Price formation in Bouwteam projects

Negotiating versus aligning the prices during the Bouwteam phase for infrastructure works and services in the Netherlands

Mehmet Uzun

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Supervised by

Prof. dr. ir. L. (Leentje) Volker
University of Twente, Chair

Drs. ing. J. (Hans) Boes
University of Twente, Daily supervisor

Drs. ing. J.N. (Jaap) de Koning
Witteveen+Bos, First supervisor

MSc E. (Erik) Schulte Fischedick
Witteveen+Bos, Second supervisor

Abstract

In the construction industry, an effort is made to shift towards better cooperation between client and contractor to tackle problems that vary from adversarial relationships to issues with costs and quality of projects. Different contract forms or approaches are being recommended and used, one of them being the Dutch 'Bouwteam'. Currently, the use of Bouwteam is popular for infrastructure projects in the Netherlands. The Bouwteam is a well researched topic and in some cases, several studies investigated the price formation (process) in a Bouwteam. However, there is a lack of research regarding the techniques used during the price formation and their limitations. In this research, an attempt is made to analyse and document how the contractor and client perform the price formation and what their limitations are. This is done with a case study and interviews with experts from the field is used to propose how the contractor and client can set up the price formation (process). As a result, the proposition of this research is a framework (generic model) for the price formation (process) in the Bouwteam phase, that can be used as a guideline or tool for further Bouwteam projects. Besides this, the results show that a concept estimate, better substantiation of the calculations, cost experts earlier in the project and the content of subcontractors' quotes should be part of the price formation (process). Lastly, negotiating prices should not be seen as something negative but as a tool to keep the parties sharp and honest. Ultimately, transparency is important to maintain trust within the Bouwteam, resulting in a good feeling and confidence in the price formation and the final price.

Keywords: price formation (process), price determination (process), Bouwteam, model agreement, SSK, open-book, phased pricing, early contractor involvement (ECI), cost estimation, cost calculation

Samenvatting

In de bouwsector wordt er gestreefd naar een betere samenwerking tussen de opdrachtgever en de opdrachtnemer, om problemen aan te pakken die variëren van vijandige relaties tot problemen met kosten en kwaliteit van projecten. Hiervoor worden verschillende contractvormen of aanpakken aanbevolen en gebruikt, waaronder het (Nederlandse) Bouwteam. Momenteel is het gebruik van Bouwteam populair voor infrastructurele projecten in Nederland. Het Bouwteam is een goed onderzocht onderwerp en in sommige gevallen hebben verschillende onderzoeken de prijsvorming (proces) in een Bouwteam onderzocht. Er is echter een gebrek aan onderzoek naar de technieken die worden gebruikt tijdens de prijsvorming en hun beperkingen. In dit onderzoek wordt een poging gedaan om te analyseren en te documenteren hoe de opdrachtnemer en opdrachtgever de prijsvorming uitvoeren en wat de beperkingen daarvan zijn. Dit gebeurt aan de hand van een casestudie, waarin vier verschillende Bouwteam-projecten onderzocht zijn. Daarnaast wordt er gebruik gemaakt van interviews met experts uit het veld, om voor te stellen hoe de opdrachtnemer en opdrachtgever de prijsvorming (proces) kunnen inrichten voor toekomstige Bouwteam-projecten.

Het eindresultaat van dit onderzoek is dan ook een raamwerk (generiek model) voor de prijsvorming (proces) in de Bouwteam-fase, dat als richtlijn of hulpmiddel kan worden gebruikt voor toekomstige Bouwteam-projecten. In dit model zijn alle onderdelen binnen de Bouwteam-fase meegenomen, dus inclusief de ontwerpfases, risicoverdeling en nog meer. Daarnaast laten de resultaten zien dat een concept raming, een betere onderