the lessons learned in designing the two-phase model in practice?
The outcomes from Q3 provided an overview of how the two-phase model is organized in the cases. Moreover, it provided insight into how the design of the two-phase model influences the project, what are good practices and lessons learned. From these results, statements have been formulated. In the last step of this research, these statements have been evaluated by experts from the field. For this evaluation, contracting experts with experience with the two-phase model, participated in an online expert meeting. The statements resulted in a set of lessons learned which can help client organisations by designing their two-phase model in future projects.

3

Elements of a Project Delivery Model

The two-phase model is a new project delivery model in the Dutch construction industry. The two-phase model was introduced to improve the predictability of project risks and enhance collaboration between the client and the contractor (McKinsey&Company, 2019). In this chapter, the answer to the first research question: "What design elements can be identified from literature for organizing the PDM where the contractor is involved early?" is given. By means of a literature study has the term Project Deliver Model been defined. Secondly, the commonly used PDM's in the construction industry are described. Finally, the elements that a PDM consist of, are determined.

3.1. Project delivery models

Project delivery models are used in the construction industry for organizing the performance of construction work and assigning the roles and responsibilities to project parties (Azari et al., 2014). Despite many efforts to define the term "project delivery model", there is no general consensus on the definition of the term(Azari et al., 2014). The 'old' definition of project delivery describes it as "how a project will be planned, designed, and built". The more current definition, however, is more thorough and includes the operation and maintenance as well (Pishdad and Beliveau, 2010). Miller et al. (2000) indeed include the maintenance and operation and define a PDM as "a system for organizing and financing design, construction operation and maintenance activities that facilitates the delivery of a good service".

Ding et al. (2018) argue that the PDM defines the sequence of project phases, parties involved in the project and implicitly assigned roles, and responsibilities to project parties. They name Design Bid Build (DBB), Design Build (DB), Construction Manager at Risk (CMR) and Integrated Project Delivery (IPD) as examples of PDM in the international construction industry.

In the Dutch Leidraad Aanbesteden by Jansen (2009) the term 'bouworganisatievorm' is defined as: "the way in which a contracting authority divides the execution and responsibility of the tasks in the construction process between itself and the other parties". Jansen names the traditional model, the integrated model and the alliance as three major groups of PDM's in The Netherlands. These PDM's are described further on in the report. The two-phase model is a delivery model that cannot be captured under one of these groups. The model can be applied in multiple ways, with the characteristics of different groups. The traditional Bouwteam model is for example a variation of the traditional model. The responsibilities can also be divided in a way that the two-phase model has more similarities with the integrated delivery model, and when all risks and associated costs are shared by the involved parties, the two-phase model increasingly shows similarities to the alliance. Because the two-phase model can be applied in many different ways, and as aforementioned, it cannot be grouped under one of the three major groups of PDM's, in addition to it being a rather new deliver model, it represents its own group.

3.1.1. Project delivery models and contract models

Project delivery models and contract models are often named interchangeably. Ther is, however a significant difference between the two. According to Pishdad and Beliveau (2010), a contracting strategy is a supporting means for successful implementation of project delivery approach. "A contracting strategy describes the

roles and responsibilities of the contracting parties; it determines the risk allocation strategies, methods of payment, basis for reimbursement, and incentive strategies for encouraging enhanced contribution". Jansen (2009) defines a construction contract as "a standardized legal binding agreement as made between the participants in a construction process, based on the chosen Project Delivery Model". In other words, a construction contract is a legally binding agreement based on the choices made in the PDM. Often these contracts are standardized for regularly used PDM's. Thereforen, they can be considered as contract models.

Since both terms are related and neither contracting strategy nor project delivery can function independently when they are separate, several papers (Pishdad and Beliveau 2010, Ding et al. 2018) combine the terms into 'Project Deliver and Contract Strategy' (PDCS).

3.1.2. Traditional project delivery model

In the traditional PDM, also known as Design, Bid, Build (DBB) the client is responsible for the plan-making, construction and maintenance of infrastructure projects (Lenferink et al., 2013), and for the interfaces between the different processes and contracts. All project phases are strictly separated in the traditional model (Bruggeman et al., 2010) and also placed on the market individually, based on separate contracts. The client is responsible for the design and must make sure the design is inline with his requirements, possibly with the help of a designer (Riggelen, 2019). For the realization, a contractor is procured under a fixed price to construct the project according to the specified design. If adjustments must be made to the design, this is not incorporated in the fixed price and becomes additional work for which additional costs will be made by the contractor.

Although, the client can outsource the design task to a designer, in relation to the contractor, the client is still legally responsible for the design (Jansen, 2009). The design is specified in a so-called 'RAW-bestek', a specification including a detailed technical design with an underlying preliminary calculation of materials needed (Lenferink et al., 2013). During construction, the client checks if the contractor works according to the specifications in the RAW-bestek (Riggelen, 2019). The construction contract, which is based on the traditional model is usually based on the Uniform Administrative Conditions (UAC) for the Execution of Works and Technical Installation Works. These are the general terms and conditions for Dutch building contracts (Bruggeman et al., 2010).

3.1.3. Integrated project delivery

In contrast to the traditional model, the several building processes are not separated, but integrated into one contract in the integrated project delivery (IPD). In the IPD the design and construction (D&C) tasks are outsourced to one single party in relation to the client (Bruggeman et al., 2010). Instead of providing an elaborate and detailed design as customary in the traditional model, requests the client in a D&C certain outputs to be delivered, based on the functional requirements Lenferink et al. (2013). The client takes on a less dominant role and the contractor is expected to be more pro-active in comparison to a traditional contract (Bruggeman et al., 2010). Besides designing and construction tasks, Financing (F), Maintenance (M) and Operation (O) can also be integrated within the same contract. Resulting to the most extensive form of the IPD which is Design, Build, Finance, Maintain & Operate (DBFMO).

3.1.4. Early contractor involvement

Early Contractor Involvement (ECI) is a broad term used for contracts in which, as the word suggest, the contractor is involved in an early stage. Either from the very beginning of a construction project, during the design phase or just before execution. By involving the contractor early on, the client intends to incorporate the contractor's expertise to optimize the project as a whole, counting on his knowledge of materials, planning and constructatbility (Van Wijck, 2018) (Rahman and Alhassan, 2012). ECI is considered to improve the collaboration between the client and the contractor (Van Wijck, 2018), which leads to more efficient project performance. Moreover, improved collaboration early in the project proves to be helpful into dividing the risks better (Love et al., 2008); (De Ridder and Noppen, 2009). Another main benefit of this approach is that issues that otherwise would arise during construction, can now be addressed earlier, before execution. This results in lower failure costs and an improvement of project efficiency (Rahman and Alhassan, 2012). In research by Van Wijck (2018), a list is provided with advantages that ECI brings to project delivery: Quicker project delivery, Cost reduction, Higher certainty in costs and planning, Improved quality of design and project, Improved innovativeness and Improved risk distribution and management.

ECI is mainly used in Australia, New Zealand and the United Kingdom (Van Wijck, 2018). ECI is not used in The Netherlands, but the Dutch apply some similar approaches. The PDM's used in The Netherlands similar

to ECI are: Bouwteams; Plan, Design & Construct (PD&C) and interweaving. PD&C is a form of the IPD in The Netherlands. In this model, the contractor is involved whilst the project initiation phase is not yet completed (Van Wijck, 2018). This is earlier than in other integrated projects like D&C. The objective of a PD&C is to exploit the contractor's creativity to find innovative planning solutions. However, this type of IPD is not often used (Riggelen, 2019).

3.1.5. Bouwteams

Bouwteam is a Dutch PDM with similarities to the internationally used ECI. Just like the ECI model, the contractor participates during the design phase to incorporate his expertise in the aspects of constructability and costs (Chao-Duivis, 2012) (Bruggeman et al., 2010). In 1992 a standardized contract, named the Bouwteam agreement, was created for the collaboration phase. It was purposely designed to shape the legal relationship between the client and the contractor (Chao-Duivis, 2012). Currently the Bouwteam agreement is being revised (Duurzaam gebouwd 2020 model or Model Bouwteamovereenkomst by Bouwend Nederland). In the new Bouwteam models, the UAV or the UAV-GC as general conditions for the execution phase can be applied. In a Bouwteam where the UAV is applied, all designs and specifications should be finalized before the execution phase starts. In a Bouwteam where the UAV-GC is applied, there is more flexibility in the required specifications before the execution phase starts.

After reviewing multiple literature sources, Pas (2021) formulated the definition of the Bouwteam as: *Bouwteam is a project delivery method with a two-phased contract. The first contract is for the participation of a team that includes at least the client and a construction partner in the design phase. This team, in an equal partnership, performs the tasks related to their expertise while retaining their independence and responsibility. The participants cooperate in developing the design and performing risk and cost management. With this, the involved contractor is, for the time being, the only one that may make a price offer for the second contract, the project execution agreement.*

The Bouwteam and the two-phase model are often used as synonyms in the infrastructure industry. Although the Bouwteam technically is a two-phased contract (because the design and execution phase are split, and the realization price is determined after the design phase), a distinction should also be made. According to CROW (2020) a Bouwteam agreement is intended for the realization of one specific project, while the two-phase model can also be effective for a portfolio of projects. Such two-phase models are also known as names such as Framework agreements, Territory contracts, Portfolio contracts or cooperation contracts. However, there is another difference between the two-phase model and the Bouwteam model. The allocation of roles and responsibilities is somewhat standardised in the Bouwteam model. In the two-phase model, this standardization is non-existent and allows the client the ability to allocate responsibilities more freely. For example, the client can choose to assign the contractor a coordinating role and take on more design responsibility. The two-phase model is therefore an umbrella term which also covers the Bouwteams, including being a more standardized form of PDM than the two-phase model.

3.2. Elements of PDM

Selecting an optimal PDM, according to literature, is seen as a critical task for clients to ensure project success and many articles can be found that provide tools for selection (Al Khalil, 2002; Mafakheri et al., 2007; Pishdad and Beliveau 2010). Despite various attempts to characterize selection factors for project delivery systems, the construction industry has not yet been able to achieve the desired outcomes through these systems. Traditional approaches to project delivery have been inefficient and ineffective due to a variety of reasons ranging from the fragmentation of people and specializations, to diverse and sometimes conflicting goals and interests of the stakeholders, to ineffective management approaches (Azari et al., 2014).
Based on an extensive literature review Pishdad and Beliveau (2010) found that a Project Delivery Contracting Strategy (PDCS) consists of elements that can be categorized into three groups. Selection factors, macro elements and micro elements. The three major categories Pishdad and Beliveau (2010) introduced in their framework consist of the elements given in Figure 3.1. The first column contains elements that influence the selection of a specific PDM. The middle column contains 'macro elements', which are important considerations that influence the PDM a great deal. The third column contains 'micro elements'. These are considerations determining the organization of, and the collaboration in, the PDM.

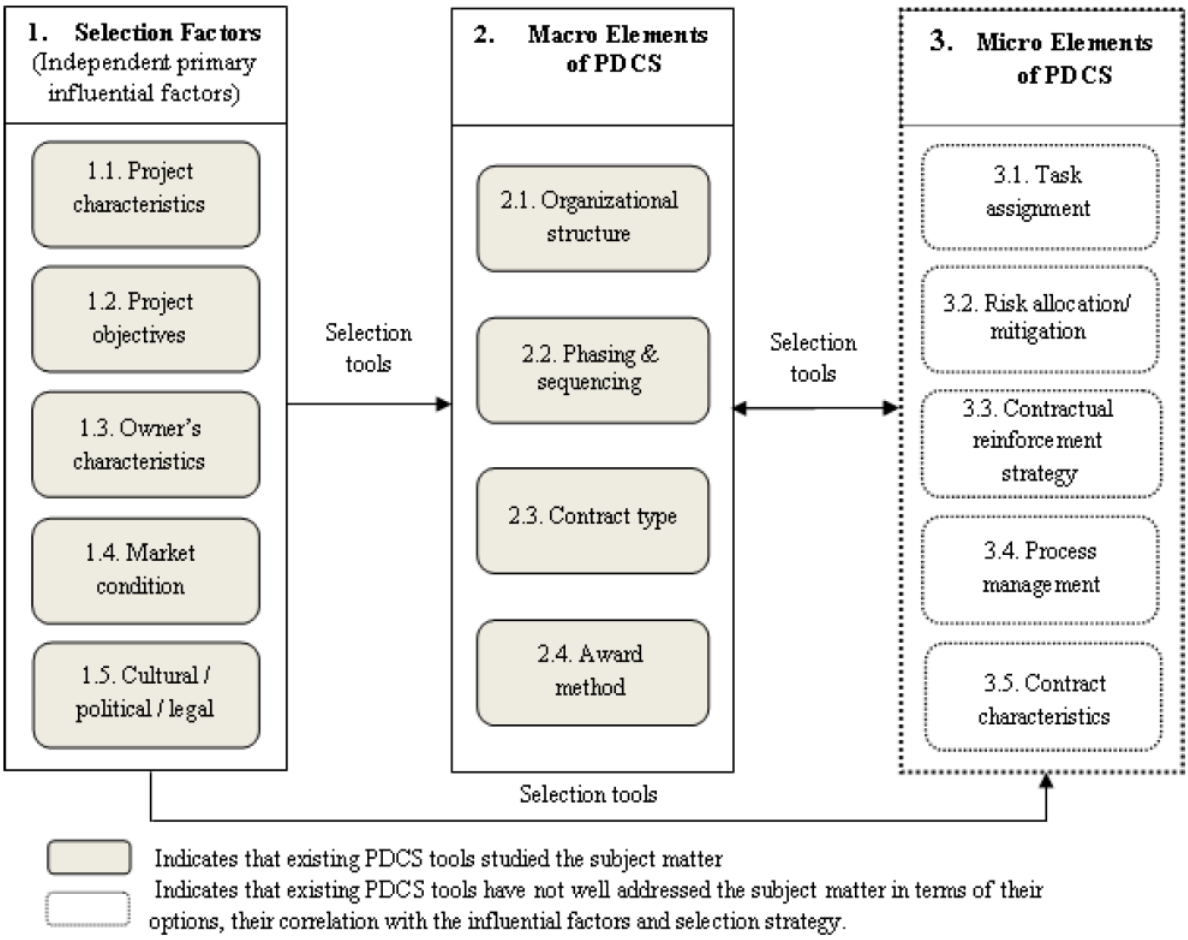

Figure 3.1: Elements of a Project Delivery Contract Strategy (Pishdad and Beliveau, 2010)

Column 1, the 'Selection Factors' describes factors that influence the selection of a PDCS. The project characteristics and objectives influence the aim of the PDCS. The owner's characteristics can be the owner's available in-house resources and expertise, its tendency for applying a specific PDM or a desire for control over the project. The market condition describes the availability of the required services. Political or regulatory constraints can provide limitations and force a client towards a certain PDCS. These five selection factors influence the choice of a certain PDCS. In the case of a project that is characterized as complex and with unclear risks, this can be influential for the client to apply the two-phase model with the aim to improve risks allocation. The owner's characteristics like the availability of in-house resources, can in turn influence the

level of involvement of the client in the design phase of the two-phase model.

Column 2, the macro elements describe strategic choices that are made on a high abstraction level and take place before or during the procurement process. The choice for the organizational structure basically determines which PDM will be used in the project. If project phases will be executed in sequence or if there will be a certain overlap, is decided in the phasing and sequencing elements. In the contract type, the payment method is chosen. In construction projects, a fixed price is usually determined. In the two-phase model the price is determined in a later stage in the process. The award method describes what selection criteria are used for the tendering parties. Since the realization price is determined later in the two-phase model, 'quality' becomes increasingly important as a selection factor.

Column 3, the micro elements have a lower abstraction level than the macro elements and determine the organization of the PDCS. They influence the collaboration between the client and the contractor during the project. Tasks assignment and risk allocation might be the most important elements in a two-phase model. These elements determine which parties are responsible for which part of the project. Within the contractual reinforcements, incentives can be added to steer. In the process management plan, the decision-making process and information management and ownership are described. If there will be a classical or relational contract, it is also described in this stage.

Klakegg (2017) describes in his research that when a client or owner has defined his organization's project model and his project implementation strategy, there are five important choices to make in the organization of the PDM.

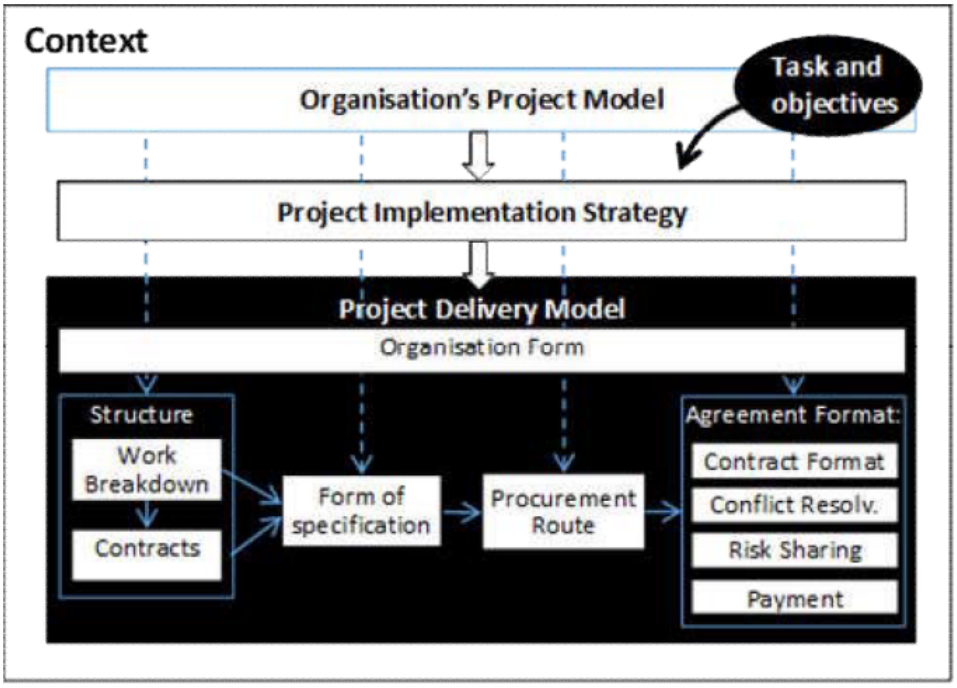

Figure 3.2: Elements of a PDM according to (Klakegg, 2017)

According to Klakegg (2017), the first choice a client has to make for defining the PDM is the design of the organization model. This determines how the owner secures decision-making capacity and his involvement in the project. This also determines how many resources the client's organization will assign to the project and it defines the client's own room to maneuver. Consequently, this also defines the room that can be filled in by other parties. In the second choice, the form of specification and performance description is defined. This describes how and on which level of detail the tender must be specified. The third element is the structure of the tasks themselves. The Work breakdown structure (WBS) defines the project scope as controllable elements in work packages or activities. The client decides on a basis of work packages how many contracts and what scope to allocate to each contract. After deciding on the contract structure, the procurement route must be selected. This includes processes for selection of the procurement procedure, contract model and compensation formats. The final group of elements in the PDM is the actual format of the agreement. This

involves key elements like the contract format, conflict resolution, risk-sharing policies and payment options.

Analysis
Figure 3.1 by Pishdad and Beliveau (2010), provides a clear overview of the several elements of selecting and designing a PDM and it indicates three different levels. Also Klakegg (2017) provides an overview of a procurement process, which also includes multiple levels of detail. To define the elements out of which a PDM exist, the model by Pishdad is taken as a starting point. The column describing the 'micro elements' gives a good overview of the elements that are important in a PDM and it provides the right level of detail for this research. After reviewing all sources of literature, some adjustments were made resulting in Table 3.1 which shows the elements of a PDM. The left column can be compared to the 'micro elements' by Pishdad, but again some changes were made. The Form of specification was missing in Pishdad's model, but is seen as a good addition from Klakegg's model. The second column describes the elements in another level of detail such as activities and considerations that must be undertaken in organizing the PDM.

Table 3.1: Elements of a PDM

Elements of a Project Delivery Model	
Task & Responsibility allocation	Pre-project planning Design & Engineering Construction Project management
Form of specification	'Early' / 'late' phase transition Detailed / conceptual design or functional requirements
Risk measures	Allocation Sharing Mitigation Insurance
Contractual reinforcements	Price determination Incentives / penalties Rewards / saving sharing Losses sharing
Process operating systems	Decision making (integrated, linear) Dispute management Information management & ownership
Form of collaboration	Classical / relational contract Intensity of collaboration

- Task & responsibility allocation
  This element describes the consideration about where to allocate tasks and responsibilities for the different activities in the building process from (pre-)project planning until construction. It must also be considered which party will be responsible for the project management.

- Form of specification
  The phase transition describes the transition from the exploration phase into the first phase (design phase) and the transition from the first phase into the second phase (execution phase). This describes the form of specification required before a phase transition is undertaken. Options are to opt for an 'early' transition when there is not much specified and still a lot is uncertain or for a 'late' phase transition, when all requirements are fully specified and detailed.

- Risk measurements
  The risk measurements describe the options that a project organization has for dealing with project risks. Risks can be contractually allocated at a certain party, or be shared between several parties. If and how the risks will be mitigated or insured is also part of this element.

- Contractual reinforcements
  The contractual reinforcements describe the elements that must be arranged in the contract, to make

the PDM work. Price determination describes how the execution price is determined. This is especially important to determine this process in a two-phase model, because the price is determined out of competition. Incentives and penalties describe elements in the two-phase model that motivate the contractor to align its efforts with the client's objectives. Rewards and saving sharing describes if and how the contractor will be rewarded for achieving specific objectives. Losses in the project can however also be shared between both parties.

- Process operating system
  The process operating system describes how the parties in the project operate with each other. It describes how the decision making process is arranged and how disputes are handled. It also describes how information and documents are owned and shared by the parties, because it is important to be aware of the correct document versions.

- Form of collaboration
  The form of collaboration describes how the parties collaborate. The parties can collaborate intensively by for example, integrating the management team. It is also possible to apply a coordinated collaboration, where both parties have their own tasks and work less integral. The contract classically describes which party is responsible for which tasks, but it can also describe how the parties will behave while collaborating, which is known as relational contract.

Table 3.1 presents the elements for a PDM as a result from the literature study. Overall, the table provides an overview of the elements that are important when a PDM is designed. Whether these elements for a PDM also apply to the two-phase model, is evaluated by experts in Chapter 4.

4

Expert interviews

This chapter describes a series of expert interviews which were conducted to answer the second research question: "What are the design elements for the first phase of the two-phase model in practice and what activities are done differently in the two-phase model compared to other contract forms?" Expert interviews were carried out to identify if the theoretical elements for a PDM in general also apply for the two-phase model. The interviews determine the elements that must considered when designing a two-phase model and theory is evaluated by practice. Secondly, the interviews identify which activities are done differently in the two-phase model compared to other delivery models. The interview sessions resulted in a model that describes the elements of the two-phase model that must be considered when the two-phase model is designed. Additionally, the interviews provided findings for how the elements in the two-phase model can be operationalized in projects.

4.1. Setup

Six contracting experts were selected, based on their experience in procurement and contracting in many different projects, working with a variety of clients. Table 4.1 provides an overview of the selected experts. Four consultants from TwynstraGudde participated in the interviews. Due to their participation in multiple projects, working for multiple clients, they have a wide perspective on the industry. Expert 1 and 4 were selected because of their participation in advisory assignments on the two-phase model. Expert 2 was selected because of the expert's extensive experience in different contract forms (including the two-phase model) in the construction industry. Expert 3 was selected to involve an expert in collaboration in the construction industry. To prevent a bias, two other experts were selected who both work for a different client organization and have experience with the two-phase model. The six experts work (mainly) for client organizations. Because the client has a leading role in designing the two-phase model, the contractor's perspective is not incorporated in this part of the research.

The expert interviews took place in individual, online or face-to-face, meetings with a duration of approximately one hour. At the start of the interviews, the experts were asked to give their definition of the two-phase model, and explain what the motivations are to apply a two-phase model. The main matter of the interviews was divided into two parts. The objective of the first part was to determine the elements of the two-phase model. Therefore, the experts were challenged to name and explain the elements of a two-phase model, from their perspective. After which, the table with the elements of a PDM, which was the result of the literature study in Section 3.2, was presented to the expert. The expert was asked if he/she recognized the elements from the table, or if changes should be made to fit the elements to the two-phase model. In this way, the table derived from theory has been evaluated in practice, and has been matched to the two-phase model.

The objective of the second part of the interview was to determine which activities in a two-phase model differ from other forms of contracts. The interviewees were therefore asked which activities are done differently in the two-phase model, than in other contracts. The setup and questions of the expert interviews can be found in Appendix A.

Table 4.1: Expert overview

Expert	Organization	Function description and experience
1.	TwynstraGudde	Consultant procurement and contracting >5 years of experience
2.	TwynstraGudde	Senior consultant procurement and contracting >20 years of experience
3.	TwynstraGudde	Senior consultant procurement and contracting Expert in collaboration in the construction industry >20 years of experience
4.	TwynstraGudde	Consultant procurement and contracting >9 years of experience
5.	RWS	Consultant procurement and contracting >15 years of experience
6.	Waterschap Rivierenland	Senior procurement advisor >26 years of experience

4.2. Interview results

During the interview sessions, the experts shared their ideas on the required elements in a two-phase model and Table 3.1 was evaluated. The expert interviews have resulted in a revised graph of the elements of a two-phase model. Several experts described the elements in Table 3.1 as being relatively global terms, but the elements were considered as fairly complete. Although the elements are almost complete, some clarity in the structure of the table was lacking in the opinion of several experts. A certain order should be added to the elements since there is a sequence in organizing a two-phase model, and several elements depend on choices earlier in the sequence. Sequence and structure are therefore the biggest improvement of the revised graph, compared to the table. The revised graph is given in Figure 4.1.

The attitude and behaviour of the project actors and the qualifications of the organizations are named as significant requirements for the two-phase model to have a chance to be successful. The following four items describe the elements that must be considered when the two-phase model is designed. In all interviews, the motivation for a client to opt for a two-phase model were described as the starting point of the thinking process for designing the model. An item that the expert missed in the table from the literature study, is the consideration if the two-phase model should be applied to the full project scope or to a specific part of the scope. Secondly, the results of the first phase and the allocation of responsibilities are named as the leading considerations to determine, to a great extent, the organization of the project. Thirdly, collaboration can be organized in several forms. The intensity of the collaboration and the task and role division are the most important elements in this stage. How risks are handled in the contract, how the realization price is determined during the design phase, incentives to motivate the contractor towards the project goals, and how disputes are handled are described in the contractual reinforcements. Figure 4.1 describes all elements that must be considered for designing the two-phase model. The blue and orange boxes describe the elements of the two-phase model. The text in white boxes describe options for the operationalization of the sub-elements. In Section 4.3, the origin and explanation of the elements from Figure 4.1 is described per subject.

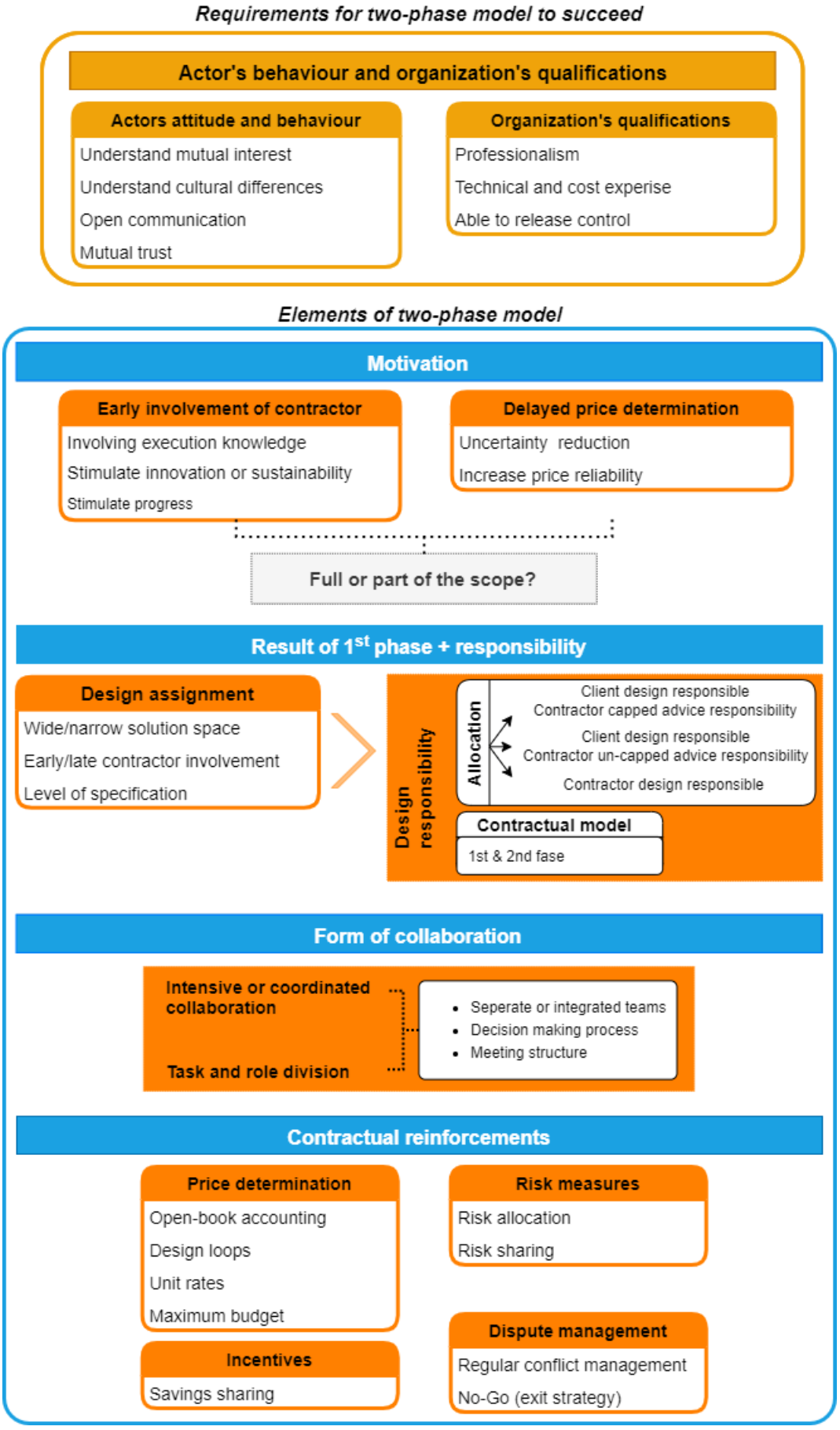

Figure 4.1: Elements of a two-phase model

4.3. Details per element

4.3.1. Actors behaviour and qualifications

The experts made clear that the attitude and behaviour of the involved actors, and qualifications of the involved organizations are most important in a two-phase model. Figure 4.2 describes the behaviour and qualification of the actors. This can be seen as a requirement for the two-phase model to be successful.

Figure 4.2: Attitude, behaviour and qualifications are requirements for a two-phase model

Attitude and behaviour

All six experts stated that the attitude and behaviour of the involved actors become increasingly important in the two-phase model. During the design phase, the client and the contractor collaborate to a greater or lesser extent on the design. This makes the attitude and behaviour of the actors increasingly important in this contract model. At the start of the project, both parties should invest in the collaboration, and continue to do so during the project. Desired behaviour by the project parties is described as:

- understanding the interest of the other party;
- understanding cultural differences between organizations;
- open communication between actors;
- mutual trust.

In a collaboration of a two-phase model, tasks and responsibilities can become less clear than in other deliver models. The actors should therefore keep each other actively informed and openly discuss arising issues. At the start of the project, the client must share his ideas on how he envisions the collaboration. The contractor should, however, also have a say in how the collaboration should be organized.

Organizational qualifications

The two-phase model is a very different PDM than other delivery methods. The client's organizations requires some qualifications to bring the two-phase model towards a good end. The same required qualities apply for the contractor's organization, although in a lesser extent. First of all the client's organization must be professional enough to procure a project with the two-phase approach. The client must make well-considered choices in the application of the two-phase model. The client must be able to determine and apply clear processes. During the design phase, technical and cost expertise are required qualifications for the client to be able to collaborate with the contractor on an equal basis, and to be able to control the contractor. Without technical and cost expertise the client is unable to control the design activities and the price determination of the contractor. Lastly, the client must be able to release control. The client and the contractor will collaborate during the design phase. The contractor will influence the decision making process. This requires that the client gives the contractor room to have influence.

4.3.2. Motivation for a two-phase model

The design of the two-phase model starts for the contracting party at the consideration about the motivation to apply the two-phase model. The definition of a two-phase model is clearly described by the experts as the following: "A two-phase model consists of two phases, namely a design phase and a realization phase, the contractor is early involved in the project, and the price of the realization costs is determined at the end

of the first phase, without competition". These three characteristics directly imply some important circumstances that should be in place before a two-phase approach can be applied: a desire to involve the contractor early in the project, and a reason to delay the pricing. These circumstances are both described in Figure 4.3. If these circumstances are not in place in a certain project, the two-phase model should not be applied, is the shared opinion of the interviewees. When both elements are present in a project, it is possible to apply the two-phase model. The client must than decide if the two-phase model is applied to a part, or to the full project scope.

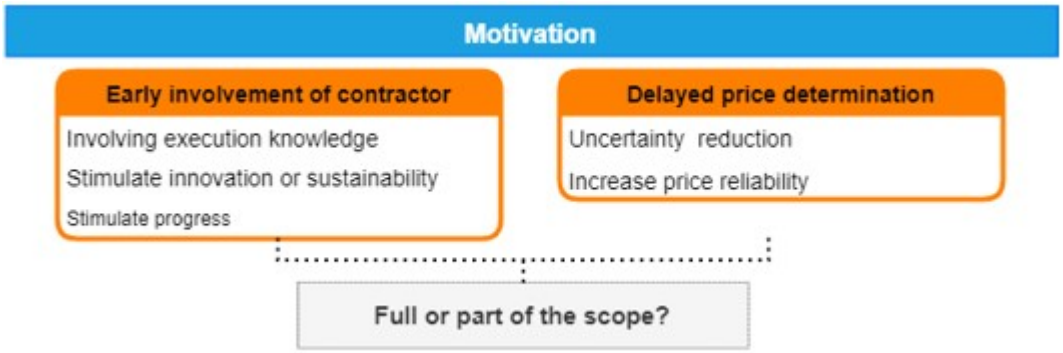

Figure 4.3: Motivation for the two-phase model

Early involvement of the contractor

A certain form of complexity in a project can be a reason for a public client to involve a contractor early in the project. Complexity can occur in many forms like challenges on the technical, surroundings, planning or stakeholders side of the project. A contractor can bring clever solutions to a project by exploiting his executional knowledge in the design. This can improve the efficiency of the design on material, costs and planning or reduce hindrance. Besides having construction knowledge, a contractor is also a cost expert. Having the contractor on board during the design phase enables the project parties to decide on design alternatives with considering the costs for both alternatives.

Early involvement of the contractor can also stimulate innovation or enable sustainability in a project. In a two-phase model there is more room for collaboration between the client and the contractor, which is an important factor for innovation and sustainability. Secondly, the delayed price determination makes it possible to investigate the possibilities of innovative solutions or sustainable added value during the design phase. The fact that there is no financial competition helps to implement innovation or sustainability in a project. Also, the decisiveness and the speed in which a contractor can operate is named as a motive to involve the contractor early to increase progress during the design phase albeit that this is named as a minor motive to apply a two-phase model.

Delayed price determination

Complexity in a project also brings uncertainties, which makes it difficult to determine the realization costs of a project. A delayed price determination, until the end of the first phase, when the design is finished, will improve the reliability of the realization price. During the design phase the contractor can determine, which investigations and calculations should be carried out to provide insight into project risks. This can help to mitigating the risk, giving the contractor the opportunity to calculate the remaining risk in the realization price. According to the experts, delayed pricing is recognized as a solution to prevent major disputes in infrastructure projects.

The two-phase model originated at the waterboards with the High Water Flood Defence (HWFD). These dike reinforcement projects are many times larger than the Waterboard's annual budget. The projects are financed by state subsidies, but the waterboard is fully responsible for cost overruns. This makes that the waterboard requires a high price certainty, which can be provided by the two-phase model. The experts named the financing method of the HWFD the initiation to the two-phase model.

Delayed pricing also brings a disadvantage. When the price is determined without other competitors, the risk arises that the price can increase. Although there are some measures to control this risk, this remains an uncomfortable feature of the two-phase model. The advantages of the two-phase approach should therefore

compensate for this disadvantage.

Complete or partial project scope
In projects where constructional knowledge is useful to involve in the design and where uncertainties seem too risky to apply a fixed price, the two-phase model can be applied. According to the experts, it should be decided if the two-phase approach should be applied to the full scope or purely to the complex parts of the project scope. Five of the six experts were of the opinion that it is logical to apply the two-phase approach only on the complex parts of the project scope since there is no advantage to gain on the simpler parts of the project. One of six experts opposes this idea. In his opinion having a fixed price on a part of the scope and a part that is determined later, stimulates opportunistic behaviour by the bidders and should therefore be avoided.

4.3.3. Result of the first phase and responsibility
When the required motives are present and the choice for a two-phase model has been made, several important choices should be considered. This starts with the desired result of the first phase and the responsibility allocation of that result, as described in Figure 4.4. These choices have major influence because many organizational choices are dependent on them.

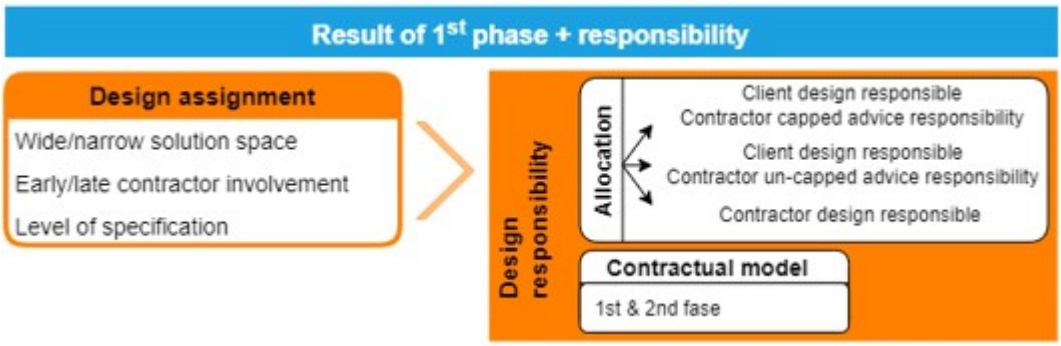

Figure 4.4: Result of the first phase and responsibility division

Result of the first phase
The result of the first phase describes the tangible products that must be created during the design phase. One of the experts described it as: "The result of the first phase should be a design, with corresponding costs estimate and risk register, of which the client and the contractor are confident to move into the second phase." The required design assignment in the first phase can be wide or narrow. This depends in the first place on how far the client has already specified the design when he involves the contractor. Secondly, the moment when the first phase ends and the second phase starts are important for the magnitude of the design assignment. When the contractor is involved early, a large design assignment is to be carried out, with a wide solution space. It is also possible that the client is already well advanced with the designs. This would only leave a design optimization for the contractor during the design phase, which is a much smaller design assignment. Design optimization can be focused on increasing the efficiency of costs, material use, execution methodology and planning or hindrance minimization. The level of detail that is required before the first phase can proceed into the second phase also has influence. It is possible to specify the design towards a full specification or an execution design (UO), or the design phase can stop when a final design (DO) is reached.

Responsibility
The owner of the design responsibility determines to a large extent the risks allocation, the role division of both parties and the decision making process. The allocation of the design responsibility has large influence on the organization of the two-phase model. The client can stay responsible for the design and use the contractor's advice. This approach is applied in the traditional Bouwteam. The contractor holds the responsibility for the given advice, but has a limited liability. The design responsibility can also be transferred to the contractor. In that case, the contractor will take a more leading role during the design phase. Especially

towards the end of the first phase, the contractor will become increasingly directive to determine what investigations are required and which design decisions should be taken. This type of responsibility allocation is the preferred choice in many projects, according to the experts. The party responsible for the design will most likely demand to have a leading role during the design phase and to have the final say in a discussion about design solutions. Not every client will agree to these demands, which can lead to discussions about risk allocation or the cost of certain risks. There is another option, where the client stays responsible for the design and the contractor is responsible for the given advice, but without a limited liability. In that case, the contractor takes one more risk.

The responsibility allocation determines to a large extent the form of contractual conditions that will be used in the project. In a project where the design is detailed until a fully specified set of requirements, and where the client wants to stay responsible for the design, the execution contract will be based on the UAV. In a project with a wider design assignment, where the contractor will have design responsibility, the execution contract will be based on the UAV-GC. In the first phase, the contract type can be based on a certain design agreement, or the UAV-GC can be applied.

4.3.4. Form of collaboration

The result of the design phase together with the responsibility allocation of the design determines to a great extent how the collaboration in the two-phase model will be organized. Figure 4.5 describes the element of the form of collaboration. In a traditional Bouwteam, the solution space for the design assignment is usually limited and the client stays responsible for the design. As a result, in such a project the role of the contractor is limited. The contractor has an advisory role and is given the task to provide input and warn when he foresees risks. In a two-phase project where the contractor is involved early in the project, with a much broader design assignment, an intensive collaboration with input from both parties seems suitable. Moreover, when the contractor in such a project will bear design responsibility, he will become increasingly directive towards the end of the design phase. The intensity of the collaboration and the task and role division is therefore influenced by the responsibility and result of the first phase.

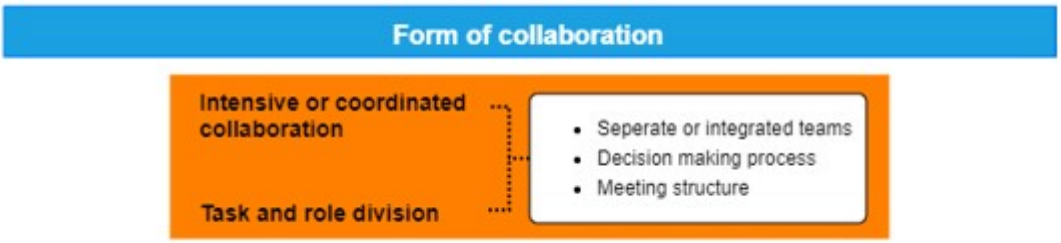

Figure 4.5: Task and role division and the intensity of collaboration

Intensive or coordinated collaboration

The collaboration between the client and the contractor parties in a two-phase model can differ in intensity. Parties can cooperate in an integrated project team and both contribute to a collaborative design effort. On the other hand, is it also possible that roles and tasks are clearly coordinated between parties. The contractor can, for example, execute all the design work and the client can take the role of assessor of the design products. Also, many forms in between are possible. The experts describe that the intensity of the collaboration is dependent on the culture and in-house resources of the client. Waterboards, for example, have a lot of in-house technical expertise which enables them to deliver valuable input in a collaborative design effort. Within the waterboards, there is a culture in which they like to keep control of the project. This can also stimulate intensive collaboration. RWS on the other hand has fewer technical resources available in projects and has acquired a role as an assessor in their integrated projects during the last decade. Intensive collaboration with substantial technical design input is therefore less obvious for RWS. Four of six experts appointed this difference in collaboration intensity between the Waterboards and RWS.

One of the experts shared the opinion that in every two-phase project an integrated project management team should be created. Although both parties could perform their coordinated tasks separated from each

other in their own teams, all discussions, design choices, risks and other issues should be discussed and dealt with in the integrated project management team to avoid a blaming culture. A mirrored management team is, however, also possible. In a mirrored management team the client and the contractor both deliver a representative for a certain position. This means there are two people on every role. The integral management team is seen as more intensive way of collaboration, while a mirrored management team is seen as less intensive collaboration.

Task and role division

The task division describes which party executes a certain task in a project. The tasks that need to be divided can be certain design and engineering activities, investigations, permit applications, stakeholder management etc. The role and task division as well depends on the responsibility division in the first phase. The party that is responsible for a certain task will in most cases also take a leading role in executing that task. For example, a contractor that is responsible for the design will also want to take a leading role in the design process. The contractor will need to determine what research should be carried out and which design alternatives will be investigated.

An expert described a project where the client was already quite far in the design process and had gained a lot of knowledge. The contractor needed to optimize a part of the project scope and would also become design responsible. When the design phase started, the client took a leading role in transferring the information that he had gained to the contractor. Later in the project, the contractor would take-over this leading role, because he became responsible for the design.

Another element that should be considered is the meeting structure. How regular the meetings take place and on which levels. Which subjects are discussed in the meetings, who should be present and which party provides a chairman are all items to consider. Also, the decision-making process should be considered. Are decisions taken in a top-down or bottom-up hierarchy, and which party has the last say.

4.3.5. Contractual reinforcement

The contractual reinforcements in Figure 4.6, describe the subjects that can be implemented in the contract to strengthen the client's position in several situation. This can help to motivate the contractor to align it's the client to motivate the contractor towards the project objectives.

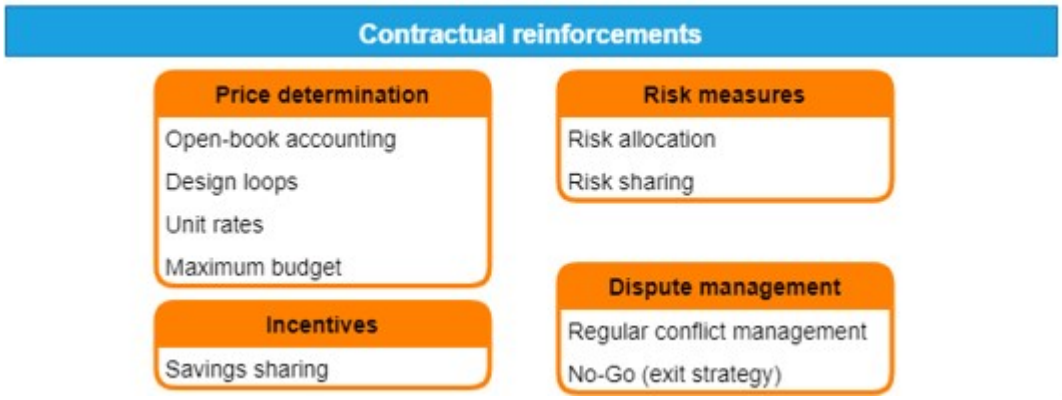

Figure 4.6: Contractual reinforcements

Price determination

As described earlier, the delayed price determination creates a disadvantage for the client due to the absence of price competition. Still, all experts were of the opinion that this should not discourage the client from applying the two-phase model. The experts believe that there are enough tools available to stay in control of the realization price. Most projects apply open-book accounting, meaning that the contractor must be transparent about how his prices are calculated. Design loops with cost estimates are often used in two-phase projects. During every design loop, the certainty of the final costs should become increasingly clear. In some projects, unit rates are used during the tender stage to find the most economical contractor, these unit rates then form the basis for the execution price. This however brings the risk that the unit rates are not represen-

tative of the actual execution or that the contractor will try to increase the units to increase his revenue. The client can also set a maximized budget. During the design phase, the contractor and the client can mutually strive to implement the most added value in the design as possible within the available budget. When the client is not sure if the prices that the contractor uses are representative, he can ask a third party to make a cost estimate to compare both prices.

Risk measures

One of the motives to apply the two-phase model is to increase the predictability of risks and to decrease uncertainty. To achieve this goal it should be made clear how risk will be managed in the project. To a large extent, most risks are already allocated when the design responsibility is allocated and the contract conditions are set. Although, during the project, it might be probable that unforeseen risks will arise. It should be clear from the start how such situation would be handled and how these risks will be allocated. Secondly, a choice should be made about the owner of the risk register. The risk register can be a joint responsibility, or it can be the responsibility of the contractor. Some projects have financial resources ready to use for unforeseen risks that are difficult to allocate to one of the parties. This is a form of risk-sharing, where both parties contribute when such a risk occurs.

Dispute management

Despite good intentions, discussions in infrastructure projects can result in disputes. Both parties should try to avoid an escalation, but when disputes occur some sort of process should be in place. What dispute management should look like did not become completely clear during the interviews. A regular conflict management is possible, which is the same as in other contract forms. When the parties can not reach a mutual agreement, the parties have the option to scale-up and involve a higher layer of management. If that does not help there is a possibility for mediation or, at last resort, eventually court.

The exit option is a specific form of dispute management for the two-phase model. At the end of the design phase, a 'Go / No-Go' decision is made. When the client and the contractor, cannot come to an agreement for the execution phase, an exit option is available. A clause should be included in the two-phase contract, stating that when the parties do not come to an agreement, the client becomes the rightful owner of the designs. This gives the client the opportunity to find another contractor for the execution work.

Incentives

An incentive is something that motivates or encourages someone to do something. Therefore incentives can be applied to encourage the contractor to work towards the client's project objectives. The contractor can be motivated in a positive sense by awarding him for achievements, or he can be motivated by penalizing him when targets are not achieved. The second option is often seen when contractors can't make planning milestones. Penalizing the contractor is in the opinion of one of the experts something that should not be applied in projects since it hurts the relationship between the client and the contractor. An expert named an example of an incentive in a two-phase model where the contractor would receive 50% of the cost savings that he could achieve. This motivates the contractor to improve the efficiency in the design and minimize costs.

4.3.6. Activities that differ in the two-phase model compared to other contract forms

The two-phase model is new in the industry. In the last part of the interview, the experts were asked which activities are done differently in a two-phase model compared to other contract forms.

Delayed price determination

The delayed price determination, outside of competition, is a unique characteristic of the two-phase model which is not seen in any other contract type. The client's position is a bit weakened since there is no financial competition for the contractor. This entails the risk that the contractor will increase its prices. To keep the realization price under control, the client needs to take some precautions to keep the realization price in control. This is a fundamental difference compared to other contract forms. Several experts explained that multiple design 'loops' are applied during the design phase. At the end of every design loop, the designs are reviewed on their quality and their associated costs. This ensures that the client keeps insight into the price development. The discussion at the end of every design loop about the realization costs and the project risks should be an open conversation based on equal information. This was named by all experts as an essential part of the design process. To enable an open discussion with equal information, the contractor should be

open about the price structure and the backgrounds of risks. Another requirement is that the actors on the client side have expertise on price build-up and the technicality of risks. Qualified people are therefore very important in a two-phase project.

Selecting a collaborative partner
During the tender, before the two-phase model is started, the client is searching for the best collaborative partner instead of the best execution party. One of the experts stated it as: "After the pre-selection, all remaining candidates are well capable for executing the project, the client is searching for the party that is most capable to collaborate with during the design phase." This entails the advantage that there is no need for a technical tender process, which makes it is possible to make the tender process simpler and shorter.

Attitude and behaviour
All six experts stated that the attitude and behaviour of the project parties become increasingly important in the two-phase model. One of the experts stated that the right attitude and behaviour improve the collaboration in every project. Although, in the two-phase model the right attitude and behaviour are essential for a successful project. Attitude, behaviour and qualifications are therefore inserted at the top of Figure 4.1.

4.4. Elements of the two-phase model

This chapter has described the elements of a two-phase model that must be considered when designing a two-phase model. Figure 4.1 provides an overview of the elements of the two-phase model, and the options for the implementation of the elements are identified. The five major elements in the two-phase model are:

- **Actor's behaviour and organization's qualifications** are requirements for the two-phase model to be successful.
- **The motivation** to apply the two-phase model must consist of a desire to involve the contractor early and to delay the price determination. This can apply on the full, or a part of the project scope.
- **The result of the first phase and responsibility** describe the design assignment that can be wide or narrow and the responsibility allocation over the design.
- **The form of collaboration** can be integral or coordinated. This has influence on task and role division between the parties, separated or integrated management teams and decision making.
- **The contractual reinforcements** describe the subjects that can be implemented to motivate the contractor towards the project objectives. Price determination, risk measures, dispute management and incentives are elements that must be considered.

Secondly, the activities that are done differently in the two-phase model compared to other delivery models have been described.

- **Delayed price determination**
  The execution price is determined without financial competition for the contractor. The client's position is therefore weakened. The client needs to take precautions to keep the realization price in control.
- **Selecting collaborative partner**
  During the tender, the client aims to select the most collaborative contractor for the project. The focus during the tender phase is therefore different than in other projects where the best capable party for the execution is selected.
- **Attitude and behaviour**
  The attitude and behaviour of the project parties become increasingly important in the two-phase model. In the two-phase model the right attitude and behaviour are essential for a successful project.

5

Case study design

In the previous chapter, the elements of the two-phase model were established. These elements are needed to design a two-phase model. To answer the third research question: “How are the elements of the two-phase model combined in practice?”, a case study has been executed. This chapter first describes the selection of case study projects. Secondly, the data gathering method within the case study projects is described. Thirdly, the analysis of the gathered data is explained. The chapter ends with a description of the selected projects.

5.1. Case selection

To select cases, a list was compiled of all infrastructure projects, known to TwynstraGudde, in which the two-phase model is applied. Many projects are still in the very early stages of the project life cycle and have not yet been tendered. This narrows the selection as the case study will investigate projects that are currently in the first phase of the two-phase process, or further. The remaining projects have a variety of clients and different technical characteristics. To compare how the two-phase model is organized in different projects, three infrastructure projects were selected for the case studies. The projects are selected on the following criteria:

- the two-phase model is applied to a part, or the full scope of the project;
- the project is currently in the first phase of the two-phase process, or further;
- there is one contracting party or consortium involved;
- the client and the contractor collaborate, to a certain extent, during the design phase.

5.2. Data gathering

The data for the case studies is gathered by a document study and interview sessions. The document study will provide the context of the project and give insight into how the first phase of the project was intended. After the document study, semi-structured interviews were preformed to investigate how the planned approach was applied in practice. How the model is experienced in practice was also discussed during the interviews. The objective of the case studies is to determine:

- what the motive was for applying the two-phase model;
- what the project goals are;
- how the elements of the two-phase model are organized in the project;
- how this contributes for achieving the project goals and the motivation for the two-phase model;
- which obstacles are encountered during the design process in the first phase;
- which lessons were learned during the project.

5.2.1. Document study

By means of the document study, information was investigated that was available before the first phase of the project started. This provided insight into the project goals, the motivation for applying the two-phase model and how the organization of the two-phase model was intended. In addition, the document study will provide the context of the project, like the technicality and challenges. This information will be gathered from open sources like the project website, and from documents like the tender guideline.

5.2.2. Interview sessions

Interview sessions were planned with project participants to gain insight into how the two-phase model is implemented in the project. Members of the project's management team participated in the interview sessions because they have the best perspective on the organization of the two-phase model. An overview of the interviewees is provided in Table 5.1. It is expected that the client has a leading role in organizing the two-phase model. The client also knows best if his project goals are achieved. The contractor, however, also influences the collaboration. Therefore, managers of both the client's and the contractor's organizations were interviewed. Per organisation, two managers have been interviewed to increase the reliability of the results. Because of their expected leading role in organizing the two-phase model, the client was interviewed first in the sequence of the interviews. The contractor was second in line during the interview sessions. The semi-structured, (digital) face-to-face interviews took about 1,5 hours. The set-up, including the interview questions, can be found in Appendix B.

Before an interview started the interview's privacy policy was explained to the interviewee. The privacy policy stated: The interviewee-participation in the case study is voluntarily. The interviewee is not obliged to answer any of the questions. The interviewee is not named in the research report and the interview results have been anonymised. After the interview, a summary has been written, which was approved by the interviewee before the results were processed in the research report. The interviewees agreed to the above, and signed a consent form.

5.3. Data analysis

The data that is gathered in the case studies consist of the information from the document study and the interview summaries. The gathered data from the document study and the interviews are combined and thematically analysed. To compare the information of the three different cases, a hierarchic comparative analysis is applied (Yin, 2018). This means that the data is first analysed per case individually, after which, the findings are compared over the cases. The themes, that are based on the results of the literature study, are:

- Motivation for applying the two-phase model
- Results of the first phase
- Responsibilities
- Form of collaboration
  - Task and role division
  - Management team and project organisation
  - Decision making
- Contractual reinforcements
  - Risk measures
  - Price determination
  - Incentives
  - Dispute management
- Culture, attitude and behaviour

In the case study interviews, also topics were discussed that are not in the list above. These topics can be captured in: 1. Additional elements that were important for the organization of the two-phase model, or 2. Topics that describe the actor's experiences with the two-phase model like obstacles, or learned lessons. These topics are also thematically analysed. First for each case separately. Later, the findings of the cases are compared.

Table 5.1: Interview participants

Interviewee / case	ID	Years of experience and project involvement
Case A. Dike reinforcement 1.		
Water board Project Manger	A.1.Cl	20 years; working for the Waterboard. Has been involved since the project's initiation in 2017.
Water board Stakeholder Manager	A.2.Cl	9 years; in the field of hydraulic engineering. Got involved during the exploration phase in 2018.
Contractor Project Manager	A.3.Con	20> years; large infrastructure projects. Got involved in the project during the start-up phase in Nov. 2020.
Contractor Contract Manager	A.4.Con	25 years; in large (international) hydraulic engineering projects. Has been involved since the start of the tender in Dec. 2019.
Case B. Dike reinforcement 2.		
Water board Contract Manager	B.1.Cl	30> years; in the infrastructure industry. Has been working for the Waterboard since 2017 and is the founder of the contractual model for this project.
Water board Project Manager	B.2.Cl	24 years; in the infrastructure industry. Was involved in the exploration phase of the project in Nov. 2019.
Contractor Project Manager	B.3.Con	Worked over 25 years for Dutch contractors on large infrastructure projects. Has been involved since the start of the tender in 2019.
Contractor Technical Manager	B.4.Con	Over 20 year of experience in the hydraulic engineering industry. Has also worked for an engineering firm. Has been involved since the start of the tender in 2019.
Case C. Riverbank lowering		
Client Contract Manager	C.1.Cl	Has been working for the client party for 25 years. Has been involved since the exploration phase in 2017.
Client Contract advisor	C.2.Cl	10> years of experience in the infrastructure industry. Involved in the project since the exploration phase in 2017.
Contractor Project Manager	C.3.Con	17 years; in the Dutch infrastructure industry. Is involved in the project since the tender phase in 2018.

5.4. Description of cases

This section describes the three selected cases to understand the context and content of the project. The technical scope, complexities and project phases are described.

5.4.1. Case A: Dike reinforcement 1

Case A is a 29 kilometres long dike reinforcement project on one of the Dutch rivers that is part of the HWFD programme. When the water levels are high in the river and the floodplains fill with water, the dike is under high pressure. The dike is being reinforced in order to comply with legal requirements. The Waterboard in this area is the client in this project. One of the major complexities in this project is the amount of stakeholders. The dike is not owned by the Waterboard but by 250 landowners consisting of local residents and farmers. Besides the local residents, the province and the municipality are also important stakeholders. On the inner side of the dike, a Natura 2000 nature preserve area is located. The outside of the dike is owned by the local residents and mainly used as gardens. Due to the vast project area and limited space on both sides of the dike, executing the works will be a logistical challenge.

Project phases

The project phases of Case A are illustrated in Figure 5.1. The project is currently in the design phase, which is the first phase of the two-phase model. The execution phase is the second phase of the two-phase model. The main objective of the design phase is to get the main permit approved by the province. Before an application for the main permit can be submitted, the definite design must be finished. Obtaining the main permit can take roughly a year. The Waterboard decided that during this procedure, the project organisation can continue work on the execution design (UO) for a more efficient lead time of the project. In the tender, during the exploration phase, the contractor was selected. The parties started their collaboration in a project start-up of 8 weeks. During the start-up, the parties determined the work method for the design activities during

the design phase. The project's organisation is currently working on the preliminary design. During this phase, the project organisation will start gathering the design requirements from the stakeholders. Secondly, some design alternatives will be investigated, after which, one will be chosen and elaborated on further. This is an important step since it determines the definitive required space for the dike body, and the temporary required space for the execution works. The HWFD delivers the subsidy for the dike reinforcement projects in two stages, where the first stage subsidy is meant for the design works until the application for the main permit. The second stage subsidy is meant for the execution phase. The design activities for the execution design are included in the second subsidy application.

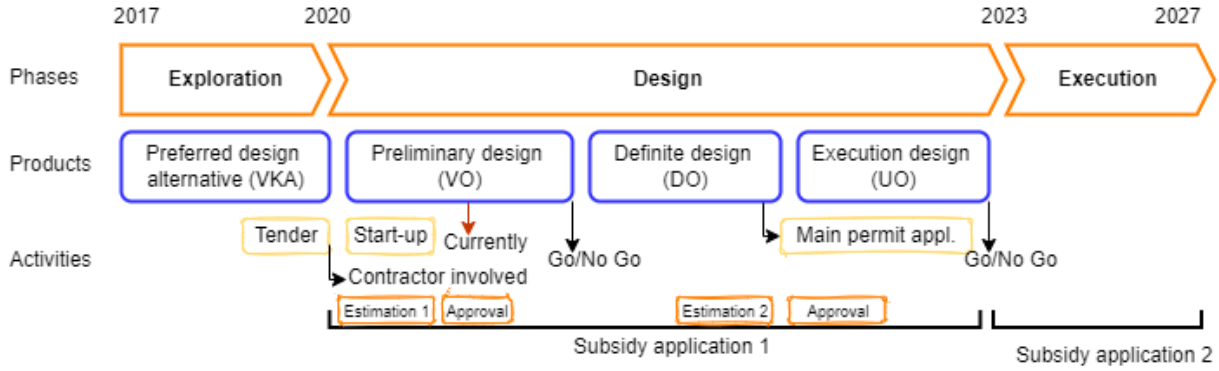

Figure 5.1: Case A. Project phases

5.4.2. Case B: Dike reinforcement 2

Case B describes a project where a dike of 55 kilometres in length must be reinforced. The dike, which lies somewhere central in The Netherlands, protects a large part of the a densely populated and industrialised part of The Netherlands. The project is part of the HWFD program and the regional Waterboard is the project's client. Because of its scale, the project is split into 6 sub-projects, which will be started and executed in a phased sequence. This is illustrated in Figure 5.2.

Besides the two-phase model, the Waterboard applied another procurement method in this project. The Waterboard has high aspirations for this project and these cannot be achieved by traditional solutions. Innovative solutions are therefore needed. The procurement method that the Waterboard applies to this project is a combination of the two-phase model and the innovation partnership. The Waterboard and three contractors have joined forces in the innovation partnership. The contractors have the opportunity to develop their technical innovations in one of the sub-projects. This will provide the contractors the opportunity to share knowledge and gain insights from each other. If the contractor performs well on his sub-project, he can be awarded a second sub-project. The focus of the case study lies on sub-project C.

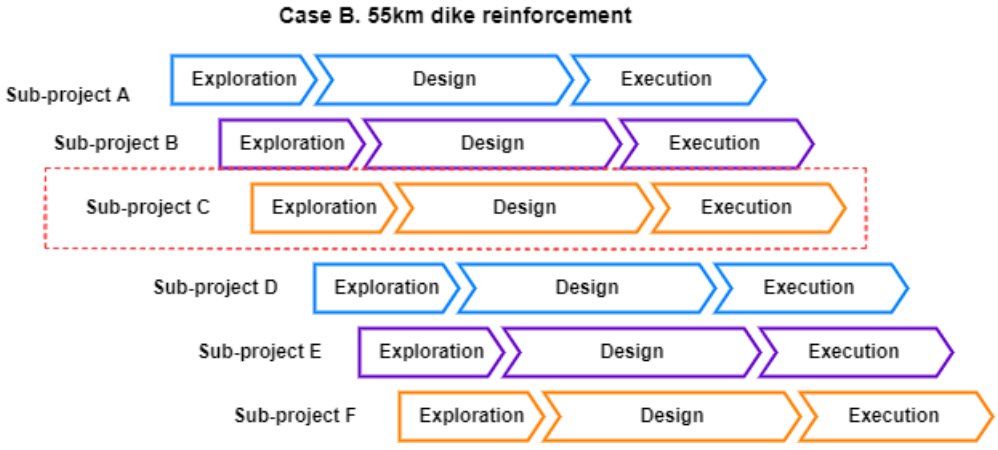

Figure 5.2: Case B. Sub-project overview

Project phases

Figure 5.3 illustrates the project phases of sub-project C. This is similar to the project phases of the other sub-projects. Due to the sub-project A, B and C having been tendered simultaneously, but commenced in phases, there elapsed some time between the end of the tender and the start-up of the project. This meant that the selected contractor for the sub-project had to wait before he could actually start work on the project. The project is currently in the first design loop of the design phase. The start-up period, in which the project management plan and the first subsidy estimation were determined, is finished. After the first design loop, the application for the main project permit from the province can be started. The application process is expected to take a considerable amount of time. The application for the HWFD subsidy is split into two parts: The first subsidy stage for the design works until a definite design, and the second stage for the execution design and the execution works.

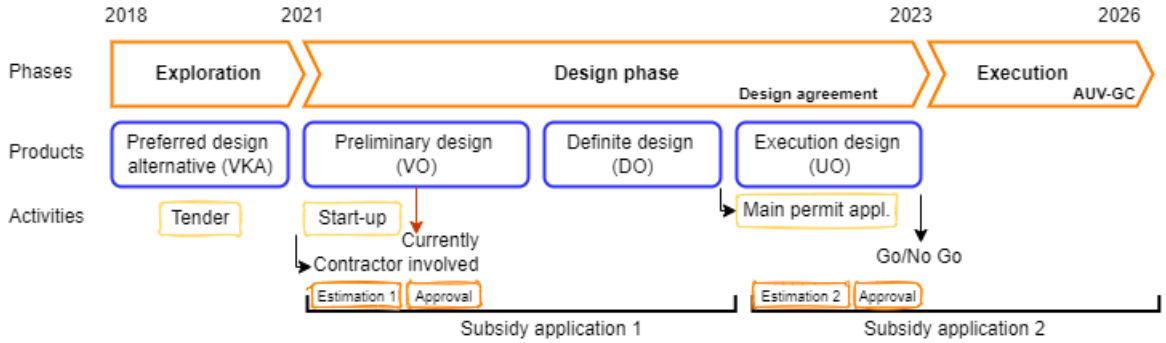

Figure 5.3: Case B. Project phases

5.4.3. Case C: Riverbank lowering

Case C describes the lowering of 16 hectares of the riverbank and 38 groynes with the aim to achieve a 5 cm drop of water level during high water discharges. As a result, the people in the area are well protected against high water. The groynes are very old structures, and not much is known about their technical specifications. Which could prove risky to the design and execution phase. The two-phase model is applied to a part of the project scope instead of the full project. Only for the items that have a high uncertainty, the price determination is delayed and are therefore not part of the bidding process. Design activities, project control activities and some items of the executing process, are awarded for a fixed price.

Project phases

Figure 5.4 illustrates the project phases of Case C. The project is currently in the last stages of the design phase and execution will commence shortly. During the tender, a contractor was selected, based on the best quality/price ratio for the design phase and unit prices for some of the execution works. The contractor, therefore, had to make a bid on the costs for the design phase. He also had to make a bid, in the form of unit prices, on some of the execution work. At the end of the design phase, a 'Go / No-Go' decision must be made. To award the contractor with the execution work, the following items must be in place: 1. The parties must be in agreement about the execution contract and execution price. 2. All required permits have been obtained. 3. Ministerial approval for the execution phase has been given.

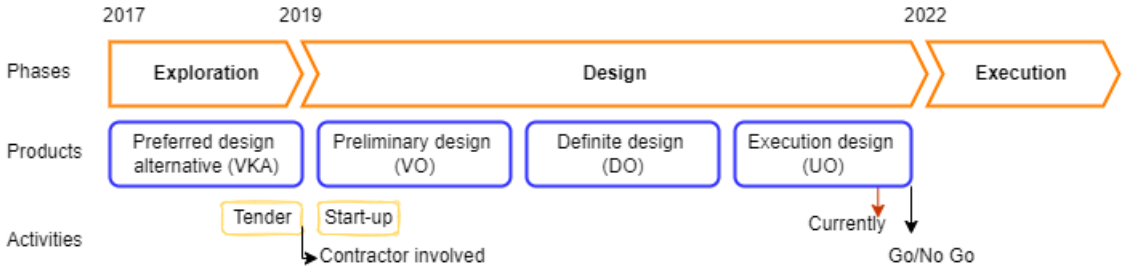

Figure 5.4: Case C. Project phases

6

Case study results

To answer the third research question: "How are the elements of the two-phase model operationalized in practice?", case studies are executed. This chapter describes the results of the document study and the interview sessions of the three cases. The results are described thematically per case in Section 6.1, Section 6.2 and Section 6.3. The used themes and the method for the data analysis are described in Section 5.3.

Per case, the case study results are divided into two subsections. The first subsection describes how the elements of the two-phase model are operationalized in the project. This is based on the results of the document study and the interview sessions. The document study describes the client's perspective. The interviews describe both perspectives, of the client and the contractor. If the findings originated from the client's or the contractor's perspective, has been indicated. After each interview, a transcript was made. These interview transcripts have been thematically combined in Appendix C to ensure the traceability of the results.

To gain insight into obstacles and good practices in the projects, the second subsection describes how the model is experienced . The case results are briefly combined in the third subsection.

6.1. Case A: Dike reinforcement 1

In Case study A, the tender guideline and the project's governance model were studied. Interviews have been conducted with two managers from the Waterboard and two managers from the contractor.

6.1.1. Organization of the two-phase model in case A

This subsection describes how the elements of the two-phase model are operationalized in case A. The results are the outcomes of the document study and the interviews. The elements were discussed in the interviews to get a better understanding of why they were operationalized in this way and to verify whether the client's intentions became practice. It has been indicated if the described results come from the document study or the interview sessions.

Project objectives

Document study:

The intended result of this project is a safe dike that is completed before 2027. The project must stay within the budget, which is yet to be determined. Besides the project result, the Waterboard wants to achieve five project objectives:

- a predictable design and execution phase;
- the project must be realized at socially responsible costs;
- the involved stakeholders are as satisfied as possible during the design and execution phase;
- the project is realized in a safe manner and the dike can be safely used and maintained ;
- an excellent collaboration between the Waterboard and the market party. The market party must endorse the project goals.

Motivation for two-phase model

Document study:

Instead of other contract models, the Waterboard chose to apply the two-phase model in this project. The document study shows that there are three major motives for the client to apply to the two-phase model. Firstly, the 250 landowners influence the project by sharing their requirements and wishes for the design and execution phase. This calls for an integrated approach during the design process, in which the Waterboard and the contractor ensure flexibility and predictability towards the landowners.

Secondly, the area in which the dike is located is intensively used which makes there is limited space. This makes the design choices and execution method closely interdependent. The risks in the execution phase are largely controlled in the design phase. This requires close cooperation in the design phase for risk management and makes that the design phase and execution phase cannot be separated.

Thirdly, the HWFD subsidy scheme stipulates that costs overruns, in addition to the obtained subsidy, are entirely at risk of the Waterboard. To match the actual costs of the project as accurately as possible WITH the subsidy, and minimize thE risk of extra costs, the Waterboard wants to work closely with the contractor.

Interview sessions:

The motivation to apply the two-phase model WHICH has been described in the document study is confirmed in the interviews. According to the interviews, the main motivations for the Waterboard to apply the two-phase model were to increase predictability and to ensure the constructability of the design. The dike with a length of 29 km is poorly accessible. Determining the execution methodology is therefore important during the design phase to ensure constructability. The project also depends on local residents, for which predictability is important. *"For the stakeholders, like 250 dike owners, predictability is important. By involving the contractor in an early stage, the contractor can guarantee the constructability of the design and he can provide predictability"* (A.2.Cl).

The way in which the dike projects are subsidized by the HWFD programme has also been named by 3 of the 4 interviewees as a motivation to apply the two-phase model in this project.

The contractor's representatives stated that when the contractor commits to a tender, he aligns himself with the project objectives which the client determined. The contractor strives to satisfy the client because his image of being a reliable contractor becomes increasingly important in the current industry. The contractor also has a commercial interest in projects to make a profit. The early involvement allows the contractor to invest time in the allocation and management of the project risks. The delayed price determination makes there is no competition in the determination of the price. This is another important element that reduces the contractor's risks in the project. *"The reduced risks, combined with an ensured percentage for general costs, risks and profit, makes that a project with a two-phase model ensures a secure profit which is better than most standard projects"* (A.4.Con). From the contractor's perspective, the use of two-phase models in the industry is a positive development.

The design phase is commercially not very interesting for a contractor. *"The execution phase is the period where a contractor can make significant revenue and some profit. Our main commercial interest in the design phase is therefore to obtain the contract for the execution phase"* (A.4.Con).

Results of the first phase

Document study

During the design phase, the parties work together on the realization of the execution design (UO). The parties must mutually ensure to complete the results like the required planning procedures, the environmental and conditioning process, the design process and the preparation of the subsidy application for the execution. To realize these products, the Waterboard drafted work packages with an estimation of the required hours to spend on those packages. During the start-up of the design phase, the parties determine the approach for the activities, and write the contract for the design phase. The Waterboard planned eight weeks for this start-up period. The work packages, which the Waterboard drafted, were supposed to be a starting point for the start-up period.

Interview sessions:
The planned eight weeks of the start-up period eventually became nine months. The work packages that the Waterboard drafted for the design phase were not used. For the contractor, it was difficult to adapt to the drafted plan. *"The client and the contractor are both 50% in the lead in the design phase. Both parties should, therefore, have a say in the approach for the first phase"* (A.3.Con).
The plans for the design phase were therefore made from scratch. The client believes it had been better if the drafted work packages Were used as a basis and some changes were made. However, the client's plan underestimated the required design efforts. Besides the start-up period that was extended by several months, the cost estimations for the design phase were also overrun. The eventual subsidy application for the design phase became 60% higher than the original assumption by the Waterboard. This was caused by underestimation and increased efforts in the design phase. According to the interviewees, there is a trend in two-phase model projects that the plan elaboration becomes increasingly intensive and expensive.

The motivation, for the Waterboard to specify the design towards an execution design, became clear during the interviews. The Waterboard chose the execution design, so the execution works can start directly after the approval of the main project permit. This is an optimization in the lead time and ensures a efficient continuity of the project staff. The costs for the design activities, to make an execution design, are however considerable. This is usually part of the execution price, which makes the cost less noticeable. Now the costs are part of the first phase, the design cost increased significantly in that phase.

Responsibilities
Document study
The contractor will bear responsibility for the design. The aim of the Waterboard is to ensure that the contractor has mastered the design before entering into the execution agreement. The contract method does not deviate from the UAV-GC, where the contractor is the producer and responsible for the design and the client reviews and accepts. The Waterboard can impose mandatory decisions based on its legal responsibility for water safety. In these cases, the design responsibility remains with the contractor, except in cases where expressly agreed otherwise. The parties are jointly responsible for the management of risks in the design phase and the execution phase. A shared risk budget is set up for this joint responsibility. Decision-making on withdrawals from the risk budget must take place on the basis of consensus in the management team. The money that is not used from that budget is divided among both parties at the completion of the project.

The subsidy approval is a requirement to move into the execution phase. This makes the parties have a mutual interest to get the subsidy application approved. The contractor is therefore also motivated to make reasonable and effective design choices. This is the requirement for the HWFD subsidy. It's in the contractor's interest to keep costs within the limit This is a special and effective incentive in this approach.

Interview sessions
The contractor described it was contractually not completely clear who is responsible for which design choices. *"Although the contractor is supposed to bear the design responsibility, the waterboard is eventually responsible for the water safety. In the first year in the design phase, the design team has therefore been very busy clarifying the requirements and allocating responsibilities"* (A.4.Con).

By saving money in the shared risk budget, the contractor has an opportunity to earn a bonus on his ensured revenue. *"The principle of a shared risk budget triggers shared ownership to mitigate risks collaboratively"* (A.4.Con). Therefore, the contractor believes this is a powerful tool. How the risk budget should be applied, is however a difficult discussion. The discussion has arisen if the risk budget is large enough. The risk budget must be large enough to be able to pay for all project risks. The pot can also be not too large because the pot must be paid by the subsidy provider, who won't allow a risk budget that is too large. *"A shared risk budget works well when there is a positive balance at the end of the project that can be divided. It is however not clarified how the situation of an insufficient risk budget will be handled. An insufficient risk budget will most likely intensify discussions and complicate the collaboration"* (A.4.Con.). The Waterboard also recognized it will be difficult to decide which risks (mitigation) will be paid from the shared risk budget, and which are not.

Form of collaboration

Document study

The Waterboard wants to play an active role in the design phase because of their managerial and public responsibility and to preserve the knowledge and expertise which is accumulated by the Waterboard in the previous phase of the project. The Waterboard intended an integrated management team with six key figures, evenly distributed between both parties. Figure 6.1 illustrates the Waterboard's design for the project organization.

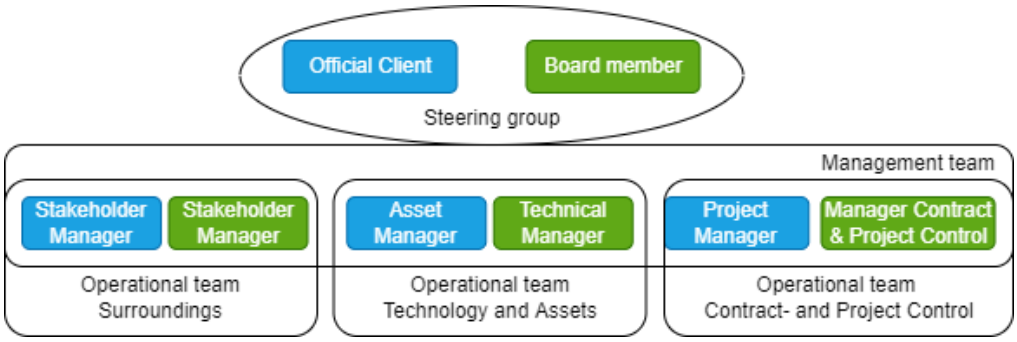

Figure 6.1: Case A. Overview of intended project organization (blue = Waterboard, green = contractor), based on documents

The basic principle is that parties work together on the basis of equality. Decision-making is based on consensus, whereby the most important interests in the development of the designs have a place in the management team. Differences of opinion will be resolved in good consultation between the parties.

Interview sessions

The parties in the project collaborate intensively. The 50/50 distribution in the management team has been implemented as planned. However, some changes were made to the roles within the management team. In the intended management team, the contractor had to fulfil the role of Manager Contract- and Project Control. *"We consider contract management and project control as different expertise. And it felt uncomfortable to look after the contractor's- and client's interest in the contract management role"* (A.3.Con). The parties decided in consultation it would be better to change the management team into its current form, which is illustrated in Figure 6.2. The new role division is based on an equal balance and the party with the best expertise to fill in the role.

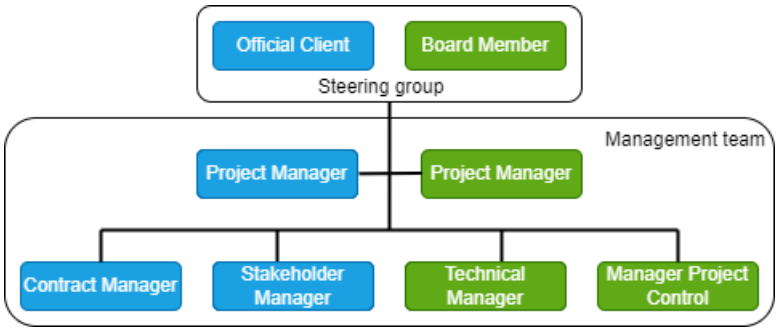

Figure 6.2: Case A. Overview of the applied integrated management team (blue = Waterboard, green = contractor)

The parties are satisfied with the applied integrated management team. *"The integrated management team is efficient and works well. There are no double roles, and the best capable person can fill in a role"* (A.1.Cl). The project organization works very integrally. Because of the integral management team, it is also logical to collaborate in all design fields in the project. *"This method prevents wasted design effort and reduces risks"* (A.4.Con).

The waterboard struggles to deliver human resources for certain roles. *"The pool of human resources is limited. To find people with the required expertise is difficult since the waterboard is not used to this size of projects"* (A.1.Cl).

Even though the role division is equal, the management team is not in balance. One of the Waterboard's managers has not been absent for half a year. The Waterboard is therefore not in full strength in the management team, which makes them feel less in control. Even though there is equal participation in the management team, the contractor still deivers the majority of the people in the project organization. Within the project organization, around 20% of the employees are from the Waterboard. The other 80% is delivered by the contractor and the engineering firm which is being managed by the contractor. *"With such over-representation by the contractor, it is difficult to give the client the feeling that they are still in control"* (A.3.Con)

The Waterboard believes they cannot make the decisions they would like. The Waterboard would prefer to have more decisive power during the early stage of the design phase. *"We would like to give a bit more focus to the surroundings, even if this is a bit more costly. The contractor is focused on the efficiency in the execution"* (A.1.Cl). Because the decision making is based on equality, the Waterboard is unable to force the contractor into certain decisions. The un-balance in the management team enforced the client's feeling of not being in control. The contractor explains that this has bothered both organizations since it did not help in the relationship. *"It is very important to have a qualified and stable management team in a project, to lead the project organization"* (A.3.Con).
The contractor is not in favour of a governance model where one party has stronger decisive power. *"The strength of the two-phase model lies in the combined leading role, where both parties must do things differently than they were used to. The essence is that both parties should be heard in the discussion, to find the strength in both party's opinions. The crux lies in how the discussions are conducted"* (A.3.Con).

Contractual reinforcements
Document study
The document study describes several clauses which are part of the contract to steer the project into the right direction. These are the following subjects: *Dispute management*, *Price determination* and *Incentives*.

Dispute management
Document study
Decisions are made in the operational teams. Larger decisions or differences of opinion will be resolved in the management team in consultation between the parties. If the management team cannot come to a solution the steering group, in which both the client and the contractor are represented, can try to find an agreement. If it is not possible to settle a dispute by mutual agreement, disputes will be settled through mediation of an independent organization.

Interview sessions
In the new organization of the management team, the Project Managers have a larger mandate than the management team. This makes that there is one more step in the layers of decision making. When the management team can't make a decision, the two Project Managers must find a consensus. Both Project Managers are satisfied with this method for dispute management. It is sometimes unclear which decisions can be made in the operational teams, and which must be made by the management team. In the operational teams, several discussions started because of conflicting project goals. The project goals, *Satisfied surroundings* and *socially responsible costs* are currently conflicting with each other. *"This discussion should however be conducted on the level of the management team, so the design teams can stay focused on their design products"* (A.3.Con).

Document study
Another form of dispute management is the exit option that is build-in in every two-phase model. In this project, two exit options are applied. The design phase consists of three design loops. After the first design loop, the first Go/No-Go decision will take place. The parties can continue the design work if there is agreed on the following three items: 1. The target costs of the project (including the design and execution phase), 2. the planning, 3. the efficiency of the collaboration between the client and the contractor. For the last requirement, an assessment will be executed where the contractor must score points to obtain a certain level of collaborative capabilities.

At the end of the design phase, a second Go/No-Go decision takes place. For the contractor to get the execution phase awarded, the following elements must be realized: 1. The execution design is established 2. all required permits, like the project resolution, are approved, 3. the subsidy for the execution phase is approved, 4. the planning is approved, and 5. the contractor scores sufficiently in the collaboration assessment.

If the contractor is awarded the execution phase, the execution agreement and the risk budget agreement are signed.

Interviews sessions
The client is happy with the exit options in the contract. The client must score on several key performance indicators that grade for example his level of cooperation. *"The exit option is a good thing to have when the relationship gets seriously damaged. Secondly, it provides a tool to force the contractor into a collaborative attitude"* (A.2.Cl). The contractor emphasizes that the exit option offers both parties to end the project. For the contractor, it is important to be comfortable with the risk level that he must accept after the first phase. *"Even though the two-phase model can reduce the risk level, risks will still exist at the end of the first phase"*. (A.4.Con).

Price determination
Document study
The tender guideline extensively describes the determination process of the price. During the tender, the tenderers had to involve a price for the design phase and dominant cost items for the execution phase in their tender bid. Secondly, the tenderers had to submit a plan to optimize the designs to lower the execution price. During the first design loops, the design team tries to implement the optimizations. During the design phase, the prices are further specified in three design loops. All price determinations are made fully transparent.

Interview sessions
The price for the design phase exceeded the estimations by 60%. This overrun was blamed on underestimation by the Waterboard and inadequate benchmarking. The HWFD subsidy provider is concerned that the two-phase model will make the dike reinforcements increasingly expensive, because the design phases become more expensive, and the execution phases won't become cheaper. Although, the Waterboard believes: *"The exit option combined with a transparent price determination gives enough tools to come to a reliable and market conform price"* C.1.Cl). The contractor also believes they can reduce the execution costs by optimizing the design during the design phase. The contractor is determined to achieve the reduction of €1million/km dike reinforcement, which they stated in their optimization plan during the tender.

Incentives
Document study
The Waterboard added several incentives in the project which help to motivate the contractor toward the project goals. The shared risk budget can be seen as an incentive to share the responsibility for risk management and motivate the contractor to minimize risks. The functioning and experiences with the risk budget have been described earlier in this section.

The Waterboard set the subsidy approval as a requirement to award the contractor with the execution contract. This incentive makes that both parties will take ownership over the subsidy application of the design. The intention is that this will motivate the contract to make sober and effective design choices.

Interview sessions
As described earlier, the contractor is focused on the efficiency in the execution work. The Waterboard wants to minimize hindrance for the surrounding stakeholders, even if this is more expensive. The contractor's motivation to look for optimizations in the design and efficiency in the execution is to reduce the execution costs to be sure that the subsidy will be approved. The contractor's intention to minimize costs, while the client believes the costs go a little higher, makes this incentive very interesting.

6.1.2. Experiences with the two-phase model in case A.

This subsection describes how the interviewees experience the two-phase model in their project. These are results from the interview sessions.

Good practices
The client values the integrated way of working. *"The project organization is working very integral. All departments are well involved in the production of the designs. This helps with predictability"* (A.2.Cl). *"The integrated management team is efficient and works well. There are no double roles, and the best capable person can fill a certain role"* (A.1.Cl). The client also values the execution knowledge which the contractor brings

to the design phase. The creativity and changes for optimizations the contractor brings are recognized as big advantages. The contractor is determent to reduce the execution costs with clever techniques and optimized execution methods. *"I certainly see more advantages of the two-phase model than disadvantages"* (A.1.Cl).

Obstacles

Cultural differences between the collaborating parties are recognized by all four interviewees as the biggest obstacle in the two-phase model. The contractor tends to rush into design activities and make rapid decisions to exclude different options. The contractor is not used to participating in a design phase where multiple design options are open. The client is not used to the contractor's quick decision making. The client likes to have more time to consider multiple options and make the hard decisions a bit later. The cultural differences make a good collaboration more difficult. The different cultures must come closer together. This means that both parties must be willing to change some of their old habits and work methods. The interviewees believe that it takes about 1/2 until 3/4 of a year before the biggest cultural differences in the team are overcome. Although, cultural differences will never completely disappear. The contractor believes that the client's organization is less flexible and less eager to change their habits. This is also caused by the years of preparation for the project. Both parties must however change course after the input from the other party. The Waterboard believes that enough workplaces in the project office to work together is helpful for team building. The COVID pandemic was therefore not helpful.

Another obstacle is that it stays difficult to estimate the required effort for the design phase. The underestimation of design effort by the Waterboard made the subsidy application more difficult. The underestimation of work efforts remains a continuing problem. This also affects the project staff. *"Many people in the project organization complain about work pressure. We scaled up the design teams too quickly. This brought extra tension"* (A.4.Con). *"The people in the project should be able to enjoy the nice project they are working on and find satisfaction in their job"* (A.3.Con)

Lessons learned

When things start to get difficult, people tend to blame the other party for mistakes. In traditional and integrated projects, the client blamed the contractor and vice versa. This tendency still prevails in the two-phase model when things start to get difficult. According to the contractor's Project Manager, openness and mutual trust might be the remedy. The project hired a coaching bureau to help the management team with their collaboration. The coaching sessions were cancelled a couple of times because the management was not fully complete. *"Collaboration is so important in a newly composed team, those coaching sessions should never again be cancelled"* (A.3.Con).

The contractor emphasized that a stable management team is very important to lead the project organization. In the management team, the most important discussions are held that determine the course of the project. The management team has not been at full strength for half a year. This caused the client to have the feeling of not being in control, which caused problems in the project. It is therefore very important to have a stable, balanced and capable management team in place.

It is important for a project organization to take time for the start-up of the design phase. The parties must keep in mind that extensive efforts are required in a (two-phase model) design phase. It takes time to determine the design processes, get used to each other, understand different interests and cultures.

6.1.3. Case A. Summary

This subsection summarizes Case A. Table 6.1 summarizes how the elements of the two-phase model are organized in Case A. Secondly, the experiences with the two-phase model in Case A are listed. A distinction is made between 'Good practices', 'Obstacles' and 'Lessons learned'.

Case A . Summary

Element	Operationalization	Elaborated operationalization
Motivation	Early contractor involvement and an integral approach to improve design quality	Integral approach for predictability and flexibility towards stakeholders
		Implementation space is limited. Design and execution method are closely interdependent. Cooperation during design activities is required.
		The contractor can guarantee the constructability of the design
	Delayed price determination for a more reliable price	Cost overruns in addition to HWFD subsidy are the risk of the client. The actual costs must match the subsidy as accurate as possible.
Results of the first phase	- Wide solution space in design assignment	The preferred design alternative has been chosen
	- Early contractor involvement in design process	Design requirements are determined mutually
	- A detailed level of design specification	Execution design level of detail
		Design approach, work methods and processes are mutually determined
Responsibilities	- Contractor carries design responsibility	Contractor becomes responsible for the design
	- Client takes responsibility over several specific elements	The client keeps ultimate responsibility for water safety.
	- Mutually responsible for risk budget	The parties are mutually responsible for the risk management. A shared risk budget is used.
		Mutually ensure to complete: planning, environmental conditioning process, design process and subsidy application
	- 1st phase: design agreement	Design agreement is drafted in collaboration at start of design phase
	- 2nd phase: UAV-GC	The UAV-GC applies. The contactor is producer of the design and the client reviews and accepts.
Form of collaboration	- Intensive collaboration	Balanced Management team
	- Client plays an active role with significant input	Decision making on a basis of consensus
	- Collaboration on basis of equality	The client can impose mandatory decisions based on its legal responsibility for water safety.
	- Role and task division based on expertise	All parties are represented in every design team
		Contractor deliver 80% of employees Client deliver 20% of employees
		Integral approach in every design task
		Role division based on expertise: - Client leads stakeholder management team - Contractor leads technical design team
Dispute management	Escalation of disputes goes up in the organization	When the management team can't find agreement, both project managers must find agreement. Final level is a steering group with representatives from both parties

	Exit option Requirements for 2nd phase: 1. Finalized execution design 2. Approved permits 3. Approved subsidy by HWFD	Exit option provides a tool to force the contractor into collaborative behaviour
	4. Approved planning by client	Contractor is made mutually responsible for subsidy approval.
	5. Contractor scores sufficient on collaboration assessments	Exit option offers both parties an exit option. If the contractor is not comfortable with the risk level, he can get out.
Price determination	- Transparent accounting - Price for design phase exceeded estimations	Inadequate benchmarking and underestimation caused overrun of expected design cost
	- Sufficient tools to control the execution price	Exit option and transparent accounting provide tools to come to a reliable and market conform price.
	- Opportunities for optimizations for the execution price	The contractor is determined to achieve cost optimization
Incentives	- Shared risk budget	Shared risk budget ensures mutual ownership of risks and stimulates the contractor to minimize risks.
	- Mutual responsibility over subsidy	The contractor takes ownership over the subsidisability of the project and makes therefore cost-conscious choices

Good practices

- The integrated management team works efficient. There are no double roles and roles can be divided based on expertise
- The team works integral which helps with predictability and improves quality
- The contractor's drive for optimizations is valued by the client.
- Sufficient work spots on project location help collaboration

Obstacles

- Cultural differences:
  - Contractor is focused on execution and efficiency
  - Client is focused on design process and stakeholder management
- Client tends to underestimate required efforts
- 80/20 division of contractor/client representatives does not help in a balanced collaboration
- Client does not feel in control and would like to have more decisive power to give more attention to stakeholder management

Lessons learned

- Start-up of the design phase takes time
- In a cooperation, determining work methods and processes must be done together
- Sufficient work spots on project location help collaboration
- A stable and balanced management team is required
- The design phase is commercially not very interesting for the contractor. The contractor can make substantial revenue and some profit during the execution phase. The contractor's main commercial interest in the design phase is to obtain the contract for the execution phase

6.2. Case B: Dike reinforcement 2

In Case B, the tender guideline and the design team agreement have been studied, and interviews have been conducted with two managers from the Waterboard and two managers from the contractor.

6.2.1. organization of the two-phase model in case B

This subsection describes how the elements of the two-phase model are organized in this project.

Project objectives

Document study

The Waterboard has high ambitions in this project. The document study describes seven objectives the client has. Besides these seven objectives, the Waterboard wants to increase their organization's expertise and professionalism, since the client is not used to procuring projects of this scale.

1. Comply with the water safety standards and management organization's needs:
   The reinforced dike must comply with the water safety standards with a design lifetime of 50 years for the dike and 100 years for the water-retaining constructions. The water-retaining constructions must also be designed with an adaptive ability to anticipate climate change uncertainties. The maintenance department of the Waterboard must be involved in all phases of the project to share their requirements.

2. Realized within the target budget:
   As in the other dike reinforcement projects, 90% of the pre-calculated costs is financed by the subsidy from the HWFD. The other 10%, and all cost overruns, are paid by the Waterboard. Therefore it is important for the Waterboard that the pre-calculation match the actual costs. The HWFD demands a sober and effective dike design. To make the dike reinforcement affordable, the Waterboard believes that technical innovations are required.

3. Satisfied in- and external stakeholders:
   Satisfied stakeholders are important for the Waterboard. Preservation of the high environmental quality is therefore crucial. The Waterboard believes that collaboration brings better-supported solutions. An open communication style is therefore needed.

4. Fast but not hasty:
   The Waterboard did not determine planning milestones. The necessary time must be taken for the design and the execution phase.

5. Implementation of sustainability ambition:
   The Waterboard has a sustainable ambition. They want to realize the dike reinforcement with zero carbon emissions.

6. Implementation of spatial quality:
   The dike is located in a historic and nature-rich area. It is important that the high environmental quality is preserved. A landscape architect is hired to ensure added value for:

   - attention to a good and sustainable elaboration of the integration task
   - smart use of available space
   - reinforcement of the biodiversity
   - preservation of the experience- and usage value
   - preserve cultural-historical values

7. Implement potential innovations:
   Innovations must be used as an efficient and necessary tools to achieve the project objectives. New technical innovations must be applied to keep the HWFD programme affordable.

Motivation

Document study

According to the tender guideline, the currently available products and services will not achieve the project objectives. Product and process innovations are therefore required. To develop these innovations the Waterboard requires a procurement method in which knowledge can be shared between the participating parties.

The procurement method must therefore stimulate a collaborative approach. It is impossible to determine the costs of innovative techniques that still need to be developed. Procurement under a fixed price is therefore impossible. The six sub-projects provide the contractors with the opportunity to get a second sub-project awarded. This continuity gives them the ability to earn back their investments in new techniques over a longer time. In the opinion of the Waterboard, the two-phase model is, because of these motivations, necessary to develop the innovations.

Interview sessions
In addition to the document study, declared the Waterboard during the interviews that it is important to involve the contractor very early in the project to enable the desired innovations. *"In traditional dike reinforcements, long clay berms are placed. When an innovative vertical screen can be implemented, this will have a positive impact on the project goals"* (B.3.Con). The two-phase model is applied in combination with an innovation partnership, in which three contractors collaborate with the client to develop the desired innovations. The two-phase approach is seen as a necessary tool to enable innovation. Secondly, project risks can be managed better in a two-phase model due to the delayed price determination and an extensive design phase.

The contractor's enthusiasm for integrated projects diminishes due to high-risk levels and limited room for collaboration. *"The two-phase model gives opportunities to better understand the content of the project which leads to reduced risks and a more reliable price"*. (B.3.Con) This is expected to be beneficial for the contractor's profitability.

Results of the first phase
Document study
The tender guideline describes the following required results of the design phase:

- definite design for the non-innovative solutions
- execution design for the innovative solutions
- accepted execution budget
- a mutually determined risk dossier

The project organization uses a process standard that is based on an ISO systems engineering standard. This process standard is used to measure the quality of the processes. The standard describes several capability levels. After every design loop, the design team must reach the next capability level. The Waterboard can measure the extent to which the innovations contribute to the project objectives.

At the end of the first phase, the parties must agree on the execution contract for the second phase. The execution design for the non-innovative solutions. The contractor has to make the execution design during the second phase.

Interview sessions
The Waterboard explained in the interview sessions that the original motivation to design towards a definite design for the non-innovative solutions since the Waterboard has low input in the development of the execution design. For the innovative solutions, the design would be specified towards the execution design, to minimize the risks in these solutions as much as possible. In the sub-project in which the interviewees participate, a different choice is made. In this sub-project, all designs are detailed towards an execution design. *"Land must be purchased from local stakeholders. For these people there can be no surprises during the execution. Therefore the project team chose for a maximum specified design"* (B.4.Con)

The Waterboard explained that the process standard is used to stimulate explicit working and to make founded decisions that are well documented. *"The standard stimulates structured working and making choices (on innovations) traceable"* (B.1.Cl). The process standard also helps with determining the approach of the design phase, because it describes the required input and output for all required design products. The standard, however, is quite extensive. *"It, therefore, took time to get the method up and running in the project, which resulted in some resistance against it"* (B.1.Cl). The contractor values the process standard. *"Once the standard is well understood, which takes some time, it ensures a lot of structure in the project"* (B.4.Con).

Responsibilities
The Waterboard and the contractor write three contractual agreements in the sub-project: a collaboration agreement, the design team agreement and the execution agreement. The collaboration agreement describes general processes, safety standards and an agreement about knowledge sharing between the partners in the different sub-projects. In the design team agreement, the basic principle is that the participants in the design team jointly and in consultation come to a design for the sub-project. The execution agreement is based on the UAV-GC, with some adjustments.
The document study shows an overview of the tasks and responsibilities of both parties. The Waterboard carries the tasks and responsibilities over:

- assessing designs, plans and budgets
- consultation with other authorities for obtaining permits
- land purchase

The contractor carries tasks and responsibilities over:

- design and execution work
- staffing
- guaranteeing constructability and practicability
- advise on cost optimizations for the execution price

During the start-up of the design phase, the parties mutually write the project management plan, with the planned approach for the design phase. The parties also determine the costs and the subsidy application for the design phase.

Interview sessions
The contractor becomes responsible for designs of the traditional parts of the project scope. For the innovations, however, the client takes 90% of the design responsibility. In return, the client becomes the owner of the intellectual property of the innovations. This allows the client to implement the innovation on other projects.

The start-up of the design phase took a full year. The contractor believes that this period has been too long. The start-up was already started during the exploration phase.*"Although this was meant to accelerate, it slowed the start-up process down, because a part of the project team was still focused on the exploration phase"*. (B.4.Con)

A full year of start-up costs money. *"The costs have been included in the subsidy application for the design phase. This has increased the costs for the design phase, which may cause a difficult discussion with the subsidy provider"* (B.4.Con). The Waterboard and the contractor are however happy with the project management plan they created. *"The elaborate start-up phase to write the project management plan helps for a good start of the design phase"* (B.2.Cl). *"The approach is very integral. The compartmentalization of different disciplines and design fields is completely eliminated in the approach"* (B.4.Con).

Form of collaboration
Document study
The parties will collaborate on an operational level in the project organizations of the sub-project and on a tactical level in the program management team. An overview of the project organization is given in Figure 6.3. Both parties are represented in all layers of the project organization. The case studies focuses on sub-project C.

Parties make agreements to ensure that decision-making in the management team takes place in an explicit manner and that decisions are documented properly. The parties strive to make design choices in mutual consultation and on a basis of consensus. If the Parties cannot find mutual agreement, or if a proposal from the contractor for a design choice is unacceptable for the Waterboard, the Waterboard can make a binding decision by itself.

Interview sessions
The design process is very integral. This ensures that all disciplines influence the direction of the project. The

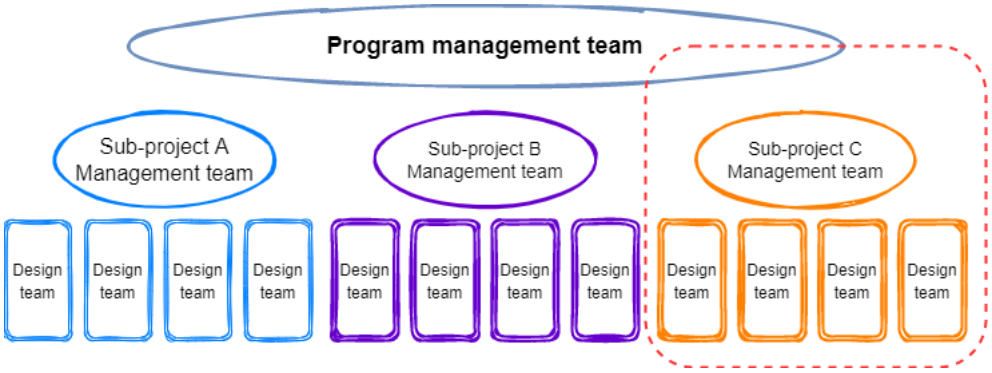

Figure 6.3: Case B. Project organization overview

strengths of the different parties can be used in the integrated project management team. *"The contractor is very capable of systems engineering. While the waterboard has good knowledge of internal and external stakeholder management and the process of subsidy application at the HWFD"* (B.1.Cl).

The contractor, as usual, delivers the Technical Manager. In this project, the Contract Manager and the Project Control Manager are also delivered by the contractor. These roles are traditionally delivered by the waterboard. *"As the contractor, I am pleasantly surprised. It shows the Waterboard's confidence in the contractor. This is something that we must handle with care"* (B.3.Con).

The Waterboard explained that it is unlikely that they will use their authority to force the contractor into a certain decision. *"Once we force the contractor into a certain decision, the responsibility of that decision will return to the client. Secondly, it is not wise to force the contractor into a certain methodology that he advises against"* (B.1.Cl). When the management team cannot come to a decision, the decision can be made by the Program management team. Within the design teams, decisions are made on basis of a trade-off matrix that is aligned with the project goals and requirements for the permits.

The project organization consists roughly of 2/5 contractor, 2/5 engineering firm, 1/5 waterboard. That the Waterboard delivers the least people in the project organization has not yet been a problem. The contractor recognized that it was difficult for the engineering company to find their role in the team. They are well represented by many people and have also been involved in the earlier phases. However, formally, the engineering firm only has a supporting role in the design phase and they have no decision power.

Contractual reinforcements

The contractual reinforcements in this project descibe *dispute management*, *price determination* and *incentives*.

Dispute management

The subsidy approval of the HWFD is a requirement for the Waterboard to award the contractor with the execution contract. This exit option makes the client and the contractor mutually responsible for the subsidisability of the project.

Price determination

Document study

The Waterboard requires the contractor to work with a transparent budgeting system. In the tender, the tenderers had to compete on the percentage General Costs, Risk and Profit (AKWR), that they were going to use in the project. The lower the AKWR, the higher the score. The tenderers also had to deliver an Innovation plan, human resource management plan (including a team assessment) and a financial management plan on which the tenderers are graded.

During the start-up, the parties mutually determine the required efforts, and thereby the price, for the design phase. At the end of the design phase, the contractor determines the price for the execution phase. The Waterboard then assess the price offer before there is applied for the subsidy of the second phase. During the price determination, the client is entitled to request quotes from third parties to compare these with the contractor's price offer.

Interview sessions
The determined price for the design phase exceeded the reference values that the subsidy provider uses. Therefore, the project organization had to lower the price by cutting in activities and budget of the design phase. *"Cutting in activities that we think are necessary makes the collaboration more difficult"* (B.3.Con).

The contractor thinks there are plenty of options to control the execution price in a one-on-one price determination. *"The review process on the execution price often results in a price that makes the contractor nervous. At the same time, the parties preach for a vital sector. These two are not in line with each other which causes tension in the collaboration"* (B.3.Con). The contractor also believes that the reference values should be adjusted for the two-phase model. *"The reference values that are used in the review process come from competitive projects, where unhealthy prices are used. These don't match the two-phase model"* (B.3.Con). The reference values are part of a framework that is laid down by the law for the dike reinforcement projects. The contractor thinks there is still a lack of trust, that the contractor won't use realistic prices. The contractor is therefore fully transparent in his budgeting to gain the client's trust.

The design phase in this project will take about three years. In these years, the contractor only makes revenue on the hours that staff members work. This revenue is very small compared to revenue in the execution phase where a lot of machinery is in operation. A contractor's Project Manager that usually manages maybe 50-100 million euros in an execution phase, now manages only a couple of million during a design phase. This is problematic for the contractor's revenue model. Therefore, the contractor and the waterboard agreed to increase the General Cost, Profit and Risk (AKWR) by 3 times on the man-hours during the design phase. This results in an 'engineering firm like' revenue model during the design phase. This prevents the contractor's higher management will complaining about the revenue model on the project.

The negative stigma on the two-phase model is that it is too expensive. The client however believes that an extensive design phase will result in a more successful project with a smoother execution phase, with fewer failure costs and maybe also lower costs.

Incentives
To acquire the second sub-project, the contractor must show the required growth in its process organization. This stimulates the contractor to improve his work processes and it requires him to comply with a certain benchmark. If the contractor does not perform well, this tool allows getting rid of the contractor in the second sub-project. *"The second sub-project that we can acquire is a good trigger to show a positive attitude on the project"* (B.3.Con). The Waterboard is not fully convinced of this incentive. *"There is a risk that the contractor can get too focused on the benchmark and less focused on the project objectives. The benchmark can become a goal in itself, while it was meant as a tool to stimulate the contractor.*" (B.1.Cl). Because incentives lead many times to perverse motivations, the client believes that as few as possible incentives should be included in the contract.

6.2.2. Experiences with the two-phase model in case B
This subsection describes how the interviewees experience the two-phase model in their project. These are results from the interview sessions.

Good practices
A contractor is used to eliminate all vagueness out of the project scope, to make it as SMART as possible. The contractor also has the drive to find optimizations in the design or the execution method. By optimizing the calculation approach, the contractor already reduced the required dike reinforcement in this project from 10km to 7km. There is a potential that the scope can be reduced to 6km or even 5km. These are huge savings for the execution costs, which is positive for the client and the taxpayer. The contractor is positive about this reduction since it leads to space in the budget for the client, which makes the collaboration easier. *"Although, when the scope is reduced by maybe 50%, this can become problematic, since the contractor anticipated on a larger scope with more revenue and profit"* (B.3.Con).

The early involvement of the contractor has caused an efficiency gain through a reduction of km's dike reinforcement. To find such optimizations, the design phase of a two-phase model becomes extra extensive, very detailed and also more expensive. The higher costs of the design phase, divided over the fewer kilometres

of the dike (due to the scope optimization), makes the costs per kilometre is relatively high compared to the HWFD's reference values.

Both parties see the integral way of working in the management team as a good practice. Also, all systems and processes are used integrally. *"Within the integrated management team the parties are also forced to collaborate. It is not an option to reduce the collaboration"* (B.2.Cl).

There is a big motivation from inside the waterboard for the collaborative approach. This works very well. There is a lot of confidence within the client that the approach will lead to the accomplishment of the project goals. The project will for example be executed with zero emissions. The first zero-emission excavators are already up and running.

Obstacles

During the design phase start-up, the required effort for the design activities was underestimated. The design phase start-up, that exists of writing the project management plan and obtaining the subsidies for the first phase, took a full year, while half a year could also have been sufficient. It is important to get to know each other during the project start-up and to get familiar with all the new processes. The COVID pandemic made this increasingly difficult.

The project organization consists of people from the client, contractor and engineering firm. This means there are three different organizational cultures present that must come closer together. The management team insisted to held collaboration workshops. This is needed because difficulties will come, it will storm and it will not always be pleasant. These difficulties and unpleasantness are required in the forming of a team. *"During a start-up period, it is important to invest time to understand each other and to mutually understand the things that must be done and the (technical) content of such. Secondly, it is important to invest time to get to understand the cultures and working methods. It is important to share your amazement and to stay curious. The contractor is for example amazed why the decision making processes within the waterboard organization is so complicated. As client I am amazed that the contractor only seems focused on progress"* (B.2.Cl).

Tight reference prices, that are used by the subsidy provider can bring tensions in the project. Due to these tight prices, the project organization has to cut in activities that they feel are necessary. According to the contractor, a better benchmark over more two-phase model projects should make some room in the reference prices.

Lessons learned

A constructive attitude from all players in the industry is needed to make projects and new collaboration methods a success. *"It's always possible to destroy collaborations methods and contract forms by showing perverse behaviour and blame attitudes. The industry should however focus on the way it wants to go forward. It is important to keep this attitude in mind during intense discussions"* (B.3.Con). The contractor is impressed by the vision of the client's organization on equality in collaboration and the effort for a vital industry. The contractor hopes that the other contractors in the other sub-projects will also go for a positive effort in this collaboration because it is very easy to destroy this contract with perverse behaviour he says.

A well-organized dialogue session during the tender phase is crucial for mutual understanding of the parties. A purely documented round of questions, without dialogue is inadequate for a complex two-phase approach.

6.2.3. Case B. Summary

This subsection summarizes Case B. Table 6.2 summarizes how the elements in the two-phase model are organized in Case B. Secondly, the experiences with the two-phase model in Case B are listed. A distinction is made between 'Good practices', 'Obstacles' and 'Lessons learned'.

Table 6.2: Case B. Summary

Element	Operationalization	Elaborated operationalization
Motivation	Two-phase model is required to develop necessary innovations	Current available techniques will not achieve the project objectives. Innovation is needed.
		Knowledge must be shared between innovative partners.
		Innovation cannot be procured with fixed price
Results of the first phase	- Wide solution space in design assignment	Develop innovations in collaboration
	- Early contractor involvement in design process	Mutually determine design approach and working methods
	- A detailed level of design specification	Execution design for maximum predictability and risk reduction
	- Process standard for explicit working	ISO process standard for explicit working and making founded design choices
Responsibilities	- Contractor is responsible for design and execution - Client takes responsibility on multiple tasks	Client responsible for: - Assessing designs, plans and budget - Consultation for obtaining permits - Land purchase
	- 1st phase: Design agreement - 2nd phase: UAV-GC - Both: Collaboration agreement	Contractor responsible for: - Design and execution - Staffing - Advise on cost optimizations
		Client takes 90% responsibility for innovations for intellectual property.
		Collaboration agreement for standard processes and knowledge sharing
Form of collaboration	- Intensive collaboration - Client plays active role with significant input	Collaboration on every level in project Integrated management team Contractor delivers: Technical, Contract and Project Control Manager
	- Role and task division based on strengths	Design choices with trade of matrix and mutual consultation
	- Trust between parties:	Client can make binding decision
		Project organization: 40% contractor 40% engineering firm 20% client
Dispute management	Escalation of disputes goes up in the organization	Programme management team handles escalations.
	Exit option	Client and other contractors from other sub-projects are represented in programme management team
	Requirements for 2nd phase: - Approved subsidy by HWFD	Contractor is mutually responsible for the sub- sidisability of the project.
	- Approved designs and planning - Contractor scores sufficient on collaboration assessments	Exit option provides the client a solution to lose a uncollaborative contractor

Price determination	- Open book accounting, exit option, benchmarking	Reviews by the subsidy provider with reference levels force the contractor to cut costs
		Cutting in costs makes the collaboration more difficult
	- Contractor's revenue model does not match the design phase	Contractor's hour rates are too low for a design phase. Overhead percentage is increased in consultation between both parties
Incentives	- Contractor must pass assessments to obtain the execution contract - Contractor is able to obtain a second project when performance is good	Possibility to obtain a second project is a good trigger to show positive behaviour

Good practices

- The project uses a very integral approach in the design phase. There is no compartmentalization of disciplines. This helps to prevent mistakes.
- Integrated management team is valued. Parties are forced to collaborate. Less collaboration is not an option.
- The contractor is used to eliminate all vagueness out of the project scope and to search for optimizations. This resulted in a scope reduction of less dike to reinforce, which is a saving of costs.
- The two-phase model helps the parties by achieving their sustainable goals. i
- The client shows a big motivation for the equal and collaborative approach.

Obstacles

- Design phase start-up was underestimated and took a full year.
- There are cultural differences between the client, contractor and engineering firm.
  - client has slow decision making
  - contractor only seems to focus on progress
  - engineering firm had difficulty to find its position in the collaboration
- The contractor's hour rates do not match the design phase. This brings problems to the revenue model during that phase.
- Tight reference prices by the subsidy provider can bring tension in the project.

Lessons Learned

- An intensive start-up period is required to:
  - Mutually understand context and complexity of the project
  - Mutually understand each other's organizational culture
  - Determine working methods
- A constructive attitude from all players is required
- A dialogue session during the tender is crucial or mutual understanding of the parties

6.3. Case C: Riverbank lowering

In Case study C, the tender guideline and contract philosophy have been studied. Three interviews have been conducted with two managers from the Waterboard and one manager from the contractor.

6.3.1. organization of the two-phase model in case C

This subsection describes how the elements of the two-phase model are organized in this project.

Project objectives

Document study

The tender guideline describes four objectives that must be achieved in this project.

1. realize a 5cm water level reduction during high water
2. preserve knowledge from the design phase in the execution phase and utilize execution knowledge in the design phase
3. makes the risk of missing or incorrect soil data manageable
4. design and built with the lowest possible burden on people and nature

Motivation for two-phase model

Document study

In earlier projects with similar characteristics, the determined execution costs have been considerably exceeded, due to uncertainties in soil and asset information. This, in combination with the project objectives, was for the client a clear motivation to involve the contractor in an early stage.
The client composed the two-phase model with the following principles:

1. keep the contract model simple
2. honest price for honest work
3. a contract based on the Design & Construct model that is recognizably in the client's organization
4. an honest risk division
5. optimal usage of the knowledge in the market
6. the client/project organization must dare to let go of existing habits

The two-phase approach is only applied to the uncertain parts of the project. the other parts of the project, that are more straightforward, are awarded at a fixed price.

Interview sessions

During the interview sessions the client further motivated the choice for the two-phase model. Because the structure of the groins is usually build-up from waste material, it is likely to find pollutants in the soil. There is also a risk of unexploded ordnance due to intense fighting in WWII. These risks must be mitigated. *"By involving the contractor early, he is involved and can take ownership of the soil investigations. When the contractor is involved in the investigations he is able to make better risk assessments, which enables him to take responsibility on these aspects"* (C.1.Cl).

The client described that a project delivery model on a project should be in proportion to the project size. *"This project is not very large, which makes that a very complex PDM would not be proportional to this project. We, therefore, chose to apply the two-phase approach only on the uncertain parts of the project"* (C.1.Cl).

The contractor is pleased with the two-phase model. *"We are very experienced in these kinds of projects. The contractor can therefore prevent situations like an un-constructible design, wrong (soil)investigations or inefficient execution approaches"* (C.3.Con). The fixed profit percentage gives the contractor the opportunity to make a better profit than most competitive projects.

Results of the first phase

Document study

At the end of the first phase, the execution design must be finalized. Besides the design, an extensive set of specified requirements for the execution phase must be made. During the execution phase, the execution design and the set of specified requirements will be used as contractual documents. At the end of the design phase, the client and the contractor have written the execution contract and must agree on the execution price.

Interview sessions

The client chose to design specify the design until an execution design. *"This makes that all design activities are executed during the design phase, and no design costs are part of the realization price. The execution costs are also greatly influenced by the execution methodologies and the soil balance, which can only be determined after the execution design is finished"* (C.1.Cl).

Responsibilities

Document study

There are three sets of task packages: 1. Tasks executed by the client, 2. Tasks executed by the contractor, and 3. tasks executed in collaboration. The collaborated executed tasks are part of the two-phase approach. A 'collaboration budget' is in place to pay for these collaborative tasks.

1. Client's tasks: These are tasks, that the client must execute based on its public responsibility.
    - contract control
    - public communication
    - land purchase
    - objection and appeal procedures
    - obtain internal (political) approval
2. contractor's tasks: These tasks are outsourced to the contractor in a classic client-contractor relationship. This work can be estimated in advance and thus priced, for which a fixed price is determined in the tender.
    - design activities
    - preparation and application for the permits
    - price determination at the end of the design phase
3. collaborative tasks: These are tasks for which the contractor and client jointly determine the approach and which they will carry out jointly. Tasks only end up in this package if the contractor or client can reinforce each other through collaboration.
    - collect, manage and honour stakeholder requirements
    - detection and management of unexploded ammunition
    - soil and asset investigations

Besides the execution contract is also the contract for the first phase based on the UAV-GC. The principle in the UAV-GS is that the client assesses the products that the contractor prepares. The collaboration budget and a specified risk allocation document are the largest changes the client made to the standard model.

Interview sessions

In the traditional part of the project is the contractor in the lead. The contractor designs and the client assesses the design products. In the collaborative part, both teams are in the lead. Even though the contractor is in the lead, the technical manager from the client is also involved in the design process. The technical managers have a weekly consultation to discuss design choices.

The role division resulted in a hybrid version between the classic client-contractor relation and a collaborative approach. The client explains that this hybrid version of collaboration is often unclear for the contractor. *"The contractor does not always understand on which parts of the project the parties collaborate and on which parts they collaborate less"* (C.1.Cl).

After the soil investigations, not all risks can be eliminated. *"In consultation is determined if the resulting risk is allocated with the contractor or with the client"* (C.2.Cl).

According to the contractor, the advantage of an involved client in the design activities is that it can result in a quicker approval of the designs. *"However, the design process can become sluggish, since both parties have their ideas. This makes the decision making becomes slower. Although the design process requires more energy, the satisfaction of the client is guaranteed due to its continued involvement. The design quality, therefore, increases as well as the support for the design in both organizations"* C.3.Con).

Form of collaboration

Document study

The responsibility division should not exclude that parties help each other with tasks that are necessary to achieve the joint project objectives. The division of responsibilities is determined in the contract, collaboration does, however, take place in human contact. The contract functions as a safety net when parties are unable to work together. The required work within the collaborative package is jointly determined immediately after the start of the design phase. This should be more efficient because the contractor and the client can both optimally contribute their expertise and experience.

A mirrored management team is applied in the project. Figure 6.4 illustrates the management team.

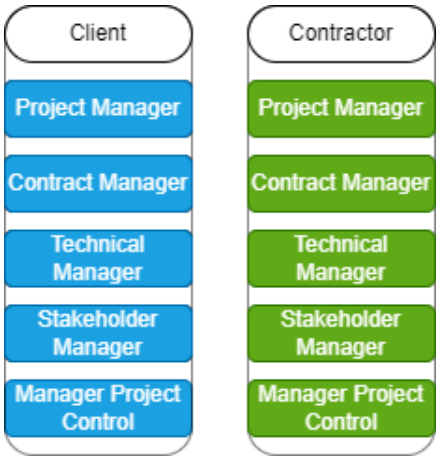

Figure 6.4: Case C. Overview of the mirrored management team (blue = Waterboard, green = contractor)

Interview sessions

The client explained in the interview sessions that the mirrored management team was applied since the client's organization is used to this governance structure. *"In an integrated management team, it would be difficult for the contractor's representatives to find their way into the client's organization"* (C.2.Cl) Most systems are used integrally. This means there is one system used over the complete project organization. For example, LEAN planning and an integrated risk allocation document are used by both organizations.

The contractor believes that it could have been better to have an integrated management team instead of a mirrored management team. *"There are currently two managers per subject. That's not very efficient. Secondly prevents an integrated management team that both parties can produce their own truths. It makes a collective outcome in decision more likely since everyone must debate with the rest of the team"* (C.3.Con).

According to the client should the party that takes responsibility for a certain activity also have the last say in the discussions on these activities. Because the contractor is responsible for design choices and the soil investigations, he will need influence in the investigations. The design products are, however, assessed by the client. Therefore, the client has the last say in the decision making. Due to the regular communication between the technical manager of both parties, many discussions are handled before the designs are assessed. Although, does the contractor does not allow to be forced into decisions by the client. *"When the parties don't agree to a decision, this can influence the realization price and the risk allocation"* (C.2.Cl).

Both parties have their tasks and responsibilities, causing limited collaboration. In the collaboration budget, the intensity of collaboration is higher. To improve the collaboration the contractor determined a weekly working day on the project location. *" This makes that the actors speak to each other before and outside the meetings. This makes informal conversations easier and enables smoother collaboration"* (C.3.Con). Both parties were positive about this idea. Since the COVID measures, the weekly collaboration day has not been possible. according to the contractor, this had a negative influence on the collaboration in the project organization. To keep everyone informed, an integral meeting is now planned every Monday where new information is shared. The contractor also initiated a two-weekly informal consult, in which the management team can discuss their worries and ideas in an informal setting.

"Even there is a lot of communication between the parties, still many cases are discussed within the organization itself before they are discussed with the other organization. This is not a fully open way of collaboration. Maybe an integrated management team could prevent this from happening" (C.2.Cl)

Contractual reinforcements

The contractual reinforcements in this project describe: *Dispute management*, *Price determination* and *Incentives*.

Dispute management

A Go/No-Go moment takes place between the design and execution phase. Only when all required permits are irrevocable, the ministerial approval is obtained and a reasonable realization price has been reached, the realization phase is assigned to the contractor. When a No-Go occurs, the client can find another contractor with the execution design and the set of specified requirements.

Price determination

Document study

During the tender the contractor had to make a price offer on the following elements:

- the activities in the design phase
- project management activities in the execution phase
- reference unit prices for several dominant cost items in the execution that will be the basis for the execution price

The client drew up the following control measures to control the execution price.

- The submitted reference unit prices, that were part of the competitive offer, serve as the basis for the execution price. Deviations from the unit prices can only take place with sufficient substantiation.
- The budgeting system is fully transparent.
- fixed percentages are used for the General Costs, Profit and Risk.
- the collaboration budget and the risk budget, are set by the client

Interview sessions

The contractor recognizes that it is difficult to determine the required efforts in a design phase. The bid that the contractor made for the fixed price of the design phase was higher than the competition. Because of fictional discounts, the contractor won the project. But sill, its budget for the design phase is under pressure. Another contractor with a smaller budget would even have more costs issues. *"When the budget becomes tighter during the design phase, the first costs that are reduced are the costs of collaborative efforts. Therefore, I don't think that competition on the costs of the design phase is a good thing because it does not help the collaboration in the project"* (C.3.Con). The fixed budget for the design phase is an extra incentive to stay within the planned schedule for the design works.*"Although, if there would be no fixed price for the design phase, this could have increased the quality of the design phase"* (C.3.Con).

The client doubts if the bidding on the dominant price items has been beneficial for the project. Although it created a bit of financial competition during the tender, it mostly caused difficulties during the price determination. *"The unit prices are not representative since many assumptions have changed during the design phase. The contractor must motivate why the prices changed. This requires a lot of consultation and effort"* (C.2.Cl).

The contractor also thinks that the unit prices have not been worth the efforts. *"Calculating the unit prices during the tender took a lot of effort. The unit prices proved to be not representative anymore. This lead to a lot of discussion in the project and it requires a lot of energy to motivate why the prices changed"* (C.3.Con).

The contractor would prefer a system where there is more trust towards both parties. The client has demanded transparency from the contractor. *"This already prevents the contractor from using high prices. But more trust is required"* (C.3.Con) If the procurement law would not prescribe the need for competitive financial bidding, the client believes that it would be better to not use unit rates during the tender.

Incentives
If there is money not spent from the collaboration budget and the risk budget, at the end of the project, this is equally distributed between both parties. This will encourage the contractor to minimize costs to make the bonus is as large as possible. The contractor believes that this is an incentive that can work well. *"It is however always a discussion how large the budget should be"* (C.3.Con).

6.3.2. Experiences with the two-phase model in case C

The previous subsection describes how the elements of the two-phase model have been organised in case C. This subsection describes how the interviewees experience the two-phase model in their project. These are results from the interview sessions.

Good practices
Both parties appreciate the two-phase model. *"The approach is focused on collaborative working towards a mutual result which is beneficial for the project. The early involvement of the contractor, to guarantee the constructability, is a huge benefit of the model."* (C.3.Con). *"Combining the knowledge of the client and the contractor brings more knowledge into the project organization. Yet it also requires more coordination"* (C.2.Cl).

Both parties value the informal meetings and the scheduled working day at the project location. This improves the atmosphere of the project. The project organization uses LEAN planning with weekly deadlines, sub-deadlines and dependencies that are discussed every week during an integral planning session. This has increased the efficiency of the design phase.

The two-phase model has been beneficial to the sustainable ambitions of the client and the contractor in this project. Consultation during the design phase and the delayed price determination made it possible for the contractor to develop an electrified excavator on the project.

Obstacles
During the start of the project, the cultural differences between the parties made things difficult. The contractor is used to short lines of communication, is very solution-driven and is focused on the execution. The client is much more process and design phase focused. *"Both parties must invest time in the collaboration process. Cultural differences must be a focal point during the project start-up. This is required to enable a good collaboration"* (C.3.Con).

The contractor has no experience with design phases. According to the client, a different skill set is required in the design phase than in the execution phase. It is important to stick to the processes of a design phase. In the next two-phase model, the client wants to take more time for the project start-up for:

- getting acquainted
- understanding and overcoming cultural differences
- commonly understand the activities, requirements and processes of the design phase ahead
- commonly understand the content of the (design) assignment

Lessons learned

The client recognized that the mirrored management team is not the most efficient approach. *"Efficiency is lost in consulting the other party"* (C.1.Cl) . This is however the policy of the client which is set to the authorization of the roles. In another project, the client would like to transfer some management roles to the contractor. *"The client's organization needs to gain confidence to let some roles go"* (C.1.Cl).

During the several design loops, it is important to make a cost estimate. In this project, the rest items were left out of the estimate. This can result in an uncontrollable price determination. When the design team is not in control of the costs during the design process, this causes difficult conversations at the end of the design phase, when the definite cost estimate is determined. When the estimates are done correctly, this can enable the design team to make design choices by taking the costs into consideration. The client-side must also have expertise in cost and price build-up. Otherwise, it won't be possible to keep the price in control.
A contractor usually makes revenue in an execution phase. The client recognized that it is important for a contractor to have a revenue model during the design phase. When a design phase is an extensive activity, higher managers of the contractors will demand a certain revenue from their project managers.

6.3.3. Case C. Summary

This subsection summarizes Case C. Table 6.3 summarizes how the elements of the two-phase model are organized in Case C. Secondly, the experiences with the two-phase model in Case C are listed. A distinction is made between 'Good practices', 'Obstacles' and 'Lessons learned'.

Table 6.3: Case C. Summary

Element	Operationalization	Elaborated operationalization
Motivation	Two-phase model is mainly applied for risk reduction.	Uncertainties in soils and asset information bring risks
		By involving the contractor early he can take ownership over soil investigation to make a better risk assessment
Results of the first phase	- Narrow solution space	Two-phase approach is only applied on the uncertain parts in the project scope
	- 'Late' contractor involvement in design process	Requirements are set by the client
	- A detailed level of design specification	Execution design level of detail to minimize risks Requirement specification for in case of a 'No-Go'
Responsibilities	- Contractor producer of designs, - Client assessor - Mutual responsibility over soil investigations and stakeholder management	Contractor responsible for: - Design activities - Preparation and application of permits - Price determination
	UAV-GC in both phases	Client responsible for: - Assessing designs, planning, price - Land purchase - Obtaining internal political approval - Contract control
Form of collaboration	- Mirrored management team	Integrated management team is difficult in client's authorization process
	- Most systems and documents are used integral	- LEAN planning - Integral risk allocation document
	- Regular communication and meetings between parties	Client assesses design documents and has thereby a last say in discussions
		Set working days on the project location

Dispute management	Exit option: Requirements for second phase: - Approved execution design - Permits irrevocably obtained - Agreement on realization price	Client is unlikely to use authority to force contractor into certain decisions.
		In case of a 'No-Go' the client can the finalized designs to find a new contractor
Price determination	- Fixed price for the design phase	Fixed price for the design phase puts pressure on the collaboration
	- Open book accounting	Required design efforts are easily underestimated
	- Reference unit prices during tender	Unit prices where established during the tender that must be used for the execution price
	- Exit price	The unit prices are not representative anymore after the design phase
Incentives	Risk budget	The client sets-up a risk budget. Saved money is equally shared between both parties. The amount in the budget is determined by the client

Good practices

- The focus on a collaborative approach is beneficial to the project.
- Combined knowledge from both parties brings more knowledge into the project organization which improves the quality of the designs.
- Collaborative working day on the project site and informal meetings improve collaboration.
- Lean planning with weekly deadlines improves the efficiency of the project organization.
- The two-phase model helps to achieve both parties' sustainable ambition.

Obstacles

- For the contractor it was unclear on which scope parts the parties could collaborate and in which parts the standard contract applied.
- Cultural differences:
  - The contractor is used to short lines of communication and is very solution driven
  - Client's organization is more complex and more focused on processes
- The contractor has no experience in the required activities during a design phases.

Lessons learned

- Design phase start-up is required to:
  - getting acquainted
  - understanding and overcoming cultural differences
  - commonly understand the activities, requirements and processes of the design phase ahead
  - commonly understand the design assignment
- A mirrored management team is not the most efficient approach. Many roles are done double. The client must gain confidence to let some roles go.
- Cost estimates must be made completely.
- Cost expertise is required in the client's organization to be able to control the price determination.
- The contractor must have a sound revenue model during the design phase.

6.4. Operationalization of elements in practice

This chapter has described how the elements of the two-phase model are operationalized in the three cases. Per case, the operationalization of the elements has been summarized. All elements of the two-phase model are applied in all three cases. Although, how the elements are operationalized, differs per case. The similarities and differences in the operationalization over the cases are studied in Chapter 7.

7

Cross-case synthesis and expert evaluation

This chapter provides the answer to research question four: "What are the lessons learned in designing the two-phase model in practice?". To do so, a cross-case synthesis is performed that compares the results of the three cases in Chapter 6. The case transcending results are captured in a set of statements that are described in Table 7.1. These statements, and their origin, are described in Section 7.1. The statements have been evaluated by a group of industry experts in order to improve the quality of the statements. The experts' perspective on the industry is wider than the three cases. The statements are therefore projected on a broader perspective than the three cases, hence the statements can be considered as lessons learned for two-phase models in general. The description of the expert's evaluation is described in Section 7.2. In Section 7.3 the lessons learned are concluded.

7.1. Cross case synthesis

This section describes the statements which are the case transcending results from the case study. The statements are clarified and for each statement, the origin from the case study is described. The statements are the result of the outcomes of the case study in Chapter 6. Some statements are formulated with the aim to stimulate discussion during the expert evaluation.
Table 7.1 gives a joint overview of the statements origins.

Table 7.1: Statement overview per case

	Statement	**Case**		
		A.	B.	C.
1.	Early involvement of the contractor ensures an increased quality of the designs.	X	X	X
2.	Early involvement of the contractor enables efficiency gain by scope optimization.	X	X	
3.	There are two streams that apply the two-phase model for a different objective: One stream applies the model to make risks better manageable. The other applies the model to integrally improve the design and make risks better manageable.	X	X	X
4.	An integrated management team is preferred over a mirrored management team.	x	X	X
5.	The client does not want to release control	X	x	X
6.	The design phase becomes increasingly extensive and expensive	X	X	x
7.	There is no added value in price competition in the tender, by unit prices for the execution price.			X
8.	The exit option, transparent budgeting and benchmarks combined, provide sufficient tools to control the execution price	X	X	X
9	Although cultural differences are difficult to handle, they provide added value	x	x	x
10.	Joint effort is required to determine working methods during the project start-up	X	x	x
11.	There is no revenue model for the contractor during the first phase	x	X	x
12.	Joint responsibility for subsidy approval works for the contractor as an incentive to make cost-oriented choices	X	X	
13.	The two-phase model provides opportunities to include innovation and sustainability in a project		X	X

1. Early involvement of the contractor ensures an increased quality of the designs

In all three case studies, the early involvement of the contractor and working integrally is experienced as a good practice since it improves the quality of the designs. In the first place, the contractor can guarantee a constructable design. Creativity, specifying capability, cost expertise and a drive for optimization are also valued capabilities of the contractor. The integral way of working, where both parties deliver input for the design and all stakeholders are involved increases the quality of the design. Issues can be handled earlier, which prevents hick-ups later in the process. This should lead to lower the failure costs in projects.

2. Early involvement of the contractor enables efficiency gain by scope optimization

In Case A and Case B, the contractor applied optimizations during the design phase to reduce the execution price. The contractors showed a natural drive for optimization. By specifying the scope in such way that no ambiguities arise, the contractor can optimize the scope. Creativity and clever execution methods can also lead to an efficiency gain. The contractor's optimizations can lead to cost savings which is beneficial for both the client and the taxpayer.

3. There are two streams that apply the two-phase model for a different objective: One that applies the model integrally and one that is focused on risk reduction

A different approach was applied in Case C compared to Case A and Case B. In Case A and Case B, the contractor is involved early in the design phase when the requirements yet have to be collected. An integral way of working is applied, involving the expertise of both parties in the design process. In Case C, the model is mainly applied to improve the management of the project risks. In the specific case, a model is applied that is largely similar to a standard Design and Construct contract. For the uncertain parts of the project only, a two-phase approach is applied. The contract of both phases is also based on the UAV-GC in which the contractor is the producer of the design and the client is the assessor. The collaboration between the client and the contractor is less integral and more coordinated in this stream. These two streams are described in further detail in subsection 7.2.3.

4. An integrated management team is preferred over a mirrored management team

In Case A and B, a management team is applied with actors from the client and the contractor in one integrated team. Both projects valued the integral way of working which helps with having open and transparent discussions in the management team and preventing parties from creating their own truths. In Case C, a mirrored management team has been applied. The actors in this project recognized that this method was less efficient, since many consultations had to be held between the counterparts. Moreover, there is a risk that parties discuss subjects internally first, before discussing it with the other party.

and there is a risk that parties first discuss items within their own organization before it is discussed with the other party.

5. The client does not want to release control

In all three cases, the management teams seek to make decisions base on consent. To the satisfaction of the actors. Although, the client parties are not willing to have full contractual equality with the contractor in decision-making power. In Case A and B, the client built a clause in the contract providing the last say in discussions when necessary. In Case C, the client is the assessor of the design products and therefore has the ability to demand changes in the designs. In Case A, the client did not feel in control within the management team due to the long absence of one of their management team members. The client was uncomfortable in this situation and would have liked to have a stronger position in the project governance. The cases show, even though the clients try to come to joint decisions, they still want to have the last say to maintain control over the project.

6. The design phase becomes increasingly extensive and expensive

In Case A and B, the budget for the first phase was determined during the start-up of the design phase. In both cases, the determined planning and costs for the design phase exceeded the original assumptions. In Case C, a fixed price was set for the design phase. The contractor indicated that even though his offer for the design phase was higher than the offer of the competitors, he still experienced budget tensions. Therefore, it can be said that the design phase is likely to be underestimated and becomes increasingly extensive and expensive in the two-phase model. The actors in the case studies, however, believe that the quality of the design phase increases. The actors also have confidence that this will result in fewer cost overruns, or even a lower cost price, in the execution phase. No proof for these hypotheses can be provided yet because the projects yet to be completed.

7. There is no added value in price competition in the tender, by unit prices for the execution price

In Case C, the contractor had to bid on unit prices for several dominant cost items in the execution. The unit prices provided the basis for the price determination, with good motivations only, the contractor could deviate from it. The actors stated that is approach did not lead to the desired effect and therefor was not helpful. Moreover, it required a lot of effort to motivate the cost deviations.

8. The exit option, transparent budgeting and benchmarks combined provide sufficient tools to control the execution price

Several actors within the case studies indicated that the exit option, transparent budgeting and comparison to benchmarks provide enough tools to control the execution price. Contractors are eager to obtain the execution contract. Therefore, a contractor will always try to prevent a 'No-Go'. The contractor in Case B described that when the determined price was too high compared to benchmark values, he had to reduce costs. He explained that the reduced price made him nervous since he was not sure whether the price would be sufficient for a positive financial outcome of the project. Several actors from the client party in Case A and C indicated that they had confidence in the prices that the contractor determined. Transparent budgeting should however result in increased trust between the parties.

9. Although cultural differences are difficult to handle, they provide added value

Cultural differences between the client and the contractor's organization have been observed as obstacles in all three case study projects. The contractor tends to make quick decisions to exclude different options and is focused on results, progress and execution efficiency. The contractor's experience with design phases is limited. The client's decision-making processes are usually complex and slow. The client is process-oriented, focused on stakeholder management and more used to keep different options open to come to well-considered decisions. Cultural and organizational differences are recognized in the cases. Although cultural differences can lead to difficulties, having them within the project organization can also lead to positive outcomes. The strength of the two-phase model is based on combining both organizations' qualities in order to get a better outcome. The actors in all cases do also appreciate the collaborative and integral way of working. The parties should therefore take time to understand the differences in culture and learn to work with them. Both parties must be willing to adjust their habits to come to a new way of working. In discussions, both parties must be heard and be willing to adjust their position to come to a solution that contains both viewpoints. This attitude of the involved actors is essential for a good outcome.

10. Joint effort is required to determine working methods during the project start-up

All three projects endorse the importance of the project start-up period. During the start-up, the parties must get to know each other, understand and overcome cultural differences, commonly understand the content of the project and determine the processes and work methods of the design phase. In Case A, the client determined the work methods for the design phase before the tender. The contractor could not adapt to this plan. Therefore the parties had to determine the work methods again in a joint effort. For the contractor, it is important to have an influence on the working methods during the first phase. In Case B and C the contractors were also involved in determining the work methods.

11. There is no revenue model for the contractor during the first phase

In all three cases, the contractors described that their main interest lies in the second phase of the project. In that phase, their machinery starts working and the major revenue is made. The hourly rates of the contractor's personnel are also lower compared to an engineering company and are not feasible during the design phase. For an extensive design phase, this can lead to problems. In Case B, the client and the contractor agreed to raise the overhead on the man-hours during the design phase to limit this problem.

12. Joint responsibility for subsidy approval works for the contractors an incentive to make cost-oriented choices

In Cases A and B, the approval of the subsidy application of the HWFD is required to grant the contractor the execution contract. When the subsidy is not provided, the client cannot proceed with the project and the contractor does not obtain the project. Contractors from both cases want to avoid this situation by all means. Therefor, the contractor takes ownership over the subsidy application and starts making cost-oriented choices.

13. The two-phase model provides opportunities to include innovation and sustainability in a project

In Case B and C, electrified machinery will be used during the execution to achieve the sustainability goals of the parties. The two-phase model enables contractors to apply electrified machinery because the contractor has more preparation time, can consult with the client about the ambition for sustainable machinery and does not have to compete financially with other contractors. In Case B the two-phase model is applied in combination with an innovation partnership. These procurement methods fit well together since the two-phase model stimulates collaboration between the parties and the costs of innovations are difficult to estimate during a tender.

7.2. Expert evaluation

7.2.1. Expert evaluation setup

Experts in the field of contract management, with experience in two-phase models, were invited to participate in the evaluation session. In order to prevent a bias from one organization, experts from multiple organizations are selected to participate. In the case study projects, three different client organizations were part of the research. Moreover, in the result evaluation, experts participated who have knowledge of the different perspectives. Of the three experts, two experts work mainly for client organizations. One of the experts has extensive knowledge of the contractor's perspective. The experts have multiple years of experience in the industry and have experience with the two-phase model.

Table 7.2: Expert overview and experience

	Organization	**Function and experience**
Expert 1.	TwynstraGudde	Senior consultant procurement and contracting 20> years of experience on a large variety of contracts and for many different clients. Consulted several clients on their market approach strategy for the two-phase model
Expert 2.	RWS	Project Manager on two two-phase model projects 14> years of experience on the client side of projects
Expert 3.	Adjust	Senior consultant procurement and contracting 30> years of experience, working for the client, a contractor and a consultancy Involved in several two-phase model projects on the side of Waterboards or contractors

The main objective of this step in the research is to improve the quality of the statements. Therefore experts from the industry are asked if they recognize the results from the case studies. During the session, the experts participated in a questionnaire to give their individual opinion about the statements. For each statement, the expert shortly motivated the expert's agreement or disagreement with the statement. When all statements were evaluated, a discussion was held on some of the statements that received the most divergent evaluations.

7.2.2. Expert evaluation results

This section describes the expert's evaluation of the statements.

1. The early involvement of the contractor ensures an increased quality of the designs

The experts agreed with this statement. According to the experts, early involvement of the contractor is especially beneficial in a project with many stakeholder interfaces or when innovative solutions are required. The experts endorse this beneficial since discussions about uncertainties can be conducted earlier in the process. The parties are able to tackle issues earlier in the process when costs to make changes are still low. One of the experts indicates that the client must also show involvement. This is a requirement for the early involvement of the contractor to succeed. *"Involving the contractor early without the involvement of the client does not work."*

2. Early involvement of the contractor enables efficiency gain by scope optimization

The experts agree with the statement. By involving the contractor, a lot of risks can be reduced during the design phase. This involvement requires more effort in the design phase. The experts are confident that this will result in an efficiency gain in the execution phase. The experts however describe that the efficiency gain in scope optimization is not realized automatically. If the client wants to realize efficiency, the contractor must be made aware of this objective. Professionalism from the client is required to control the contractor to keep the focus on optimizations and efficiency.
The experts emphasize that confidence in this approach is required. More costs are being made in the first phase, with the aim to reduce costs or risks in the execution. The experts describe that it often remains to be problem to convince the organization behind the project team of the efficiency potential in the two-phase model.

3. There are two streams that apply the two-phase model for a different objective: One that applies the model integrally and one that is focused on risk reduction

The experts recognize the two streams. The experts describe that the stream that is focused on risk reduction, is mostly applied by RWS. Other clients like Waterboards apply the two-phase model more integral.

4. An integrated management team is preferred over a mirrored management team

The experts had a wide spread within their scores for this statement. One expert fully agreed with the statement, one fully disagreed, and one was neutral. The experts argued that the composition of the management team depends on many factors in the project. *"An integrated management team is preferable for complex assignments. For less complex assignments, a mirrored team may also be suitable."* Another expert agreed with this statement and believes that an integrated management team, with a qualified team, is key towards a successful project. *"Two separate teams spent a lot of time and energy on internal discussion, which often doesn't lead to the best solutions for the issues at stake."* In an integrated team, issues can be tackled from two perspectives which can result in mutual decisions and better solutions. The experts, however, also name that a mirrored team can be beneficial since it ensures redundancy within the management team. Although it can be a challenge to decide who must be invited to meetings, redundancy is beneficial since people can easily stand in for each other. On the other side, a large mirrored team is more costly since more man-hours are made and it results in extra interfaces in the project. Therefore both alternatives have their pros and cons. The experts explained that a mix of both options is also possible. In that scenario several roles are mirrored, and several roles consist of one responsible person. (e.g. one stakeholder manager from the client, one technical manager from the contractor but two project managers and two contract managers). The experts unanimously argued that there is a difference between separated mirrored teams' and a 'collaborate mirrored team'. In the separate team, there are two separate management teams. In a collaborative mirrored team, several roles are filled with double capacity from both organizations. These roles, however, form one

management team in which the decisions are made. All experts emphasize that a separate mirrored management team is not desirable. This has a big chance of leading to disruptions in a project.

The statement has been adjusted after the expert evaluation. The experts explained that the integral management team is not necessarily preferred over the mirrored management team, since this is very context-dependent. According to the experts, a mix of an integral and separated management team is also possible. Separated management teams are however disrupting a project and do not stimulate collaboration, the experts state. This resulted in the following adjusted statement:

4. Two separate mirrored management teams are undesirable in a project.

5. The client does not want to release control

The experts do not clearly agree or disagree with the statement. During the discussion, the experts recognize that the degree of releasing control is an issue in every procurement approach. According to the experts, this is project-specific and client organizations must make a well-considered decision. *"The two-phase model is not an alliance, therefore there will always be an issue in the degree of transferring control"*. An expert explains that the involved people of the client in the project often are often willing to release control and come to mutual decisions. The client's organization which is not involved in the project is however, often more hesitant to do so. The case study showed this trend. The experts explained that the client in many cases is the party that decides on the content of the scope. The contractor has the opportunity to determine the price for that scope. Also when the risks increase due to a decision that the client made, he can include this risk in the price. The contractor can also decide if he can accept the risk level. The two-phase model enables discussions about these choices between the parties. The situation in which one party forces the other party into certain decisions is therefore not likely to happen.

The statement has been adjusted after the expert evaluation. The cases show that the client does transfer control to the contractor, but is not willing to release full control. This is not strange since the two-phase model is not the alliance model. It is however important for the client to consider to what degree he wants to involve the contractor in the decision making. The client must keep in mind that responsibility and decisive power must be in balance. The statement has therefore been adjusted to:

5. The degree of releasing control is an important consideration for the client.

6. The design phase becomes increasingly extensive and expensive

The experts agree with the statement. The concept is to invest in the design phase which will result in a more efficient execution phase. The experts indicate that clients tend to underestimate the costs that contractors make during the design phase.

7. There is no added value in price competition in the tender, by unit prices for the execution price

The experts do not clearly agree or disagree with the statement. In some projects in the past, unit prices worked well. When there is competition on the prices in the tender, this should not carry significant weight in awarding the project, because it could enhance opportunistic behaviour. The experts describe that the moment of involving the contractor plays an important role in the consideration if unit rates can be applied. When the design requirements are already quite well determined, it is possible to let the tenderers make a bids. In most HWFD projects, the contractor is involved way earlier. In that case it is not possible to have competition in prices for the execution phase.

The experts explained that unit prices can work in a project and are therefore not necessarily to be banned. The case study, although, shows that unit prices can also bring difficulties to the price determination process. The statement has therefore been adjusted to:

7. Clients should be hesitant to use unit prices for the execution price during the tender

8. The exit option, transparent budgeting and benchmarks combined provide sufficient tools to control the execution price

The experts somewhat agree with the statement. The client needs to validate that the taxpayer's money is adequately spent. Therefore the client sometimes needs more tools to guarantee that the price is controlled sufficiently. There is however also an element of perception. Even when the project team can indicate that the prices are right, there sometimes still is a feeling of spending too much. The experts indicate that one tool is missing. A financial expert judgement is often used as a tool to review the execution price. These experts can check the factual and the emotional side of the price determination. The experts describe that it is important to establish well-considered conditions for the exit options. When the client and contractor cannot come to an agreement for the execution phase, the contractor must be somehow rewarded for his efforts in the first phase.

The experts indicate that the tool of expert judgement should be added to the statement. The statement has therefore been adjusted to:

8. The exit option, open-book accounting, benchmarks and expert judgement combined provide sufficient tools to control the execution price

9. Although cultural differences are difficult to handle, they provide added value

The experts agree with this statement. According to the experts, two parties with different perspectives can see more than one party. It is important that the actors in the combined team share this belief. Managing cultural differences must not be underestimated. *"If the project organization can find a way to make the cultural differences productive, it will definitely lead to a win-win situation".*

10. A joint effort is required to determine working methods during the project start-up

The experts fully agree with the statement. The contractor should be given the opportunity to make a proposal to determine the work methods. The extent to which the work methods must be determined together depends on the size and complexity of the assignment in the first phase. When collaboration is desired, both parties must influence how that collaboration should look like. The client can set boundaries if needed.

11. There is no revenue model for the contractor during the first phase

The experts disagree with the statement. Since the contractor does get paid for the work in the first phase, he does have a revenue model. The experts however agree that the contractor is mainly interested in the revenue that he can make during the execution. The traditional hour rates and the rate for general costs are too low for a long design phase. In a short design phase, it is manageable for the contractor. When an extensive design phase takes several years, this might lead to financial problems for the contractor. The contractors, therefore, should consider that a long design phase results in a different cost and income ratio. In several projects, the general costs, for hour rates are increased. This ensures that the contractor does not make losses in the design phase. This is seen by the experts as a good way to fix such problems in a project.

There is a revenue model for the contractor during the first phase. The traditional hour rates and the percentage for general cost are however not sufficient in an extensive design phase. The statement has therefore been adjusted to:

11. The contractor's traditional hour rates and percentages for general costs are not sufficient in an extensive design phase

12. Joint responsibility for subsidy approval works for the contractors an incentive to make cost-oriented choices

The experts somewhat agreed with the statement. Getting the execution phase awarded is a huge motivation for the contractor. When the contractor is aware that financial choices can influence this awarding, this might influence his decision making. The experts however explain that the contractor often has limited influence on the subsidy approval.

13. The two-phase model provides opportunities to include innovation and sustainability in a project

The experts agreed with the statement. Especially when innovation or sustainability are clear objectives in the project, the two-phase model can help to achieve them. The fact that there is no financial competition on added value makes it possible to implement.

7.2.3. Two streams

The case study indicated two streams that apply the two-phase model differently. The streams have been mentioned under statement 3 and recognized by the experts. This section describes the two streams in more detail. The way in which the streams are operationalized is presented in Figure 7.1 and Figure 7.2.

The integral stream

The integral stream applies the two-phase model in an integral way to overall improve the design quality. The stream is applied to highly complex projects. The contractor is early involved to benefit from both parties' expertise to deal with the project complexities during the design phase. The delayed price determination improves the price reliability. The projects' complexity is usually not limited to a part of the project scope. The 'integral' approach is therefore usually applied to the complete scope of the project

There is a broad solution space in design assignment in the integral stream. At a stage when a preliminary design is (almost) finished, but still many requirements from stakeholders must be determined, the contractor is involved. Therefore, the contractor is involved early in the design process. The designs can be specified towards a final design or towards an execution design. The full design process is performed in a collaboration between the client and the contractor. The contractor is responsible for the design, but the client also has a significant role in the design process and can take responsibility for specific tasks. In the first phase, a design agreement is applied and the contract for the execution phase is based on the UAV-GC.

The parties in the integral stream collaborate intensively, on an integral basis. Both parties have significant input in the design activities and roles and tasks are allocated based on expertise. A more or less balanced integrated management team is applied with representatives from both parties. Decision making in the management team is based on consensus. Even though in some cases, the client might have the last say. Meeting structures are held integrally or on thematically.

It is undesirable to apply financial competition in a tender by using unit rates for the execution of a project in the integral stream. Due to the wide solution space and because of the contractor's early involvement in the design process, it is unlikely that a contractor is able to make the right predictions for the unit rates during the tender.

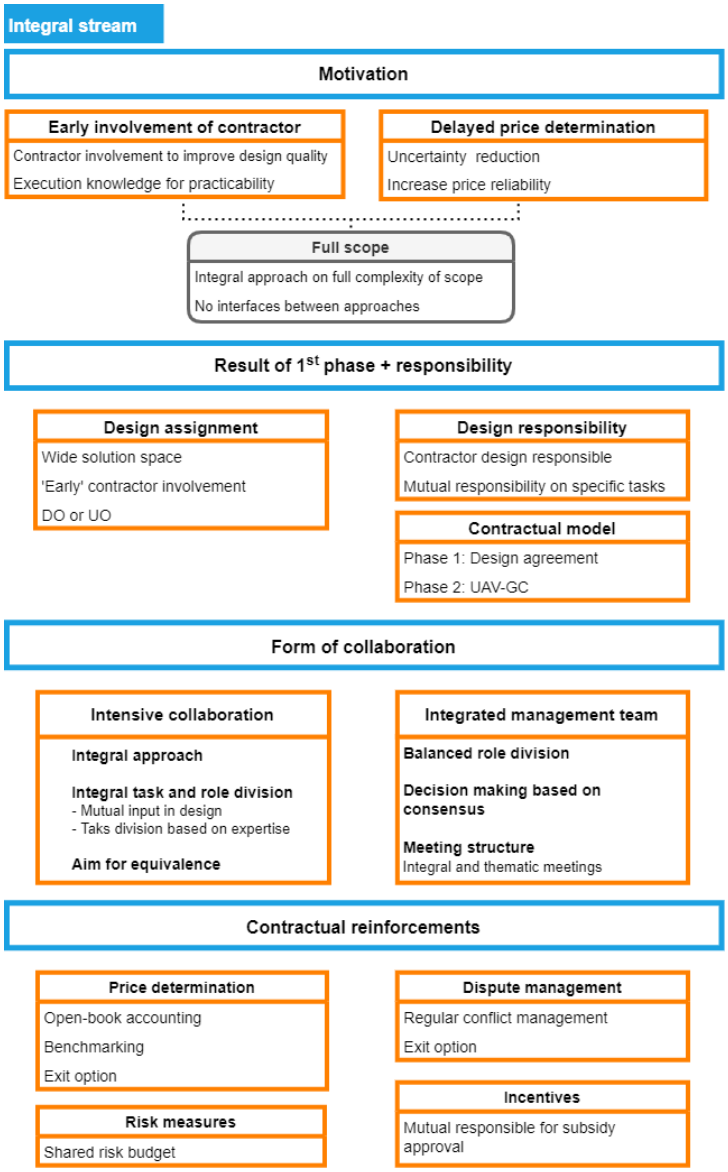

Figure 7.1: Operationalization of the integral stream

The risk reduction stream

The 'Risk reduction' stream applies the two-phase model mainly to improve the manageability of project risks. The involvement of the contractor in the design process combined with delayed price determination can improve the manageability of uncertainties. This approach is therefore solely required for the complex parts of the project scope. The standard parts of the project scope can be procured with a regular contract model which is well known in the market. The client's disadvantage of the delayed price competition could therefore be avoided for a part of the project. Since the focus lies on risk reduction, the solution space for the design activities is narrower than the integral stream. Compared to the integral stream, the contractor is relatively late involved in the design process since the client determines all requirements by itself. Since the UAV-GC is applied in the first and the second phase, the contractor is the producer of the design products and the client the assessor.

The contractor is relatively later involved in the design process since all requirements have already been set by the client. The designs can be specified towards a final design or until an execution design. Also here, the contractor becomes responsible for the design. In this stream, the contracts for both the design and the execution phase are based on the UAV-GC. In principle, this means that the contractor is the producer of the design products and the client is the assessor of these products. The parties in a 'Risk reduction' two-phase

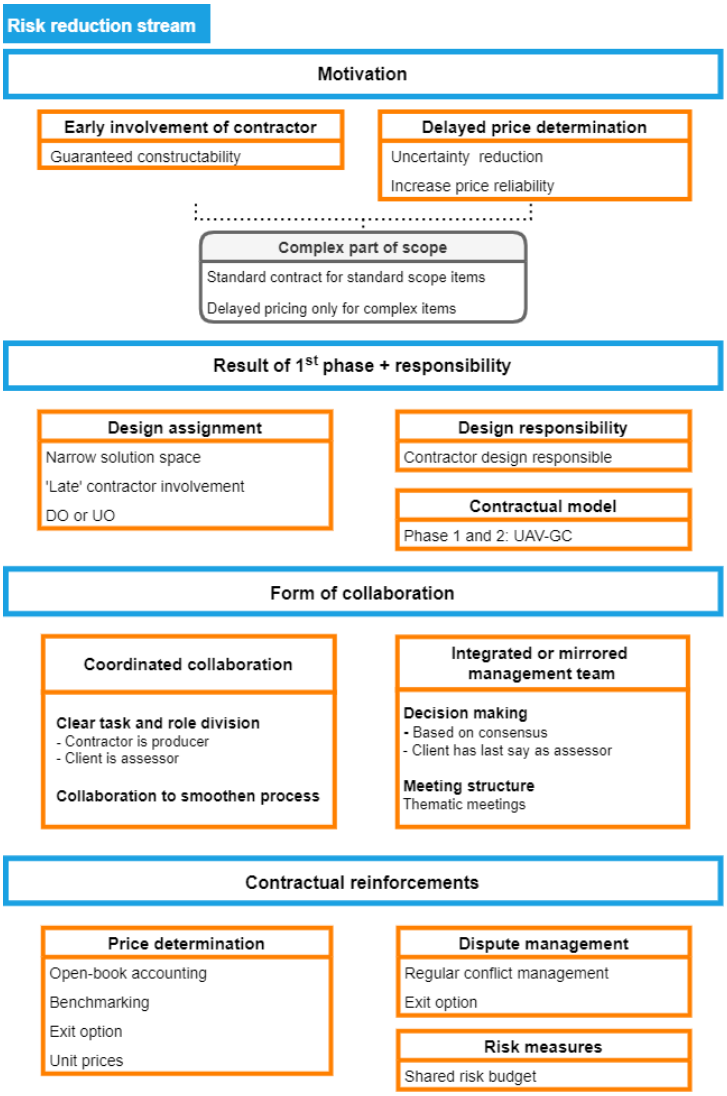

Figure 7.2: Operationalization of the risk reduction stream

model collaborate more coordinated. The tasks and roles are clearer divided into a producer of the designs and the assessor. Collaborative behaviour is helpful to smoothen the process, but it is not required for the completion of tasks. The management team can be integral, or (semi) mirrored where one or more roles in the management team are represented by one person from the client and one person from the contractor. An integrated management team is likely to enhance collaboration. A mirrored management team can however be easier for organizations' internal authorization and can improve redundancy. The management team tries to find consensus for the decision making, but as the assessor, the client has the last say. Meeting structures are held integrally or on thematically.

7.3. Lessons learned

The statements have been evaluated by the experts in Section 7.2. After the expert's evaluation, the statements are considered as lessons learned for the two-phase model. The lessons learned are listed in Table 7.3. After the expert's evaluation, statements 4, 5, 7, 8 and 11 have been revised. The thirteen statements provide lessons learned from the case studies. These lessons can help client parties when they intend to apply the two-phase model in a project. The thirteen lessons learned are the direct answer to research question four.

Table 7.3: Lessons learned - revised statements are indicated with 'x'

	Statement	Revised
1.	Early involvement of the contractor ensures an increased quality of the designs.	
2.	Early involvement of the contractor enables efficiency gain by scope optimization.	
3.	There are two streams that apply the two-phase model for a different objective: One that applies the model integrally and one that is focused on risk reduction	
4.	Two separate mirrored management teams are undesirable in a project	x
5.	The degree of releasing control is an important consideration for the client	x
6.	The design phase becomes increasingly extensive and expensive	
7.	Client's should be hesitant to use unit prices for the execution price during the tender	x
8.	The exit option, open-book accounting, benchmarks and expert judgement combined provide sufficient tools to control the execution price	x
9.	Although cultural differences are difficult to handle, they provide added value	
10.	Joint effort is required to determine working methods during the project start-up	
11.	Contractor's traditional hour rates and percentages for general costs are not sufficient in an extensive design phase	x
12.	Joint responsibility for subsidy approval works for the contractors an incentive to make cost-oriented choices	
13.	The two-phase model provides opportunities to include innovation and sustainability in a project	

8

Discussion

In this chapter, the research results are discussed. First, the research results are discussed, and recommendations for future research are provided. Secondly, the contribution of this research towards science and practice is discussed in Section 8.2. Lastly, the limitations of this research are discussed in Section 8.3.

8.1. Interpretation of the results and recommendations

Limited literature is available on the two-phase model. On ECI, a delivery model similar to the two-phase model, much more research has been conducted. The advantages of ECI have been widely described in literature. ECI is described to improve the collaboration between the client and the contractor Van Wijck (2018), which leads to better project performance. Moreover, improved collaboration early in the project is also helpful to divide the risks better Love et al. (2008); De Ridder and Noppen (2009). Another main benefit of this approach is that issues that would otherwise arise during construction, can now be addressed at an earlier stage, before execution. This results in lower failure costs and an improvement of project efficiency (Rahman and Alhassan, 2012). In this research, the improved quality of the design in the two-phase model has been outlined. This conclusion is in line with the expectations, based on the literature about ECI.

Thirteen lessons learned have resulted from the case studies, which describe remarkable points and challenges in the experiences with the two-phase model. These lessons learned have been evaluated by experts from the industry. The observations should, however, be treated with caution. Only three projects that apply the two-phase model have been subject to the case studies. The pool of projects is limited.

One of the lessons learned describes that the increased efforts and expenses that occur during the design phase of a two-phase model, will result in an efficiency gain during the execution phase. In the future, when the first projects that apply the two-phase model are completed, research should identify if the anticipated efficiency gain also became measurable. When efficiency is measurable, research can focus on what influence the design of the elements in the two-phase model have on the efficiency score.

Another lessons learned describes two streams in the industry that apply the two-phase model differently. The experts fully agreed with this statement. The existence of these two streams is remarkable. Future research can further investigate the streams to compare their efficiency.

The risk reduction stream applies the two-phase model mainly to make risks better manageable. Beside the extended price determination on the complex parts of the project scope, the contract approach is kept remarkably identical to a standard Design & Construct contract. One could argue, that when the 'risk reduction' stream is applied, the two-phase model is not a special PDM, but only an alternative for an already existing Design & Construct contract.

The attitude, behaviour and qualifications of the actors and organizations that are involved in a two-phase model, were often named during the research as the key to success. Although these items are named several times in this research, the elements have not been studied in this research. The scope of this research lies on the organization of the two-phase model, and not on the social skills that are required. These elements were, however, named during the expert meetings and the case study interviews, as important requirements

for the success of a two-phase model. The actor's behaviour and organization's qualifications are therefore recommended subjects for future research. Future research should identify which qualifications, attitude and behaviour are required from the actors and what can be done to stimulate these attitudes, behaviour and qualifications.

8.2. Contribution of this research

To complete a master thesis, the thesis must contribute to science, and preferably also to practice. This section describes the contribution of this graduation research to science and practice.

8.2.1. Contribution to science

The literature study in this research revealed that very limited literature is available on the topic of two-phase deliver models. Pas (2021) studied the two-phased price determination process in Bouwteam projects. Clemens (2021) studied the risk management process in two-phase deliver models. In his research Clemens focuses on Bouwteams and the two-phase model. Van de Hoef (2020) and De Hoog (2020) also dedicated their research to Bouwteams. On the two-phase model specifically, research was lacking. This research provides a humble start to fill this niche. The research gives a clear oversight of the elements that must be considered in designing the two-phase model. Furthermore, the research indicates how the two-phase model can be organized and salient points and challenges have been described. Overall, this provides insight in how the two-phase model can be organized, which is a step in the right direction in order to gain more understanding about the application of the two-phase model. Therefore, this research contributes to making reasoned choices on how the two-phase model can be designed in infrastructure projects.

8.2.2. Contribution to practice

Interest from the market in the research subject has been recognized by the researcher. All the industry representatives that were contacted, were eager to participate in and contribute to this research. This eagerness demonstrates the motivation which is present in the market to gain knowledge in the topic of two-phase models.

This research investigated how the design phase of a two-phase model can be organized. The elements that must be considered when designing a two-phase model are described. The research also offers choices in designing the two-phase model which are suitable in different circumstances, and choices that are less suitable. Experiences and challenges that have been encountered in the case study projects have also been described. This combined can provide client organizations with insights about the application of the two-phase model. This insight can be helpful for a client organization that wishes to apply the two-phase model.

8.3. Research Limitations

- **Literature study:** The literature study focused on the elements of a project delivery model (PDM) and the mainly applied delivery models in the Dutch construction sector. For the two-phase model, scientific literature were not found. Scientific literature on the two-phase model is therefore lacking in this research. To form a basis, papers on Bouwteams and ECI were reviewed since these delivery models show similarities with the two-phase model. Specifically on the two-phase model, reports and standardization's of organizations in the industry were reviewed.

- **TwynstraGudde bias in expert interviews:** In the first round of expert interviews, six interviews were conducted with experts from the industry. Four of these experts work at TwynstraGudde as advisors for multiple projects at different client organizations. Although the advisors work for different client organizations, yet a 'TwynstraGudde' bias is possible. To reduce this risk, two experts from two different client organization's participated in the expert interview.

- **Limited number of case studies:** Three infrastructure projects that apply the two-phase model were investigated in the case studies. Two of these projects have similar characteristics. They concern dike reinforcements and a Waterboard authority is the client in both projects. The third project is less similar and has a different client. This resulted in the finding that there are two streams in the industry that apply the two-phase model for a different objective. The experts evaluation agreed with this statement. The robustness of the research results could have been improved with a fourth project with a client different than a Waterboard.

- **Progress of case study projects:** The two-phase model has only recently been implemented in Dutch infrastructure projects. None of the three case study projects have been completed. One of the projects was at the end of the design phase. The other two projects were in the middle of the design phase. It was therefore not possible to evaluate the intended application of the two-phase model indeed had the desired outcome.

- **No Waterboard involved in expert result evaluation:** In all steps of the research, by involving different Waterboards and RWS, the perspective of different client organizations were present in every step of the research. In the case studies, the contractor's perspective was also investigated. Advisors from TwynstraGudde, that work for different client organizations have also been involved in the first and the last expert session. During the last expert session, when the case study results were evaluated the representative of the Waterboard had to cancel at the last minute before the session. The Waterboard perspective was therefore not present in the last expert session.

9

Conclusions and Recommendations

In this chapter, the conclusions for the sub-questions are presented after which the main research question is answered. Thereafter, the recommendations for practice and research are described.

9.1. Research questions

1. Which design elements can be identified from literature for organizing the PDM where the contractor is involved in an early stage?
A project delivery model (PDM) is a method that describes how the tasks to be performed in a construction process, are distributed among the contracting authority and the other parties. The traditional model, the integrated model and the alliance are three major groups of PDM's in The Netherlands. The two-phase model cannot be captured under one of these groups. The model can be applied in multiple ways, with characteristics of different groups. In an international context, the Early Contractor Involvement (ECI) contract model is used. ECI is a broad term used for contracts in which the contractor is involved in an early stage. According to literature, ECI improves the collaboration between the client and the contractor which leads to better project performance. Issues that otherwise would arise during construction, can now be addressed earlier in the design phase. This results in fewer failure costs and higher efficiency. In the two-phase model, the contractor is also involved in an early stage. ECI and the two-phase model therefore have similarities. The advantages of ECI are also expected to occur in the two-phase model.

Based on the literature, the elements of a PDM can be captured as shown in Table 9.1. The left column describes the elements that must be considered when a PDM is designed. The right column describes these elements in another level of detail such as activities and considerations that must be carried out in organizing a PDM.

Table 9.1: Elements of the PDM from literature

Elements of a Project Delivery Model	
Task & Responsibility allocation	Pre-project planning Design & Engineering Construction Project management
Form of specification	'Early' / 'late' phase transition Detailed / conceptual design or functional requirements
Risk measures	Allocation Sharing Mitigation Insurance
Contractual reinforcements	Price determination Incentives / penalties Rewards / saving sharing Losses sharing
Process operating systems	Decision making (integrated, linear) Dispute management Information management & ownership
Form of collaboration	Classical / relational contract Intensity of collaboration

2. What are the design elements for the first phase of the two-phase model in practice and what activities are done differently in the two-phase model compared to other contract forms?
The two-phase model is a PDM that cannot be captured under one of the three standard groups of PDM's. The elements from literature that describe the elements for a PDM in general have been evaluated by experts from practice to check if the same elements apply for the two-phase model. A group of experts evaluated the elements of a PDM in Table 9.1 which resulted in the elements for a two-phase model in Figure 9.1. The model describes all elements that must be considered when a two-phase model is designed. Figure 9.1 starts with the attitude and behaviour of the involved actors and organizations, since this is a requirement for the two-phase to be successful. Secondly, the model shows the elements that must be considered when the two-phase model is designed. The design of the two-phase model starts for the contracting party at the consideration about the motivation why he would want to apply the two-phase model.

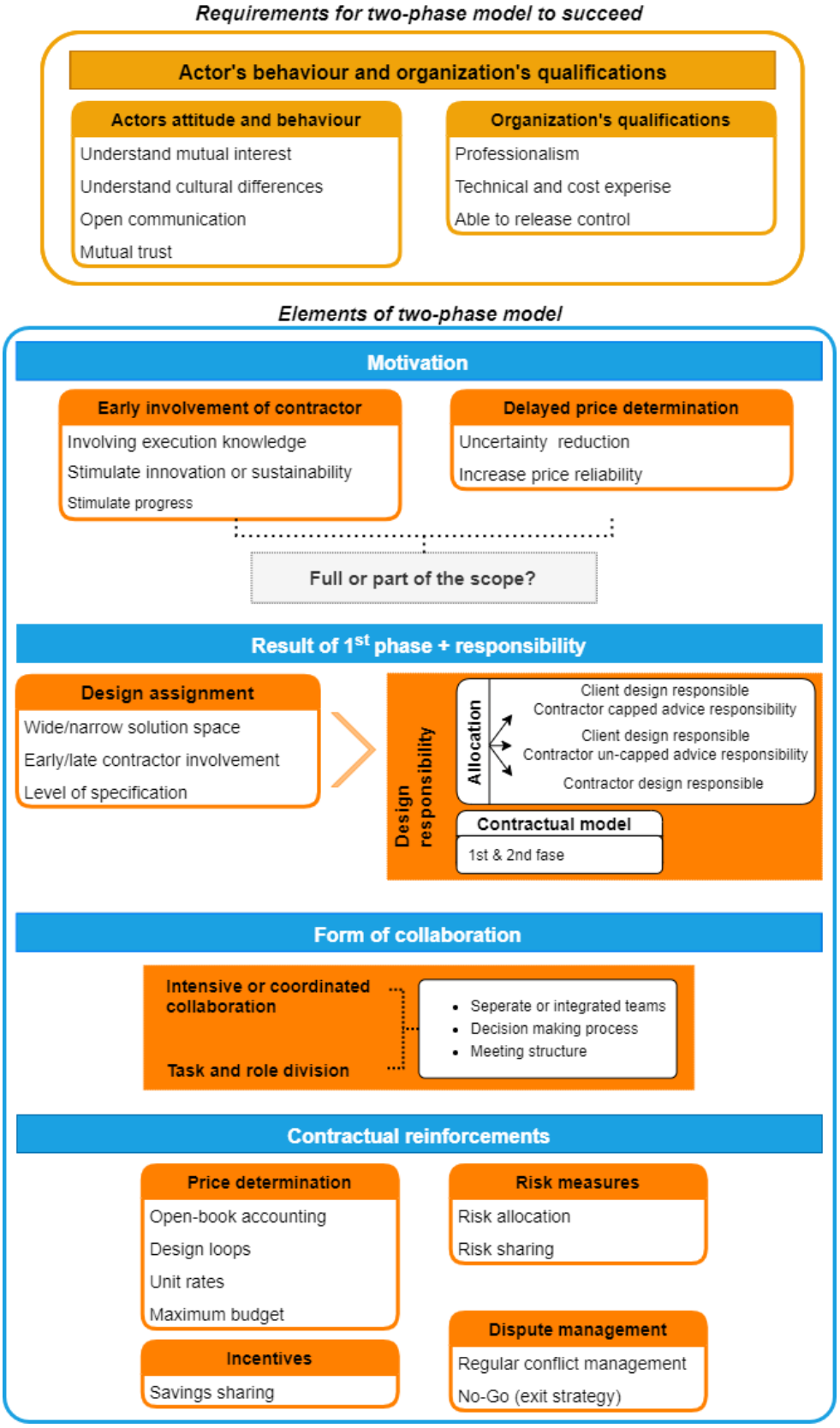

Figure 9.1: Elements of a two-phase model

Actors behaviour and qualifications
The attitude and behaviour of the involved actors and qualifications of the involved organizations are most important in a two-phase model. This can be considered as a requirement for the two-phase model to be successful. Because this is such an important requirement, this element is added at the top in Figure 9.1. For the involved organizations, it is important to show professionalism in the cooperation. The client organization must possess technical and cost expertise to be able to control the contractor. The parties must also have the ability to release control. In a collaboration two parties have influence. Therefore both parties must understand that they cannot decide individually. Different parties stem from different corporate cultures. The actors in a two-phase project must show understanding for the cultural differences and the different interests in the project. With open communication and trust between the actors a win-win situation can be created in the collaboration.

Motivation
The design of the two-phase model starts at the consideration about the motivation to apply the two-phase model. Motivation is necessary to apply a certain PDM. A certain degree of complexity in the project, which causes a desire to involve the contractor early, and to delay the price determination, is required to apply the two-phase model. Early involvement of the contractor can be desired in a project to utilize the contractor's expertise to be able to better handle the complexities in the project. Early involvement of the contractor can also stimulate innovation or sustainability goals in the project. Lastly, the contractor can also stimulate progress. Delayed price determination in the two-phase model helps to reduce uncertainty in the project and increase the reliability of the construction price. The two-phase model can be applied to the entire, or a part of the project scope. Standard items in the project scope can be procured with a regular delivery model.

Result of the first phase and responsibility
The design assignment in the first phase can have a wide or a narrow solution space. In a narrow solution space, many design choices are already made by the client in the preliminary phase. In a wide solution space, less design choices have been made by the client which results in a larger design assignment in the first phase. The wide/narrow solution space goes together with early or late involvement of the contractor. When the contractor is involved relatively late in the design, the solution space will be narrow. When the contractor is involvement early on in the design, there will be a wide solution space. The level of specification describes the level of detail that is required before the parties move into the second phase. The considerations in the design assignment have influence on the allocation of the design responsibility. The responsibility for the design can be allocated to the client or the contractor. The contractual model that is used for the first and the second phase correlates with this choice.

Form of collaboration
The collaboration between the client and the contractor in a project can be intensive or coordinated. Along with the tasks and role division this determines if there are separate or integrated teams applied to the project and how the decision making process and meeting structures are organized.

Contractual reinforcements
The contractual reinforcements describe the subjects that can be implemented in the contract to strengthen the two-phase model in the project in order to succeed. The client can choose to allocate risks or to share risks in the form of a risk budget. There are several tools available to keep the determination of the execution price in control. Open-book accounting is the most common tool used in the two-phase model. Dispute management in a two-phase model can be handled in regular way, as would be done in other contract forms. The exit option is a tool that is characteristic for the two-phase model. When the client and the contractor cannot agree on the execution price, the client can choose to not award an execution contract and end the collaboration. Lastly, the client can implement incentives to coax the contractor in a certain direction. Savings sharing is an example in which the savings that are not spent are divided between the client and the contractor. This can be a bonus for the contractor, which motivates him to be cost effective.

Activities done different in two-phase model
In the two-phase model, several activities are done significantly different compared to other contract forms. The delayed price determination, outside of competition, is a unique characteristic of the two-phase model. No financial competition for the contractor results in a risk for the client. The client needs to mitigate this risk with the tools that have been described in the model.

During the tender, before the two-phase model is started, the client searches for the best collaborative partner instead of the best party for the execution. Besides technical expertise, the tendering parties must show collaborative qualities to win the tender.

The attitude and behaviour of the project parties becomes increasingly important in the two-phase model. In the first phase of a two-phase model the parties collaborate intensively and depend on each other. Tasks and responsibilities can be less clear during the collaboration in a two-phase model compared to other contract models. In the two-phase model it is therefore increasingly important to show a collaborative attitude. During the start of a project the involved parties must join in determining the work methods for the project.

3. How are the elements of the two-phase model operationalized in practice?
The elements that must be considered when designing a two-phase model were determined in the description of the previous research questions. To organize the two-phase model, the operationalization of elements can apply in many different ways. The optimal operationalization of elements for the project depends on the client, the content and the context of the project. The operationalization of three projects has been presented in the case study. The case study identified two streams that apply the two-phase model differently. The integral stream applies the two-phase model integrally to optimally benefit the expertise of both parties. The 'risk reduction' stream applies the two-phase model to improve the management of project risks.

The integral stream is applied to complex projects. The client intends to optimally benefit from both parties' expertise to improve the quality of the design products. The integral stream is applied to the full project scope to handle all complexities in the project. There is a wide solution space in the design assignment and the contractor is involved early in the design process. The full design process is performed in a collaboration between the client and the contractor. The contractor is responsible for the design, but the client also has a significant role in the design process and can take responsibility for specific tasks. In the first phase, a design agreement is applied. The contractual model for the second phase is based on the UAV-GC. In the integral stream, the parties collaborate intensively and aim for equivalence. Tasks and roles are divided integrally on a basis of expertise. An integral management team is applied with a balanced role division between the parties. Both parties influence the decision making and the parties try to find consensus. The use of unit rates is not suitable for the integral stream: because of the wide solution space, early determined unit rates are likely to become unrepresentative at the end of the design phase.

The risk reduction stream is applied to improve the manageability of uncertainties in the project. This approach is solely required for the complex parts of the project scope. The standard parts of the project scope can be procured with a regular contract model. Since the focus lies on risk reduction, the solution space for the design activities is narrower than the integral stream. The contractor is involved relatively late in the design process when all requirements have been determined by the client. The contractor becomes responsible for the designs. The UAV-GC is applied in both phases. A coordinated form of collaboration is applied in the risk reduction stream. The contractor is the producer of the design products and the client is the assessor. That tasks and roles are clearly divided among the parties. The management team can be integrated or mirrored. An integrated management team is likely to enhance collaboration. In the decision making, by the management team, the parties aim for consensus. However, the client has ultimate decisive power since he is the assessor of the products. The contractual reinforcements that can be applied in the risk reduction stream are the same as for the integral stream and unit prices are the only addition that can be used in the price determination in the risk reduction stream.

4. What are the lessons learned in designing the two-phase model in practice?
Three case studies have resulted in thirteen statements about the two-phase model. The statements describe lessons that were learned in the case study projects. These lessons can help client parties in organizing their two-phase model in future projects.

1. The early involvement of the contractor ensures an increased quality of the designs.
   Involving the contractor in the design phase of a project increases the quality of the design because the contractor can guarantee an executable design. Creativity, specifying capability, cost expertise and a

drive for optimization are also valued capabilities of the contractor. Especially in projects with technical or stakeholder complexities, the early involvement of the contractor is beneficial. The integral way of working,where both parties deliver input for the design and all stakeholders are involved increase the quality of the design. Uncertainties can be noticed earlier in the process which enables the parties to tackle issues earlier in the process when costs for changes are still low. In order to increase the quality of the design it is required that the client also delivers input in the design process.

2. Early involvement of the contractor enables efficiency gain by scope optimization.
   A contractor has a natural drive for optimization. By specifying the scope, ambiguities disappear and risks can be reduced. The execution price becomes therefore more reliable. This must result in an efficiency gain in the execution phase. The contractors' drive for optimization can also be applied to improve the scope efficiency. This can reduce the scope which causes lower execution costs. The contractor must be made aware of this objective and the client's professionalism management are required to accomplish this scope optimization.

3. There are two streams that apply the two-phase model for a different objective: one that applies the model integrally and one that is focused on risk reduction.
   The stream that applies the model to reduce risks has the following characteristics:

   - the client specifies the standard parts of the scope;
   - the two-phase approach is applied on the complex parts of the project scope;
   - the parties collaborate in a coordinated manner;
   - the collaboration looks similar standard Design & Construct contracts.

   The stream that applies the model integrally has the following characteristics:

   - the contractor is very early involved when requirements still must be defined;
   - the parties collaborate intensively;
   - both parties deliver significant input in the design activities.

4. Two separate mirrored management teams are undesirable in a project.
   Two separate management teams are undesirable in a project, since a lot of time and energy is spent on internal discussion. There is a risk that both parties create their own truths and are not open to the other party's perspective. This situation must be avoided in the collaboration in a two-phase model. If a partly or fully integral management team must be applied to a project, depends on the project's complexity.In an integrated team, issues can be tackled from two perspectives which can result in mutual decisions and better solutions. In a management team with members who have more double roles, there is more redundancy in the management team.

5. The degree of releasing control is an important consideration for the client.
   When the contractor is involved, he will influence the decision making. The client must consider to which extent he is comfortable with releasing control in decision making. When the contractor is responsible for the design, he will also need to be able to make design choices. In projects where the parties collaborate intensively, the client must be willing to allow the contractor to have a significant say in decision making.

6. The design phase becomes increasingly extensive and expensive.
   In the two-phase model, more effort is put in the design phase with the aim to obtain a smoother execution phase. The design phase therefore becomes increasingly extensive and expensive. Clients tend to underestimate the efforts and the costs that contractors make during the design phase. Not everyone, (mostly people that don't participate in a two-phase project) in the industry is convinced that the extra expenses in the first phase will lead to a more efficient execution phase.

7. Clients should be hesitant to use unit prices for the execution price during the tender.
   The client has a public responsibility to justify how tax money is spent. Therefore, unit prices are sometimes used to apply some financial competition to the tender. In that situation, tendering contractors bid on unit prices for several dominant cost items that are used as a basis for the execution price. Clients should be reluctant to apply this method to control the execution price since the prices are often not

representative anymore when assumptions change during the design phase. Especially when the contractor is involved very early in the design phase, it is challenging to determine proper unit prices. If the client chooses to use competition for the prices in the tender, this should not carry significant weight in awarding of the project, because it could enhance opportunistic behaviour.

8. The exit option, open-book accounting, benchmarks and expert judgement combined provide sufficient tools to control the execution price.
   The risk that arises for the client when the execution price is determined without financial competition for the contractor, can be controlled with a combined set of tools. A contractor is eager to obtain the execution contract. When his price is too high according to expert judgement or compared to benchmarks, he can be motivated to reduce the costs. Open-book accounting should result in increased trust between the parties. Benchmarks must be set correctly, to be sure that only comparable projects are compared with each other.

9. Although cultural differences are difficult to handle, they provide added value.
   Cultural or corporate differences between the client's and the contractor's organization increase the complexity of collaboration. The contractor tends to make quick decisions to exclude different options and is very focused on results, progress and execution. The contractor's experience with design phases is limited. The client's decision-making processes are usually complex and slow. The client is process-oriented,is focused on stakeholder management and is more used to keeping different options open to come to well-considered decisions. Although cultural differences are difficult to handel sometimes, they can prove useful in the project organization. The strength of the two-phase model is based on combining both organizations' qualities to result in a better outcome. It is required that the actors in such a combined team share this belief and have a positive attitude. Managing cultural differences must, however, not be underestimated.

10. Joint effort is required to determine working methods during the project start-up.
    When collaboration is desired, both parties must influence what that collaboration will look like. Therefore the client and the contractor must determine the work methods as a joint effort. The extent to which the work methods must be determined together depends on the size and complexity of the assignment in the first phase.

11. Contractor's traditional hourly rates and percentages for general costs are not sufficient in an extensive design phase.
    The contractors main interest lies in the execution phase of the project. During the execution the contractor's machinery starts working and the major revenue is made. The hourly rates of the contractor's personnel and the rates for the general costs are too low for a design phase where only man-hours are involved. The contractors, need to consider that a long design phase results in a different cost and income ratio than in traditional contracts.

12. Joint responsibility for subsidy approval works as an incentive for the contractors to make cost-oriented choices.
    When the project is dependent on a third party to approve the funds for the execution price, this can motivate the contractor to make cost-oriented choices. To get the execution phase awarded is a huge motivation for the contractor. When the third party has clear requirements for the execution price, the contractor will be motivated to accomplish these requirements.

13. The two-phase model provides opportunities to include innovation and sustainability in a project.
    Due to the increased collaboration, more preparation time and no financial competition the two-phase model, provides opportunities to implement extra added value like sustainability or innovation in a project.

9.2. Main research question

This section answers the main research question of this study:

"What is the optimal operationalization of the elements in designing the first phase of the two-phase model in infrastructure projects?"

There is not one optimal operationalization of the elements to design the two-phase model for every project. An optimal operationalization of the elements forms a two-phase model that stimulates the project organization in achieving the project objectives that are determined by the client. The right operationalization of the elements is dependent on the content and context of the project. The project contents that influence the design of the two-phase model are first of all the objectives, the complexities and the technical assignment of the project. The contexts that influence the design of the two-phase model are the surroundings, stakeholders and the client's procurement policies. The client must consider the degree of releasing control the client is comfortable with.
In the design of the first phase of every two-phase model the following themes must be considered:

- motivation for applying the two-phase model;
- required result of the first phase and the responsibility division;
- form of collaboration during the first phase;
- contractual reinforcements.

Two streams have been identified that apply the two-phase model with different intentions. The operationalization of elements in these two-phase models is therefore also different.

The stream that intends to make the project risks better manageable, clearly delineates the application of the two-phase model. The model is specifically applied on the uncertain parts of the project scope. The standard parts of the project scope can also be procured with a fixed price. In that case it is important to clearly define the split between both approaches. The tasks and roles are clearly divided, in which the contractor produces the designs products and the client assesses them. Collaboration is mainly used to smoothen the process and to share knowledge to prevent mistakes. It is therefore possible to apply an integral or mirrored management team. Fully separated management teams are undesirable since this can hinder collaboration.

In the stream that applies the two-phase model integrally, the roles are less strictly defined. The elements are operationalized with the aim to optimally benefit from the expertise of all parties in the design phase. The integral approach improves the overall quality of the designs which also results in reduced risks. Good collaboration between the parties is essential in the integral approach. The elements are applied to stimulate collaboration between the parties. An integral management team is therefore required in this stream.

In every two-phase project, an extensive start-up phase should be applied at the start of the design phase. Both parties must mutually determine the work methods for the design phase. The actors must also spend time to get to know each-other and understand the cultural differences between the organizations. When the cultural differences are well understood and the actors handle the differences with the right attitudes, the cultural differences can be transferred into a positive outcome.

The design phase of a two-phase model is more intensive and expensive than in regular projects. The required efforts during a design phase are easily underestimated. The extra effort will however result in a higher design quality. With the right focus, the extra effort can also result in optimizations in the execution price. A higher efficiency in the execution phase is also expected. The hour rates of a contractor are usually not representative for an extensive design phase. The contractor must revalidate his rates to ensure an feasible revenue model during the design phase. The delayed price determination is in first place an disadvantage for the client. There are however sufficient tools available to control the execution price. Finally, it is important that the operationalization of elements are in balance with each other. The design of the two-phase model must be in proportion with the scale of the project.

9.3. Recommendations

In this section, the recommendations for practice and further research are described.

9.3.1. Recommendations for practice

This study intends to provide insight into how the two-phase model can be organized, in a way that contributes to a project's objectives. It is recommended for a client party to start by considering why he would want to apply the two-phase model. The delayed price determination incurs a disadvantage for the client. During the price determination, the contractor has no financial competition from other contractors. To the client, this introduces a risk of a higher price for the project. The application of the two-phase model must therefore bring added value to compensate for this disadvantage. In projects where the client can clearly specify the desired result and where uncertainties are manageable, the two-phase model is not suitable.

Clients wishing to apply the two-phase model are recommended to consider all elements of the two-phase model that have been determined under research question number two. Reasoned choices must be made about the implication of the elements, by keeping the content and context of the project in mind. The thirteen lessons learned can help the client in making these choices.

The research identified two streams that apply to the two-phase model differently. For the risk reduction stream, the client is recommended to clearly identify how the approach is intended. The contractor must know from the start, what is expected of him. In projects with high complexity, the integral stream is recommended. The integral stream seems to stimulate collaboration better than the risk reduction stream. In complex situations, neither party can claim to have the ultimate knowledge about the project. The integral approach, where both parties have significant input in the design phase, can be applied to make optimal use of the expertise of both parties. The collaboration between the parties should be based on equality.

An approved subsidy is often used as a requirement for awarding the contractor with the execution contract. This can result in cost awareness by the contractor, which is positive for the client and the taxpayer. The approval of the subsidy, however, often lies outside the contractor's sphere of influence. The approval of permits or ministerial approval is more examples of requirements for a second phase, in which the contractor's influence is limited. 'Honest work for fair reward' is often used in the industry (Fijneman, 2020). Therefore, when such a requirement results in a No-Go, in which the contractor loses his prospect of getting the execution phase awarded, the contractor must be fairly rewarded for his efforts in the design phase.

Actors from the case studies mentioned that their understanding of the other party increased after they collaborated in the design phase. Increased mutual understanding between parties can already be a major contributing factor to improving collaboration. It is recommended that parties do not wait until their first two-phase model to improve mutual understanding. The parties should open up beforehand, and increase communication about each other's work, interests and concerns. When parties invest in mutual understanding before the start of a new project, collaboration during the project will be stimulated which will cause an improvement in mutual.

9.3.2. Recommendations for future research

Cultural or corporate differences have often been mentioned in this research. With the right attitude, cultural difference can be turned into something positive. It is recommended to study the competences and organizational preconditions which are required from the actors and managers in such situation to stimulate the positive side of cultural differences.

The scope of this research is limited to the first phase of the two-phase model within infrastructure construction projects. The execution phase has not been part of this research. Several actors in the case studies were afraid that the collaborative way of working in the design phase, would disappear in the execution phase due to the new roles. To the second phase, the standard UAV-GC applies, and the contractor and the client have a different relationship compared to the first phase. Future research could focus on which actions could be taken to preserve the collaborative relationship of the first phase in the execution phase. It would be interesting to see if the actions, or desired behaviour in the second phase are different to the first phase.

The case study in this research has focused on construction projects and specially on hydraulic engineering and soil movement. The two-phase model is currently also applied to renovation projects like the steel bridge

renovation in the A12 highway (Cobouw, 2021). The complexity in a bridge renovation project is completely different compared to a dike reinforcement or a river project. Instead of soil information and high water risks in a dike reinforcement, the asset information and hindrance become important uncertainties. Future research could focus on investigating possible differences between the application of a two-phase model to construction projects or a renovation project.

Two case studies showed that the HWFD subsidy provider uses strict reference levels in assessing the subsidy applications. These reference prices are based on projects in which fixed prices are applied after financial competition in the tender. In the reference prices, only the fixed price is incorporated. Potential cost overruns are not part of the reference prices. The actors in the two-phase projects have difficulty to match their prices with the reference levels. A scientific study could be carried out to determine a calculation methodology which can revalidate the reference prices.

The research indicates two streams that apply the two-phase model in a different way. The streams have a different objective and operationalize the elements of the two-phase model differently. The emergence of these two streams is still fairly new. It would be interesting to see in what direction the streams will evolve. Future research, in a couple of years, could identify if the two streams will still be clearly present. It is also possible that the streams will move closer together, or only one stream remains to be used in preference over the other. Perhaps the two streams turn out to be provide insufficient options for contracting parties, which results in new approaches. The evolution of the two-phase model is therefore recommended to be subject of future research.

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A

Expert interview sessions setup

To answer the second research question: “What are the design components for the first phase of the two-phase model in practice”, an Expert meeting will be held. Experts from the field of contract management will be asked to join an interview. All experts have experience with the two-phase delivery model. All experts are invited to an individual interview of approximately 1 hr.

The following experts are asked to join the interview:

Expert	**Organisation**	**Function**
Expert 1	Twynstra Gudde	Senior Adviseur Aanbesteden en Contracteren
Expert 2	Twynstra Gudde	Senior Adviseur Aanbesteden en Contracteren Samenwerken in de bouw
Expert 3	Twynstra Gudde	Adviseur Aanbesteden en Contracteren
Expert 4	Twynstra Gudde	Adviseur Aanbesteden en Contracteren
Expert 5	Waterschap rivierenland	Senior Inkoopadviseur
Expert 6	RWS	Adviseur aanbesteden en contracteren Projecten DOEN

The objective of the expert meetings is to discover:

1. What elements are important in a two-phase model?
2. What should the parties do different in a two-phase model compared to a regular (integrated) contract?

The interview privacy policies are explained to the participants: The experts participate voluntarily. They are not obliged to answer a question if they don’t feel comfortable doing so. The expert’s names will not be mentioned in this report. The participant were all willing to have the interview recorded by means of a Microsoft Teams recorder or a recording tool on a mobile phone.

Start

- Ask expert if she/he feels comfortable if the interview is recorded.
- Introduction of the student, and the research topic
  - Inzicht krijgen, in hoe het twee-fasen model georganiseerd kan worden.
  - Verkennende deel:
  - Uit wat voor elementen bestaat het twee fasen model
  - Wat doet men anders bij twee fasen dan in andere contract vormen?
- Explanation of the objective of the interview

- The interviewee participates voluntarily and can always choose to not answer the question when he/she feels not comfortable with this question.
- Introduction of the expert (Background, years of experience)

Part 1. Out of which elements does a two-phase model exist?

- What elements do you consider when organizing/preparing a two-phase model?
- Do they differ in different phases of a project
- In what way?

Present table with the elements of a PDM from literature.

- Does the interviewee recognize these elements when organizing a two-phase model?
  How does the interviewee recognize these elements
- Which elements are missing?
  Why are the missing elements important in the two-phase model?

Table A.1: Elements of the PDM

Elements of a Project Delivery Model	
Task & Responsibility allocation	Pre-project planning Design & Engineering Construction Project management
Form of specification	'Early' / 'late' phase transition Detailed / conceptual design or functional requirements
Risk measures	Allocation Sharing Mitigation Insurance
Contractual reinforcements	Price determination Incentives / penalties Rewards / saving sharing Losses sharing
Process operating systems	Decision making (integrated, linear) Dispute management Information management & ownership
Form of collaboration	Classical / relational contract Intensity of collaboration

Part 2. What should parties do different in a two-phase model compared to a regular contract?

- Are the elements, that are identified for a two-phase model, the same as for a regular (integrated) model?
  How are the elements different?
- Is there more or less focus on some of the elements in a two-phase model?
- Is the interpretation of the elements the same in both delivery models? or are there different actions needed in the two-phase model?
  Does the expert have an example from their own experience?

End

- Is there anything the expert would like to add on this topic?
- Thank the expert for participating
- A transcription will be send for confirmation to the interviewee. Only information from this transcription will be used in the research.

B

Case study interview setup

Introductie

- Fijn dat u wilt deelnemen aan dit interview.
- Voorstellen student en introductie van het afstudeeronderzoek
  - Onderzoek naar hoe het twee-fasen model in de eerste fase (ontwerp / planuitwerking fase) georganiseerd kan worden.
  - Eerst een verkennend deel om de elementen van een twee-fasen model te bepalen.
  - Nu verdiepend deel in de vorm van casestudies om te bepalen hoe die elementen worden georganiseerd.
- Uitleggen privacy beleid
  - De geïntervieuwde neemt vrijwillig deel aan de casestudies.
  - De geïnterviewde is niet verplicht om een van de vragen te beantwoorden.
  - De geïnterviewde wordt niet genoemd in het onderzoeksrapport en de interviewresultaten worden volledig geanonimiseerd.
  - Na het interview wordt een samenvatting geschreven, die door de geïnterviewde wordt beoordeeld voordat de resultaten worden verwerkt in het onderzoeksrapport.
  - De geïnterviewde wordt om toestemming gevraagd om het interview op te nemen. De opname wordt vertrouwelijk behandeld en is alleen in te zien door de interviewer en begeleiders van TwynstraGudde of TU Delft. Wanneer het afstudeerproces is afgelopen, worden de opnames verwijderd.
  - Is de geïnterviewde akkoord met al het bovenstaande?

B.1. Interview vragen

B.1.1. Start

1. Kunt u het project kort introduceren en welke rol/functie hebt u daar zelf in het project?
2. In welke fase bevind het project zich en hoelang bent u al betrokken?
3. In welke mate bent u betrokken geweest bij het inrichten van de eerste fase van het twee-fasen model?

B.1.2. Motivatie

4. Waarom is er in dit project gekozen voor een twee-fasen aanpak?
   (a) Waarom is de aannemer vroeg betrokken?
   (b) Waarom is de prijsvorming uitgesteld?

5. Wat zijn de gestelde doelen op dit project?
   (a) Wat zijn de doelen voor de eerste fase?
6. Wat voor belang heeft uw organisatie in dit project?
   (a) Komt dit overeen met de project doelen?

B.1.3. Vorm van samenwerken

7. Hoe ziet de verantwoordelijkheid verdeling er uit in de eerste fase?
8. Hoe is de organisatie structuur voor de eerste fase ingericht?
9. Hoe zijn de taken en rollen verdeeld?
   (a) Welke partij heeft er een leidende rol in de organisatie van de ontwerp activiteiten?
   (b) verschuift deze leidende rol ook tijdens de eerste fase?
10. Hoe intensief wordt er samengewerkt?
    (a) Worden de meeste activiteiten samen uitgevoerd, of wordt er afzonderlijk gewerkt met regelmatige overleggen?
    (b) Is er een gespiegeld of een integraal management team?
11. Hoe is de besluitvorming geregeld?
    (a) Heeft een bepaalde partij het laatste woord in een discussie?
    (b) Hoe beinvloedt dit de risico verdeling of de prijs?
12. Hoe ziet de overleg structuur er uit?
    vb. Hoe vaak? welke teams? Welke onderwerpen?
13. Wat voor rol heeft uw organisatie gehad in het inrichten van de eerste fase?
14. Wat was de motivatie om het op die manier in te richten?
15. Hoe werkt dit alles in de praktijk?
    Hoe efficient ervaart u het model?
16. Wat is er verder nog belangrijk geweest voor het inrichten van de samenwerking in de eerste fase?
17. Wat is er (aan prikkels) geregeld in het contract om de samenwerking te doen slagen?

B.1.4. Obstakels

18. Welke obstakels / uitdagingen worden er ervaren om tot het doel van de eerste fase te komen?
19. Hoe belemmert dit het behalen van de doelen voor de eerste fase?
20. Hoe kan, in een volgend project, het twee-fasen model op een andere manier worden georganiseerd om deze obstakels te voorkomen?
21. Wat zijn wat u betreft de belangrijkste lessen, qua het organiseren van de eerste fase?
22. is er nog iets dat u wilt benoemen wat niet aan bod gekomen is?

C

Interview results thematically combined

To make the origin of the interview results in the case study better traceable, this document sums the statements of the interviewees. The statements are categorized per theme.

C.1. Case A.

Motivation	
A.1.CI	The main reason to apply the two-phase model in this project was to: 1. Decrease project risks 2. Increase project predictability This is important for the 250 dike owners
	The contractor van guarantee the constructability of the design. This can help in the communication with the stakeholders.
	Technical constructability, creativity and experience of the contractor are some other advantages of the two-phase model.
	By involving the contractor in de design phase, he can take ownership and responsibility over the design. This reduces risks for the execution phase.
A.2.CI	The two-phase model was applied to increase predictability and to ensure a constructible design.
	For the stakeholders, like 250 dike owners, predictability is important. By involving the contractor in an early stage, the contractor can guarantee the constructability of the design and he can provide predictability"
	The contractor can provide predictability for the many stakeholders.
	Many soil movements will be necessary for the dike reinforcement. By involving the contractor early he can create an optimal soil movement plan (grond balans).
	The delayed pricing reduces risks. The price will be more reliable and fewer discussions will arise over investigations, assumptions and risks.
	The financing method for the dike reinforcement projects by the HWFD program has been an important incentive for applying the two-phase model.
A.3.Con	The integrated projects have proven to be very risky for a contractor. The late price determination in the two-phase model can reduce uncertainties to determine a more reliable price and prevent contractors to go bankrupt on projects. At the end of the first phase, risks are still existing. The risks will only be reduced or better predictable.
	Due to the method of subsidy prevision, the waterboards are risk-bearing in the dike-reinforcement projects. - By involving the contractor early, and letting him determine the execution price out of competition, the risks can be transferred to the contractor.
	Increasing complexity in projects asks for a more integral approach. Involving the contractor's expertise in the design phase is a therefore huge advantage.
A.4.Con	The contractor becomes early involved in all new contract forms. This is partly because of a loss of knowledge at some client organisations.
	The project is difficult to reach and a logistic challenge. Determining the execution methodology is therefore important during the design phase, for which the contractor's expertise is needed.
	The execution knowledge is needed to come to a constructible design with a reliable execution price with fewer surprises during execution.
	The method for the HWFD subsidy provider has been a great motivation for the Waterboard to apply a two-phase model. The Waterboard is 100% responsible for the

	cost overruns in this project. In these scale projects, the Waterboard cannot afford cost overruns and wants therefore to reduce the risks.
Motivation **- Contractor's interest**	
A.3.Con	A contractor needs to make revenue and profit.
	The reputation of the contractor is important. The contractor's reputation is linked to the satisfaction of the client. A client will be satisfied when his project objectives are achieved. Therefore the contractor aligns himself with the project objectives as soon as they apply for the tender.
	Market parties are happy with the two-phase model because the risk profile is much lower. The contractor has therefore an interest to make this project a success, so the contractor can do more of these projects.
A.4.Con	When the contractor commits to a tender, he aligns with the client's project goals.
	The contractor has a commercial interest to make money. The execution phase is the period where the contractor can make substantial revenue and some profit. Our main interest in the design phase, is therefore to obtain the contract for the execution phase.
	At the end of the design phase, the client and the contractor must agree on the execution contract and the execution price. The contractor must also score on a collaboration assessment to obtain the execution contract. Both parties have an exit option at the end of the first phase.
	The reduced risks, combined with an ensured percentage for general costs, risks and profit, makes that a project with a two-phase model ensures a secure profit that is better than in most standard projects"
	In the two-phase model, the profit is already ensured and risks are minimized. This is a big advantage for the contractor. The contractor is therefore very happy with the two-phase model and wants to make this project a success.
Results first phase	
A.1.Cl	• Execution design • Full environmental permit
	When the designs are specified towards the execution design, the execution works can directly start after the phase transition from the first to the second phase.
	There are three design loops during the first phase. At the end of the first design loop, the preferred design alternative must be determined. This enables the project team to start with land purchasing and the displacement of cables and pipes.
A.2.Cl	• Execution design • Full environmental permit • Approved subsidy application for execution phase
	When the project permits are approved, the client directly wants to start with the execution. Therefore the client decided to design until an 'execution design' (UO).
	On the downside, it is difficult for some designers to determine the level of specification during the different design loops. By habituation, some designers make their design already very detailed in the first design loop, while only a level of detail for a 'preliminary design' (VO) is required.

	The costs to come to an execution design are quite high. This is usually part of the execution price, which makes the cost less noticeable. Now the costs are part of the first phase, the plan elaboration cost in that phase increase significantly.
A.3.Con	The client and the contractor are both 50% in the lead in the plan elaboration phase. Therefore, should both parties have a say in the approach for the first phase
A.4.Con	The Waterboard decided that in the two-phase model, it would be possible to decrease the lead time of the project, by making the execution design during the approval phase of the project resolution. This means that the level of detail in the design goes until an execution design. Hereby, at the time when the project resolution is granted, the execution phase can start. This is an optimization in the lead time and ensures a continuity of the project staff, which is also efficient.
	The design efforts of the execution design are included in the first phase. This makes the costs for the first phase higher. The Waterboard underestimated the required efforts to make an execution design in their cost estimate. The longer start-up, combined with the underestimation of the design efforts caused that the costs for the design phase became 60% higher than originally estimated by the Waterboard.
Responsibility division	
A.1.Cl	The contractor is responsible for the design. There is an exception made to water security. The client can have the last say in design choices when it concerns water safety. The client will also take responsibility for these choices.
A.2.Cl	On this basis, is the contractor responsible for the design. On several design choices on water safety is the responsibility kept with the client. On a certain spot on the dike is the current dike reinforcement maintained, since it is still in good condition. The waterboard then takes the responsibility for this design choice.
A.4.Con	The design and execution responsibility lie with the contractor. The design team consist to a great extent of people from the contractor and their engineering firm.
	Although, the parties still have their own responsibilities, both organisations share the responsibilities for the project. The management team is balanced 50/50 and decisions are made on a basis of consent. The client and the contractor are also together responsible for cost overruns.
	Contractually, it is not completely clear who is responsible for which design choices. In the end is the Waterboard, together with their maintenance department, responsible for the water safety. The Waterboard sets the requirements and makes certain choices in the design. In the first year in the design phase, the design team has been very busy clarifying the requirements allocating responsibilities.
	The principle of a shared risk pot triggers shared ownership to mitigate risks collaboratively
	A shared risk pot works well when there is a positive balance at the end of the project that can be divided. It is however not clarified how the situation of an insufficient risk pot will be handled. An insufficient risk pot will most likely intensify discussions and complicate the collaboration"
Form of collaboration – **Management team and decision making**	
A.1.Cl	The project uses an integrated management team with 3 managers from the client side and three managers from the contractor. Earlier, the management team organized

	differently. This was changed towards the standard 'integrated project management' (IPM) roles. The new organization is an improvement.
	Currently around 80 ' full-time employees' work on the project. These are around 115 people of which 10-15% are waterboard personnel and the other 85-90% is employed by the market party. The contractor has contracted an engineering company that delivers almost half of the personnel from the market parties.
	Decisions are in principle made on a basis of consensus. The project management team is based on equality. When the four roles in the management team fail to agree, both project managers will try to find agreement. There is a possibility to go one step higher to the 'steering group'. Then there is the last option to escalate to an independent mediator.
	Enough workplaces in the project office to collaborate and work together in the office is helpful for team forming.
	In the plan elaboration phase, the parties collaborate. During the execution phase, the teams return to classic client-contractor roles. This shift of interaction can be difficult.
	The integrated management team is efficient and works well. There are no double roles, and the best capable person can fill that role.
	The waterboard struggles to deliver people for certain roles. The pool of human resources is limited and also finding people that have the required expertise is difficult since the waterboard is not used to this size of projects.
	The decision-making process is on a basis of equality. Currently, this brings some issues. The client would have liked to have a bigger say during the plan elaboration. We would like to give a bit more focus to the surroundings, even if this is a bit more costly. The contractor is focused on the efficiency in the execution"
	For future projects, the interviewee believes that the contractor should have a less steering role at the start of the design phase. during the first design loop of the plan elaboration phase, the contractor could be involved to advise on the constructability of the design. The client should however stay in the lead and make decisive choices.
A.2.Cl	The market party delivers almost ¾ of the people in the project team. That means that the market undertakes many design tasks. In all layers of the organization, people from both organizations are represented. This means that the organizations should have a collaborative leading role in the design activities and decision making.
	The integrated management team is in balance with three people from the waterboard and three people from the contractor. In the total project team, only 20% of the employees are from the side of the waterboard. The other 80% is delivered by the contractor and the engineering company that is directed by the contractor.
	Although the 50/50 division in the management team, the management team is out of balance. The Contract Manager has not been able to work for half a year and the project manager is being replaced. This results that the client is not in full strength in the management team, which makes that they are less in control. This makes that the contractor currently has a stronger say in decision making.
	The interviewee believes that 'execution minded' people tend to make hard decisions, while 'design phase minded' people (people from the waterboard or engineering company) are less outspoken.

	The interviewee believes that the client should be more in control in an early stage of the plan elaboration phase. The contractor should be involved to check the constructability of the design, but the client should take the lead.
	The project organization works very integral. All departments are well involved in the production of the designs. This helps with predictability. The level of detail in these designs is also the right one.
A.3.Con	A two-phase model where the client and the contractor are both 50/50 in the lead causes two paradoxes. Firstly, the organizations try to collaborate equally. The client however stays the client and the contractor stays the contractor. This implies an unequal relationship. There is a feeling that the client likes to keep a little more control than 50%. Secondly, the client can't deliver 50% of the people on the project. In such an unequal division with an over-representation of the contractor, it is difficult to give the client the feeling that it's still is in control.
	In the management team, many changes occurred and a member from the client's side in the management team was several months absent. This un-balance in the management team enforced the client's feeling of not being in control. Both organisations have been bothered by this since it did not help in the relationship. It is very important during the start of a project to have a qualified and stable management team, to lead the project organisation.
	The strength of the two-phase model lies in the combined leading role, where both parties must do things differently than they were used to. The essence is that both parties should be heard in the discussion, to find the strength in both parties opinions. The crux lies in how this discussion is conducted.
	The right attitude and project culture start at the highest level. The directors and managers should lead by example. The management team and the directors must have the right dialogues and attitudes, and lead the project organisation by this example.
A.4.Con	The Waterboard and the contractor collaborate on every aspect of the project. The contractor however delivers more people in the project organisation than the client.
	Because the organisations work very integral and have an integral management team, it is also logical to collaborate in all design fields in the project. The interviewee is happy with this integral way of working.
	Decisions are taken by the management team on a basis of consent. The waterboard has however formally the possibility to take decisions on items concerning water safety.
	The integral working method brings discussions forward. Because the Waterboard's maintenance department is part of design meetings, the design team can discuss if the design alternatives conform to the (long term) requirements. This method prevents wasted design effort and reduces risks in options that do not comply with the requirements.
	The parties have a shared interest to acquire money for the project from the subsidy provider. This means that both parties must aim for design solutions and work methods that are subsidisable by the requirements of the HWFD program.
	The interviewee believes that the collaboration with the Waterboard is very good.

	Collaboration during the design phase results in a risk reduction for both parties during the execution phase. The interviewee thinks this is a win-win.
Start-up of design phase	
A.1.CL	The client drafted an approach with work packages and the party that would have been responsible for those packages.
	The waterboard underestimated the required efforts for an execution design. The design phase became roughly two times longer and costly than estimated. The estimated cost for the plan elaboration increased by 60%. This was caused by an underestimation of the waterboard and a more expensive plan elaboration due to increased efforts.
	That the plan elaboration becomes increasingly intensive and expensive, is a trend that is seen on more two-phase model projects. The business case shows however that the investment in the plan elaboration phase is needed to lower the total project costs.
A.2.Cl	The start-up of the project and determining the processes of the design phase took ¾ of a year. The interviewee believes that this could have been done quicker when the drafted approaches of the client were followed.
A.3.Con	The client believed that the contractor could easily join in on the plan that the client drafted. For the contractor was it however difficult to adapt to the plan. The client and the contractor are also both 50% in the lead in the plan elaboration phase. The contractor, therefore, believes that both parties should have a say in the approach for the first phase.
	Time is required for the project start-up and to determine the approach for the design phase together. In this project, 8 weeks were planned for the start-up, while they eventually took ¾ of a year. Both parties must influence the work methods for the design phase.
	A longer start-up phase must be accepted. This brings cultures closer together. Issues and discussions will arise. The parties should have confidence in a good outcome of the discussion and take time for the discussions.
	Determining the required costs for the design phase proves to be difficult. The subsidy provider from the HWFD requires a detailed cost accrual for the design phase. There is however a lot unknown at the start of the design phase, and a detailed cost accrual is therefore difficult to make. There are also not many two-phase model projects that have already finished the design phase, which makes benchmarking difficult.
A.4.Con	During a start-up, before the actual design can start, the design requirements and the design basis must be determined. The design requirements must be collected from the stakeholders and dike owners. How the requirements are collected and how this information is compiled must be known. The project control system must be organized
	The Waterboard had decided to determine the costs for the design phase in collaboration with the contractor during the start-up of the design phase. The Waterboard is not able to estimate the costs for the design phase by itself.
Contractual reinforcements - **Price determination**	
A.1.Cl	The HWFD subsidy provider is afraid that the two-phase model makes the dike reinforcements more expensive, because more money is spent in the design phase, and the execution phases won't become cheaper.

	The exit option combined with a transparent price determination gives enough tools to come to a reliable and market conform price.
	The contractor will earn 14% of general costs, profit and risk (AKWR) over the realization price. The collaboration fund allows him to earn a bonus.
A.4.Con	There are multiple checks on the cost build-up for the execution phase, to keep the costs of the project in control. The cost price estimation is also totally transparent.
	The interviewee believes in the transparent cost price estimation process. This must help to regain trust in the contractor industry, that the clients apparently do not have.
	The cost expertise is very limited within the Waterboard. The subsidy provider has expertise on price build-up, but checks the costs in a few weeks, while the cost experts of the contractor work for more than a year to determine the costs.
Contractual reinforcements – **Dispute management**	
A.1.Cl	The project management team is based on equality. When the four roles in the management team fail to agree, both project managers will try to agree. There is a possibility to go one step higher to the 'steering group'.
A.3.Con	The project goals, *Satisfied surroundings* and *socially responsible costs* are currently conflicting with each other. This leads to discussions in the design teams. This discussion should however be conducted on the level of the management team, so the design teams can stay focused on their design products.
Contractual reinforcements – **Dispute management – Exit option**	
A.2.Cl	The following requirements must be satisfied to award the contractor with second phase: • Approved project permits • Execution design • Agreement on execution contract and execution price • Approved subsidy for execution Contractor must pass KPI assessment.
	The contractor must score on several key performance indicators (KPI) to go through to the second phase. The exit option is a good thing to have when the relationship gets seriously damaged. It is an exit option and it provides a tool to force the contractor into a collaborative attitude.
A.4.Con	When the Waterboard does not receive the subsidy for (both) phases of the project, the contractor also has no project. This makes their interest mutual.
	The contractor has one main interest in the design phase, which is to obtain the contract for the execution phase. At the end of the design phase, the client and the contractor must agree on the execution contract and the execution price. The contractor must also score on a collaboration assessment to obtain the execution phase. So both parties have an exit option at the end of the first phase.
	Even though the two-phase model can reduce the risk level, risks will still exist at the end of the first phase. We have an exit option if we are not comfortable with the risk level during the second phase.

Contractual reinforcements – **Incentives**	
A.1.CI	In the shared risk budget, risks can be paid or in which optimizations are paid back. Both parties are 50% responsible for the budget. Every euro that remains in the fund at the end of the project is 50cents of pure profit for the market party.
A.2.CI	The project works with a shared budget. This means that both parties have control over the money that is spent and profits and losses are shared
	there are some challenges to the budget. It is also exciting since the subsidy still has to be approved. The interviewee is afraid that the risk budget will be emptied on engineering risk before the execution is started, and risks from residents come to light.
A.4.Con	There is a shared risk pot applied in the project. The discussion now arises if the risk pot is large enough. The risk pot must be large enough to be able to pay for all project risks. The pot can also be not too large because the pot must be paid by the subsidy provider.
	What risks can be paid from the risk pot (and which risks are not paid from this pot) is something that must be determined carefully.
	The principle of a shared risk pot triggers shared ownership to mitigate risks collaboratively. This is very powerful believes the interviewee. How the risk pot should be applied, is a more difficult discussion.
	A shared risk pot works well when there is a positive balance at the end of the project that can be divided. However, when the risk pot is insufficient, it is not clear how this will affect the project and the collaboration.
Experienced effectiveness	
A.1.CI	In a two-phase model, the contractor is early involved. This brings a lot of execution knowledge in the design phase. It helps the contractor to prepare his execution methodologies. This is an advantage.
	Involving knowledge on constructability and execution methodology is a big advantage.
	There are certainly more advantages of the two-phase model than disadvantages.
	That the contractor is in the lead over the engineering company that was contracted is an advantage of this approach. Because an engineering company tends to extend design phases to increase its revenue.
	The integrated management team is efficient and works well. There are no double roles, and the best capable person can fill that role"
A.2.CI	It is valuable that different parties get the opportunity to see how the other parties operate. For the contractor, it is valuable to see what a plan elaboration phase entails and for a client it is valuable to see how an execution organization operates. This helps common understanding which is a huge benefit of this approach. When the two-phase contract forms are optimized, this will result in better projects.
	The project organization is working very integral. All departments are well involved in the production of the designs. This helps with predictability.
	The early involvement of the contractor makes that the temporary and permanent space occupation can be known during the first design loop in the design phase. This makes that there can be started quickly with land purchasing, cables and pipe diversions etc.

A.3.Con	Early involvement of execution knowledge is required in complex projects. This can be done with a two-phase model, Bouwteam or alliance. Experience is needed to find the best way in the division of items to collaborate on and items that should be done separately by one party.
	The increasing complexity in projects asks for a more integral approach. Involving the contractor's expertise in the design phase is a therefore huge advantage
	The interviewee is fully convinced of the success of the two-phase model. 95% of the time, people are discussing problems to solve. This distracts from all the things that are going well.
A.4.Con	The interviewee is hopeful that the execution phase will become more cost-efficient due to the extensive design phase, optimizations and risk mitigation.
Obstacles	
A.1.Cl	An engineering firm has more experience with design phases. A contractor is very decisive and likes to exclude different options, while a design phase asks for flexibility.
	The two-phase model has a negative image. The design phase would become increasingly costly and that the realization costs would not go down. The idea of the two-phase model is to intensify the plan elaboration phase to minimize cost overruns in the execution phase. The model however still needs to prove itself.
	In the design phase, the parties collaborate. During the execution phase, the teams return to classic client-contractor roles. This shift of interaction can be difficult.
A.2.Cl	There is joint decision making at all levels in the project organization. However, people that shout the hardest have the last word.
A.3.Con	The project goals, *Satisfied surroundings* and *socially responsible costs* are currently conflicting with each other. This leads to discussions in the design teams. This discussion should however be conducted on the level of the management team, so the design teams can stay focused on their design products. The management team must conduct the discussion to hear out the different opinions and different cultures. Then a decision must be made on a basis of equality, which can be passed on to the teams to give them direction. The right attitude of the participants in the discussion is important.
	We are determined to reduce the execution costs with 1million per km dike reinforcement due to optimizations in the execution methods logistics. We put this target in our tender offer. Although, when the *'Satisfied surroundings'* objective is given priority, we probably won't manage to achieve the optimization.
	Every client organization uses their own design for the two-phase model, does not provide optimal learning over the projects.
	A stable management team is very important. The management team has not been in full strength for half a year. Currently, this is causing problems.
	The people in the project should be able to enjoy the nice project they are working on and find satisfaction in their job
	Many people in the project organisation complain about work pressure. We scaled up the design teams too quickly. This brought extra tension
A.4.Con	The contractor's people in the stakeholder team are more used to an execution phase than a design phase. The focus in the design phase is on collecting the wishes and requirements from the residents and other stakeholders. In the execution phase the

	focus is more on how to execute the works in the agreed work method with minimum disturbance.
	The cost expertise is very limited within the Waterboard. The subsidy provider has expertise on price build-up, but checks the costs in a few weeks, while the cost experts of the contractor work for more than a year to determine the costs.
	Decision making is more complicated in the collaboration than the contractor is used to. The contractor has a high interest on the efficiency in the execution phase and the client is more focused on the relationships with stakeholders. The interviewee is convinced that the parties will come to a good agreement and are doing the right things. The design quality increases thereby. It, however, takes more time than expected.
	Underestimation of work efforts stays a continuing problem. Many people in the project organisation complain about work pressure. The design teams have been scaled up too quickly. This brings much tension. In a future project, the interviewee would start slow and gradually increase the capacity of the design teams.
Lessons learned	
A.2.Cl	In the next project, the interviewee would organize a 'two-phase model light'. Where the client would keep control but practical execution knowledge was involved in the design phase.
A.3.Con	A stable management team is very important. The management team has not been in full strength for half a year. Currently, this is causing problems.
	A long start-up phase should be accepted by the organisation. This is to bring cultures closer together. Issues and discussions will arise. The parties should have confidence in a good outcome of the discussion and take time for the discussions.
	Collaboration is very important in an newly composed team. Coaching sessions should never again be cancelled.
	Keep appointing all the positive things in the collaboration. The interviewee is fully convinced of the success of the two-phase model. 95% of the time, people are discussing problems to solve. This distracts from all the things that are going well.
Cultural differences	
A.1.Cl	A design phase where the waterboard and the contractor are involved is new for both organizations. There is a difference in cultures that makes the process complicated. The waterboard is focused on the surroundings and the landowners, while the contractor is mostly focused on efficiency in the execution phase. A contractor is very decisive and likes to exclude different options, while a design phase asks for flexibility.
	The contractor needs a wide construction road for its logistics. This will cross gardens, trees, shed houses etc. Since this is undesirable by the residents, the client likes to narrow the construction road in some places, to spare some of the gardens. The contractor focuses on the most efficient execution method and likes a wide road.
	The integrated team brings a cultural difference. To bring the organizations together to form one team is a challenge. COVID, with working from home is not helpful.
A.2.Cl	The contractor's focus lies within the efficiency of the execution phase, while the client has more concerns to protect the surroundings

	Bringing different cultures together in one team can be challenging. The contractor tends to rush into design activities and to make rapid decisions to exclude different options. The contractor is not used to participating in a design phase where multiple design options are open.
	The experience of the actors with a design phase is low. The parties should have more confidence in the uncertainty that is typical for a design phase. Keep the project in control by directing the process instead of excluding alternatives. The project organization also kicked off too hard. The organization grew too fast when the approach was still unclear. This causes a directionless project team
A.3.Con	The different cultures must come closer together. This means that both parties must be willing to change some of their old habits and work methods. The client organisation is less flexible and less eager to change their habits. This is also due to their years of preparation for the project. They must however change course after the input from the contractor.
	There is a significant difference between how a client and how a contractor controls a project. The client applies for a subsidy and must justify how this money is spent. The contractor uses project control to steer the project and to keep expenses in control. A discussion took place over how the project control would be approached.
	When things start to get difficult, people tend to blame the other party for mistakes. In the traditional and integrated projects, the client blamed the contractor and vice versa. This tendency still prevails in the two-phase model. Openness and mutual trust must be the remedy. The project hired a coaching bureau to help the management team with their collaboration.
	The right attitude of the participants in the discussion is important.
	The right attitude and project culture start at the highest level. The directors and managers should lead by example. The management team and the directors must have the right dialogues and attitudes, and lead the project organisation by this example.
	Culture difference are difficult, but there lies also the strength of the two-phase model. As long as the discussion are held with the right attitudes, this can lead to new and better ideas.
A.4.Con	The team must also be set up, learn to work together and cultural differences must be overcome. The contractor is used to a hierarchic organisation where the Project Manager has a large mandate. The Project Manager can quickly decide on many aspects. Mostly this goes right. When it doesn't go right, that's also part of the game and the contractor can deal with the consequences. The contractor had to get used to the slow decision making process of the client. It generally takes half a year before the biggest cultural differences are overcome.
	Collaboration is required. This depends on the right people in the project. The people are the most determining factor in such a project. On the contractor side, people are needed that have the patience for a design phase and like this different dynamic compared to a traditional execution contract. To solve this, the contractor is also hiring more people that have experience and enjoy working in the design phase of a project. On the client-side, it is also important to have the right people on board. Enough professionalism and experience are required.

C.2. Case B.

Motivation	
B.1.CI	Innovative solutions, that have the potential to make dike reinforcements cheaper, have been developed until the pilot level. These high potential innovations can be developed further to implement on a large scale. The obstacle for implementing the innovations in the dike reinforcement is in many cases the acceptance of the new technique by the end-user. The waterboard must have certainty that the new technique works, to accept the innovation.
	To realize the dike renovation within budget and environmental constraints, innovation is a necessary tool. To enable the innovation process, a collaborative approach is required.
	To enable the desired innovation, it is important to involve market parties very early in the project. It is important that both parties collaborate intensively during the Design phase. Thereby, it is hard to price the realization costs of innovative techniques that still need to be developed. In the opinion of the waterboard, a two-phase approach is therefore required for developing these innovations
	The surroundings and cooperation of the residents bring difficulties to the project. It is also important to involve the maintenance department of the waterboard during the design phase. To keep the internal and external stakeholders involved and satisfied brings complexity to this project.
	Early contractor involvement is needed to: a. Enable innovation b. Involve execution knowledge in the design
	In an innovation partnership, it is difficult to determine a detailed price since the scope is not yet defined, and the risks are difficult to define. Secondly, the innovations have the potential to make the high water flood defence program more cost-efficient. Therefore can the two-phase model become cost-efficient in this project.
B3.Con	Innovations are required to achieve the project goals and collaboration is needed to enable innovation.
	In traditional dike reinforcements, long clay berms are placed. When an innovative vertical screen can be implemented, this will have a positive impact on the project goals.
	At the start of the first phase, the scope is still very vague, and a lot of effort is needed to formulate requirements and eventually to come to a good design. when the contractor is involved, he can take ownership over the design. This will result in reduced risks and a more efficient design with lower realization costs.
Motivation – **Contractor's interest**	
B.3.Con	The contractor's enthusiasm for DBFM projects diminishes due to high risks and limited room for collaboration. The two-phase model gives opportunities to better understand the content of the project which leads to a more reliable price. This is expected to be beneficial for the contractor's revenue.
	The contractor wants to improve its position in the Dutch infra sector. The dike reinforcement projects lie the closest to the company's core business. This project is a

	good project for the contractor to position itself in the market. Being involved in innovations is always beneficial.
B.4.Con	This contractor is motivated to work on dike reinforcement projects. The intended risk reduction in the two-phase model is something we as a contractor like about the two-phase model. The risk reduction should result in less contractual discussions and a higher likelihood to make an appropriate profit.
Result of the first phase	
B.1.Cl	The project uses a process standard that is based on the systems engineering standard. The standard is used to stimulate explicit working, make founded choices and document these choices. The standard stimulates structured working and making choices (on innovations) trackable.
	The extensive process standard that is used in this project took more time to get up and running than expected. This resulted in some resistance towards the process standard. It is expected that this investment will become profitable later in the project.
B.2.Cl	The project organisation determines mutually the required efforts and costs for the design phase. The process standard that is used in this project determines for a great deal what the input and output are for all required design products
	One of the first steps in the design phase is to gather all design requirements from the stakeholders and asset management team.
	When the design is assessed for permits approval the designs are further specified until an execution design. The involvement of the contractor enables innovations but it also guarantees a constructible design. The improved lead time, combined with the guaranteed executable design are the main benefits of the two-phase model.
B.3.Con	The designs are specified to a Definitive design (DO). The idea is that the client has limited input for making the Execution design (UO). Therefore it is more efficient for the contractor to make these designs by himself.
	Design phase becomes increasingly intensive and expensive in the two-phase model. At the start of the first phase, the scope is still very vague, and a lot of effort is needed to formulate requirements and eventually to come to a good design. The contractor does not have experience with design phases. Although, when the contractor is involved, he can take ownership over the design. This will result in reduced risks and a more efficient design with lower realization costs.
B.4.Con	The designs are detailed towards a level of an Execution design (UO). In the other sub-projects, the dike is specified until a Definitive design (DO). This sub-project chose a maximum specified design, to be predictable for the stakeholders in the area. Land must be purchased from many residents. For these people, there must be no surprises during the execution phase.
	The ISO process standard has been a leading element in the approach for the design phase.
	The process standard helps a lot with structuring. Once the standard is well understood, which takes some time, it ensures a lot of structure in the project.
Responsibilities	
B.1.Cl	The contractor becomes responsible for the designs of the traditional parts of the project scope. For the innovation, the client takes 90% of the design responsibility. In

	return, the client becomes owner of the intellectual property of the innovations. This allows the client to implement the innovation on other projects.
	The project start-up, that exists of writing the project management plan and obtaining the subsidies for the first phase, took in the first sub-project one year, while half a year was estimated.
B.2.Cl	The elaborate start-up phase to write the project management plan helps for a good start of the design phase.
B.4.Con	The design phase start-up took a full year. The interviewee believes this period has been too long for the start-up. The design phase start-up was already started during the exploration phase. The people in the exploration phase were however not yet committed to the philosophy or approach of the two-phase model. Whereas the contractor was already in the tender challenged to commit to the philosophy of the two-phase model. This did not match with the client's representatives that were involved in the exploration phase. Although this was meant to accelerate, it slowed the start-up process down, because a part of the project team was still focused on the exploration phase. It took time to get both parties aligned.
	A full year of start-up costs money. The costs are included in the subsidy application for the design phase. This has made the costs for the design phase more expensive, which may cause a difficult discussion with the subsidy provider.
	The start-up phase eventually took a full year. But the interviewee is happy with the integral plan they made for the design phase. The compartmentalization of different disciplines and design fields is eliminated in the approach.
Form of collaboration	
B.1.Cl	At the start of the design phase, an integrated project management team is formed with actors from the contractor and the client. The so-called design team starts with the creation of a project management plan, in which collaboration during the design phase is described. This document is also the basis for the subsidy application from the HWFD program for the first phase.
	Both parties complement each other. The contractor is very capable of systems engineering. While the waterboard has good knowledge of internal and external stakeholder management and the process of subsidy application at the HWFD.
	The area manager and the project manager are delivered by the client. The project manager for the financial authorization from within the client's organization and the area manager for its knowledge with the surroundings, local governments, maintenance department and other stakeholders. The technical manager is delivered by the contractor because they should involve their technical knowledge. When the contractor has suitable people for the project control manager and the contract manager roles, he can provide them. This is to keep the management team, and decision making balanced.
	The integral management team members from the contractor are linked to an advisor from the waterboard with a similar role to help the contractor with the client's policies.
	Decisions are made within the integral management teams. And therefore both parties are involved in the decision making.
	In theory, the waterboard has the authority to force the contractor into a certain decision when no agreement is found. This is however not likely to occur. Since the

	responsibility of that decision will return to the client, and it is not wise to force the contractor into a certain methodology that he advises against.
B.2.CL	An integral management team is applied to the project with a balanced distribution of client and contractor representatives. The Technical Manager, Contract Manager and Manager Contract Control are filled in by the contractor. In all design teams, people from the client, contractor and engineering firm are represented.
	The integral management team must prevent deadlocks in the decision making. Because both parties are involved in the management team, it is not possible to make a decision that one of the other parties does not support. Decisions must be made on consensus. When the management team cannot come to a decision, the decision can be made by the Program level Team, after that link there is a Direction team.
B.3.Con	The roles and responsibilities within the management team are divided on a basis of expertise and interest.
	We deliver the contract manager in the management team. As contractor, I am pleasantly surprised that the client let us fill this position. It shows the water board's confidence in the contractor. This is something that we must handle with care.
	All decisions must be made in the integrated management team. If this is not possible, there can be escalated to the program management team. In the end, has the official principle to approve the larger decisions.
	Although the we will take responsibility over the design, we do not have the last say in discussions. It's both parties responsibility to find consensus in discussions.
	A constructive attitude from all players in the industry is needed to make projects and new collaboration methods a success. It's always possible to destroy collaborations methods and contract forms with perverse behaviour and blaming attitudes. The industry should however focus on the way it wants to go forward. It is important to keep this attitude in mind during intense discussions. I'm impressed by the vision, in all layers of the client's organization, on equality in collaboration and the effort for a vital industry. I hope that the contractors in this collaboration will go for a positive effort in this collaboration because it is very easy to destroy this contract with perverse behaviour.
B.4.Con	For the engineering company, it was difficult to find their role in the team. They are well represented by many people. Formally, the engineering firm is supporting in the design phase and they have no decision power.
	The project organisation consists roughly of: 2/5 contractor 2/5 engineering firm 1/5 waterboard.
Contractual reinforcements – **Dispute management**	
B.2.Cl	Decisions must be made on consensus. When the management team cannot come to a decision, the decision can be made by the Program level Team, after that link there is a Direction team.

B.3.Con	All decisions must be made in the integrated management team. If this is not possible, there can be escalated to the program management team. In the end, the official principle has to approve the larger decisions.
Contractual reinforcements – **Price determination**	
B.1.Cl	An open price calculation with a fixed profit percentage is used in this project.
	If this approach is efficient must be proven in the future. The design phase is more extensive than in other projects and costs more time and money. The prospect is however that the real efficiency profit is made in the second round of sub-projects when the learning curve over the projects pays out.
B.3.Con	When the determined price for the first phase exceeds the reference values from the subsidy provider, the price must be lowered. This causes that the parties now are cutting in activities and budget which they believe is needed for a good project. This makes good collaboration more difficult.
	In the one-on-one price determination, there are plenty of options to reduce the execution price, believes the interviewee. The review process on the execution price results often in a price that makes the contractor nervous. At the same time, the parties preach for a vital sector. This does not match and causes tension in the collaboration. The reference values that are used in the review process come from competitive projects, where unhealthy prices are used. These are not representative of the two-phase model and should be adjusted. Although, this is not so easy since these reference values fit in a framework that is laid down by law for the dike reinforcement projects.
	Here applies again, that the intentions should be positive, and the lack of trust must be overcome. The contractor is therefore fully transparent in his budgeting and price determination to gain the client's trust.
	The design phase will take about three years. In these years, the contractor only makes revenue on the hours that staff members work. This revenue is nothing compared to revenue in the execution phase where a lot of machinery is in operation. A contractor's Project Manager that usually manages maybe 50-100 million euros in an execution phase, now manages only a couple of million during a design phase. This is problematic for the contractor's revenue model. Therefore did the contractor and the waterboard agree to increase the General Cost, Profit and Risk (AKWR) by 3times on the employers hours during the design phase. This results in an 'engineering firm like' revenue model during the design phase. This prevents that the contractor's higher management will complain about the revenue model on the project.
Contractual reinforcements – **Incentives**	
B.1.Cl	To acquire their second sub-project, the contractor must show the required growth in its process organization. This is not a strange or bad thing in the contract, since it stimulates the contractor to improve his work processes and it requires him to comply with a certain benchmark that he promised to achieve. However, the client recognized that the contractor is a bit too focused on the benchmark and is less focused on the project goals. The benchmark becomes a goal in itself while the client intended it as a tool to stimulate the contractor.
	To acquire their second sub-project, the contractor must show the required growth in its process organization. This is not a strange or bad thing in the contract, since it stimulates the contractor to improve his work processes and it requires him to comply

	with a certain benchmark that he promised to achieve. However, the client recognized that the contractor is a bit too focused on the benchmark and is less focused on the project goals. The benchmark becomes a goal in itself while the client intended it as a tool to stimulate the contractor.
	The interviewee believes that as few as possible incentives should be included in the contract. Incentives lead many times to preserve motivations for the contractor.
B.3.Con	Every party in this project can very easily destroy the collaboration by showing perverse behaviour. This would only result in losing parties. Therefore, the model should ensure that all parties continue to see the win-win solutions of this collaboration. The second subproject that the contractor can get awarded is a good trigger for a positive attitude.
Good practices	
B.1.Cl	There is a big motivation from inside the waterboard for the collaborative approach. This works very well. There is a lot of confidence with the client that this approach will lead to accomplishing the project goals. The first zero-emission excavators are already up and running.
	Explicit decision making and documentation of the made decisions is something that was learned to be very important for innovation development.
B.2.Cl	The interviewee has faith in the two-phase model. The two-phase model is however not a miracle cure to all problems. Some waterboards know very specifically what they want to procure and have good experiences with the traditional contract form. For a complex project with high ambitions, the two-phase model can be a solution.
	To overcome these difficulties is worth the effort. The collaboration will prove to have many advantages. Within the integrated management team the parties are also forced to collaborate. It is not an option to reduce the collaboration.
B.3.Con	The model also results in more understanding of each other's perspectives.
	That the contractor was early involved, has caused an efficiency gain through a reduction of km's dike reinforcement.
	The contractor has already adjusted some calculation approaches, that have reduced the need for the dike reinforcement from 10km to 7km. There is a potential that the scope will be reduced to 6km or even 5km. These are huge savings for the execution costs, which is positive for the client and the taxpayer.
	The contractor is used to eliminate all vagueness out of the scope and make the scope as SMART as possible. The contractor is also used to come up with optimizations. This results in a detailed set of requirements and an optimized design. This causes that the design phase is extensive, very detailed and more expensive.
	The optimizations and scope reduction are positive since it reduces the realization costs which leads to budget space at the client-side, which is also beneficial for collaboration. Although, when the scope is reduced by maybe 50%, this become problematic for the contractor. Since The contractor anticipated a much larger project, with more revenue and profit.
	Since the scope is reduced the question now arises if the total organization of the intensive design phase isn't out of proportion for the reduced project scope. If the design phase was organized less intensive, the scope reduction would have probably not been found. So there is a discussion if this approach is efficient.

	The extensive design phase has resulted in a reduction of dike reinforcement which is a big saving. Compared to the smaller scope, the costs per km dike are relatively high.
Obstacles	
B.1.Cl	The required effort during the project start-up was underestimated. It is important to get to know each other during the project start-up and to get familiar with all the new processes. The COVID pandemic made this increasingly difficult.
B.2.Cl	However the project has high ambitions on quality, the project team is very scheduled and budget focused. Often decisions are made based on time or costs arguments, while the best option might be a little more expensive.
	Working together with a client, contractor and engineering part means working with three different cultures. This needs time, attention and workshops about cooperation. It's obvious that this attention is needed, difficulties will come, it will storm and it will not always be pleasant. These difficulties and unpleasantness are required in the forming of a team. The different parties had to get to understand each other and find their role in the collaboration. During this team bonding, the team also needed to deliver a Project Management Plan, while under pressure. This has been quite a challenge.
	During a start-up period, it is important to invest time to understand each other and to mutually understand the things that must be done and the (technical) content of such. Secondly, it is important to invest time to get to understand the cultures and working methods. It is important to share your amazement and to stay curious. The contractor is for example amazed why the decision making processes within the waterboard organization is so complicated. The client I amazed that the contractor only seems focused on progress. "every hour talking could be a lost hour working"
B.3.Con	The reference values that are used in the review process come from competitive projects, where unhealthy prices are used. These are not representative of the two-phase model and should be adjusted.
	When the determined price for the first phase exceeds the reference values from the subsidy provider, the price must be lowered. This causes that the parties now are cutting in activities and budget which they believe is needed for a good project. This makes good collaboration more difficult.
	In other projects, the contractor receives specified requirements of the things he needs to build. In this project, there was almost nothing at the start, and the parties determined the project requirements (from other stakeholders) together. The contractor now recognizes that this is a challenging process.
B.4.Con	The interviewee sees all the members of the design teams now as employees of the project instead of employees of three different organisations. It took a while before that was the case. Due to cultural differences and past experiences, people were at first a bid hesitant to trust each other. For the engineering company, it was difficult to find their role in the team. They are well represented by many people. Formally, the engineering firm is supporting in the design phase and they have no decision power.

Lessons learned	
B.1.Cl	A well-organized dialogue session during the tender phase is crucial for mutual understanding of the parties. A purely documented ‘questions and information’ round is inadequate for a complex two-phase approach.
B.3.Con	It's always possible to destroy collaborations methods and contract forms with perverse behaviour and blaming attitudes. The industry should however focus on the way it wants to go forward. It is important to keep this attitude in mind during intense discussions.

C.3. Case C.

Motivation	
C.1.CI	Soil and aerial conditions must become better predictable to minimize 'changes' and cost overruns. A contractor must be early involved in the project to preserve knowledge and background information from the design phase into the execution. This should also lead to opportunities for sustainability.
	These three ambitions: - Minimize changes that lead to cost overruns - Preserve design knowledge in the execution phase - Sustainable solutions lead to a new approach where the realization price would be determined after the design phase when risks would be sufficiently clear.
	Soil and aerial information is very unknown. The structure of the groins is usually build-up from a lot of waste material. It is likely that this has caused pollution in the soil. There is also a risk on unexploded ammunition due to intense fighting in WWII. These risks must be mitigated.
	By involving the contractor early, he is involved and can take ownership of the soil investigations. When the contractor is involved in the investigations he is able to make his own risk assessments, which enables him to take responsibility on these aspects. When the contractor is not involved in these investigations, it is likely that a discussion will arise about the legitimacy of the soil investigations.
	The contractor can influence the investigations that must be carried out during the design phase, for obtaining permits and design works, so these are also usable for the contractor to make his soil balance and determine his execution methodology. This brings a certain efficiency win.
	The two-phase model is kept simple where possible and is based on a standard Design&Construct contract model with several adjustments.
	The applied building organization form (Project delivery model) on a project should be in proportion to the project size. A very complex project organization is not proportional.
C.2.CI	Technically speaking, is the project not too complex. The client's motivation for the two-phase approach is to reduce risks during the execution phase. In traditional contract forms, the client recognizes many requests for changes, mostly on soil- and asset information, that result in exceedance of the execution costs. The execution knowledge from the contractor is also required to make a constructible design.
	Besides the standard project objectives as: time, quality and money, the project also has a sustainable objective. The project intends to reuse materials and has a desire to use electrical driven machinery during the execution phase.
C.3.Con	The big advantage of the early involvement of the contractor is that the execution knowledge can be implemented in the design. We are very experienced in these kinds of projects. We can therefore prevent situations like an un-constructible design, wrong (soil)investigations or inefficient execution approaches.
	The contractor's interest in the project is the revenue that the contractor needs to make and hopefully some profit. The profit percentage over the contract sum is fixed at 4%. This gives a guarantee that

	the contractor can make some profit, and this is a better profit than a contractor would make in a project with financial competition during the tender.
	The contractor has a sustainability goal. They are developing an electrically driven excavator that they want to apply in this project. The two-phase model makes it possible to investigate the potential to apply the electrified machinery in this project. The challenges for deploying the electrified machinery lie within the development costs that must be earned back and the logistics of battery packs. Secondly, the battery packs must be replaced regularly. This makes that the excavator is less mobile than conventional excavators.
Result of the first phase	
C.1.CI	In the design phase is the design specified as detailed as possible. So towards a UO. This makes that all design activities are executed during the design phase, and no design costs are part of the realization price.
	The execution costs are also greatly influenced by the execution methodologies and the soil balance. The execution methodologies and the soil balance can only be determined based on a UO design.
C.2.CI	The reason to choose an execution design makes that no design assignments are done in the execution phase, which makes the division between both phases clearer. Also, the execution design is very specified, which makes that the execution price can be determined in more detail.
	The biggest adjustment is made in the collaboration budget. There, both parties collaborate more intensely to determine which soil investigations are executed, to collect requirements from maintainers and to manage stakeholders.
Responsibilities	
C.1.CI	A classic UAV-gc responsibility division is the basis for the collaboration. However, some adaptions have been made. A hybrid version between a standard UAV-gc and a more collaborative approach is the result.
	The hybrid function of collaboration is often unclear to the contractor. He does not always understand on which parts the parties collaborate and on which parts they collaborate less.
	The contractor is in the lead for the design activities and to apply for the required permits. In these activities, lies the strength of the contractor.
	Some other roles are kept on the client-side. Reasons can be that the client does not want to transfer the authority over certain roles to the contractor, or that the client is better capable of executing these activities.
	In some activities, the parties have a collaborative approach. In the 'collaboration budget' decisions are collaboratively made. The soil investigations and the stakeholder management are examples of activities where the collaboration budget is used.
C.2.CI	The two-phase model is organized based on a standard Design & Construct (D&C) contract. The responsibility division, roles and collaboration are similar to the traditional contract. Some unit prices for the execution phase were part of the bid during the tender. Also, the design activities, project management activities, permit application were in a fixed price part of the tender. Only the unknown parts of the scope will be priced at the end of the design phase.

	In consultation is determined if the resulting risk is allocated with the contractor or with the client.
C.3.Con	The parties cooperated during the design phase. But the client has a double role during this phase. Although the contractor is in the lead, the client wants to influence the design choices. Secondly, reviews and contractually assesses the client of the contractor's design. This double role made the tasks of the client often unclear.
	The advantage of an involved client in the design activities is that it can result in a quicker approval by the client. However, the design process can become sluggish, since both parties have their ideas. This makes that the decision making becomes slower. Although the design process requires more energy, the satisfaction of the client is guaranteed due to its continued involvement. The design quality, therefore, increases as well as the support for the design in both organizations.
Form of collaboration	
C.1.Cl	A double management team, from both the contractor and the client, is applied to the project.
	Several documents, like risk dossier, planning, etc, are used integral.
	Both parties have their tasks and responsibilities, causing limited collaboration. In the collaboration budget, the intensity of collaboration is higher.
	There is a weekly meeting between the technical manager from the contractor and the surroundings manager of the client. This is the heart of the project. Due to this weekly consultation, there is collaboration and coordination between parties.
	An alliance model would not have been a proportional approach for this project scope. The project is not too complex, and therefore should the contractor be able to make the designs. The soil and aerial information was however a risky subject. Therefore a more collaborative approach is needed on that subject.
	The mirrored management team is not the most efficient approach. Efficiency is lost in consulting the other party. This is however the policy of the client which is set to the authorization of the roles. In another project, the interviewee would like to optimize the roles and transfer some management roles to the contractor. The client's organisation needs to gain confidence to let some roles go.
	The client has described his vision of the collaboration in an annexe in the contract. This describes principle values that should be applied in the collaboration. The contractor has made some propositions to improve the collaboration. These are items as delivering senior project managers and regular meetings to improve collaboration.
C.2.Cl	The project has a management team with 'standard IPM' roles. Where both parties have one person in each role. So the management team is mirrored.
	The mirrored management team is applied since the client's governance structure in its organization is used to this approach. For an integrated management team, it would be challenging for the contractor's representatives to find their way into the client's organization.
	Although both organizations need to put more effort into the consultation between the separate management teams, the interviewee believes that the integrated systems, like

	the mutually determined risk allocation document, ensure enough collaboration and integrality.
	The design products are assessed by the client. Therefore, the client has the last say in the design choices. Due to the regular communication between the technical manager of both parties are many discussions are handled before the designs are assessed.
	When the parties don't agree to a decision, this can influence the realization price and the risk allocation. The discussions about the final risk allocation are held on a basis of reasonableness and fairness.
	The project arranged a 'working together day' on the project location. At least one day per week is the full project organization present at the project location. The counterparts in the management team have more one-on-one consultations to discuss their roles.
	Even though there is a lot of communication between the parties, are still many cases discussed within the organization itself before they are discussed with the other organization. This is not a fully open way of collaboration. maybe could an integrated management team prevent this from happening.
	Most systems are used integrally. This means there is one system used over the complete project organization. For example, a LEAN planning and an integrated risk allocation document is used by both organizations.
	Covid made it difficult to come to the project location. To keep everyone informed, an integral meeting is planned every Monday where new information is shared.
	In the way how the two-phase model is applied in this project, with the traditional part and the two-phase part, the interviewee believes that the two separate management teams is the best way to go. This keeps responsibilities clear, but with regular consultation is knowledge utilized from both parties.
C.3.Con	The client assesses the design and has therefore a last say in the design choices. Although, the contractor does not allow itself to be forced into decisions by the client.
	The client's project organization is the piece of a large organization. The client has to get the execution price approved in its organization. The contractor has no experience and needs to get used to, the client's internal decision making. Sometimes political choices are made that conflict with the technical choices that the project team preferred to make. Changes in the client's political landscape can also influence the project decision making.
	The contractor's organization is with 100-200 employees much more compact. The project manager has a large mandate and the lines of communication with the director are quick. This ensures a very fast decision-making ability.
	Before the COVID pandemic started, the project organization worked very intensively together on the project location. About three days per week. COVID had a negative effect on working on the project location. Currently, at the end of the design phase do design teams work on their tasks. This makes the intensity also a bit less.
	In the execution phase will the contractor have an even more present role and the client will be participating more from the side-line.
	There are two managers per subject, which is inefficient. It would be better for the collaboration to have one integral management team with managers from both organizations combined. This prevents that a single team produces their own truths on

	their own subject. In an integrated management team must everyone confer with the rest of the team. This makes a collective outcome more likely.
	I would recommend integrated management on future two-phase projects.
	The client representatives work much more scattered on multiple projects, while the contractor works dedicated to one project. This makes that the contractor works with a small and flexible team on the project, while the client works with a large and inflexible team. The client has a large organization with many departments and many experts on small subjects. All advisors need to give their input for the design, which makes that there are many advisors involved.
Contractual reinforcements – **Dispute management**	
C.1.CI	Three requirements must be satisfied before the realization contract can be awarded to the contractor: 1. Agreement on realization price 2. Ministerial approvement 3. Irreversible granting of all required permits
	In case one of these three requirements is not satisfied, a no-go occurs. In that case, another contractor can be selected in a tender and the detailed design documents (UO) can still be used.
Contractual reinforcements – **Price determination**	
C.1.CI	The interviewee believes that it is good to price items and activities that can easily be priced. The bidding parties in the tender had to make a bid on the activities done in the design phase, the project management of the execution phase and some investigations that were specified in detail. These items are specified in detail and easy to price.
	When there is no fixed price for the design phase, this results in a discussion about money on the first day after the tender. A fixed price for the design phase brings comfort to the design phase and ensures cash flow.
	The market parties had to make a bid on some dominant cost items. These prices are required to be used in the determination of the realization price, or the contractor must explain why the prices are changed.
	The realization costs are determined and the client and the contractor are going through these discussions. I doubt if the bidding on the dominant price items has been beneficial for the project. The discussions, about why the prices changed, take a lot of energy.
	Secondly, this approach enhances opportunistic behaviour. The contractor can make a low bid to win the tender, and increase the prices before the execution.
C.2.CI	The cost expert from both parties works as a duo. They have many consultations and collaborate a lot.
	To keep control of the execution costs, the plan was to have a cost estimate ready for the design alternatives when a decision was to be made. This would have ensured a transparent cost build-up. The costs estimates were however mostly not made for the design alternatives. This caused that determining and agreeing on the final execution costs became a complex step during the end of the design phase

	The contractor needs to motivate the prices that he determined. The client reviews and assesses this motivation. Although this process takes a lot of energy, the interviewee is confident that the final execution price will be fair and reliable.
	Although several design loops were used in the design phase where also a cost estimate was made, exceeding the execution price, the estimate that was made in the DO loop. The current execution price exceeds the available budget. Therefore, even more, motivation is needed to explain the increased price.
	The unit prices that were used in the tender did not yield the expected result. Although it created a bit of financial competition during the tender, did it mostly cause difficulties during the price determination. The unit prices are not representative since many assumptions have changed during the design phase. The contractor must motivate why the prices changed. This requires a lot of consultation and energy. The price competition works well during the tender and by the procurement law, it is determined that the price must be part of the tender. If the procurement law would not prescribe the need for competitive financial bidding, the interviewee believes that it would be better to not use unit rates during the tender.
	Cost estimations must be made more often during the design phase to keep control on the price.
C.3.Con	The contractor had to make a bid on the design phase. The interviewee is not a fan of the fixed price of the design phase. When the budget becomes tighter during the design phase, the first costs that are reduced are the costs of collaborative efforts. This is not in favour of the project.
	The selected contractor had the highest tender bid on the design phase, but still, its budget is under pressure. Another contractor with a smaller budget would have even more costs issues.
	The interviewee would prefer a system where hour rates for the needed roles would be used in the tender, combined with the best plan. This would result in less tension in the budget which is beneficial to the collaboration.
	The bid on unit prices that the contractor had to do during the tender did not work in the eyes of the interviewee. The client's goal was to prevent the contractor from giving adsorbing prices for the execution phase when there would be no financial competition.
	Calculating the unit prices during the tender took a lot of effort. The unit prices proved to be not representative anymore. This lead to a lot of discussion in the project and it requires a lot of energy to motivate why the prices changed. Therefore it entailed more hassle than it has had benefits.
	The contractor would prefer a system where there is more trust towards both parties. The client has demanded transparency from the contractor. The interviewee believes that this already prevents the contractor from using high prices. But more trust is required.
Contractual reinforcements – **Incentives**	
C.3.Con	If money is not spent from the collaboration and the risk budget, the left over money will be equally divided by the client and the contractor. This is a good incentive. However, it is always the question how large the budget should be.
Good practices	

C.2.CI	Combining the knowledge of the client and the contractor brings more knowledge into the project organization. Yet it also requires more coordination
	The interviewee is confident that the products of the first phase will satisfy the expectations that the client had at the start of the project. With these products, the interviewee is confident to go into the second phase. The expertise of the contractor will be revealed even more during the second phase.
	In the way how the two-phase model is applied in this project, with the traditional part and the two-phase part, I believe that the two separate management teams is the best way to go. This keeps responsibilities clear, but with regular consultation is knowledge utilized from both parties.
	Most systems are used integrally. This means there is one system used over the complete project organization. For example, a LEAN planning and an integrated risk allocation document is used by both organizations.
C.3.Con	The contractor has a sustainability goal. They are developing an electrically driven excavator that they want to apply in this project. The two-phase model makes it possible to investigate the potential to apply the electrified machinery in this project.
	The design phase likely becomes increasingly costly because of the extensive efforts. It is possible the extra effort results in a more cost-efficient execution phase when there is focussed on during the design phase. If there is focussed on the most efficient execution method during the design, this can bring lower execution costs. In this project often other choices were made on a basis of quality or safety.
	A contractor is used to working with hard deadlines. This makes that the contractor can accelerate the design phase. The contractor uses LEAN planning with weekly deadlines, sub-deadlines dependencies that are discussed every week during an integral planning session. This has increased the efficiency of the design phase. The contractor has an intrinsic drive to meet the deadlines. The fixed budget for the design phase is a second incentive to keep the design works within the planned schedule.
	I have confidence in a good result in the two-phase model in this project. The designs and starting points are of good quality that provides confidence for the second phase.
	The approach is focused on collaborative working towards a mutual result which is beneficial for the project. The early involvement of the contractor, to guarantee the constructability, is a huge benefit of the model.
Obstacles	
C.1.CI	In a long design phase, it is also important that the contractor has a revenue model during the design phase. Contractors usually make revenue during the execution phase. When a design phase is an extensive activity, higher managers of the contractors will demand a certain revenue from their project managers.
	The hybrid function of collaboration is often unclear to the contractor. He does not always understand on which parts the parties collaborate and on which parts they collaborate less.
C.2.CI	The selected contractor has no experience in working with this client. This makes that the contractor is not familiar with the client's processes. It requires a lot of coordination to make the contractor understand the required process steps. It is however expected that this issue would also have occurred in a standard contract form.

C.3.Con	The cultural difference was difficult at the start of the project. The contractor has short lines of communication and is very solution-driven and focussed on the execution. The client is much more process focussed. When the processes are followed, the outcome will probably be correct. These cultural differences made it difficult to combine both organizations into one team. Even though, is the interviewee of the opinion that they succeeded in this team building.
	Both parties must invest time in the collaboration process. Cultural differences must be a focal point during the project start-up. This is required to enable a good collaboration.
Lessons learned	
C.1.Cl	More time must be taken for the start-up phase for: - Getting to know each other - Understand and overcome cultural differences - Commonly understand the activities/requirements/process of the design phase - Commonly understand the content of the (design) assignment
	The client-side must have expertise in cost and price build-up. Otherwise, it is difficult to determine the realization price and it is won't be possible to keep the price in control.
	In another project, the interviewee would like to optimize the roles and transfer some management roles to the contractor. The client's organisation needs to gain confidence to let some roles go.
C.3.Con	If there would be no fixed price for the design phase, this could have increased the quality of the design phase.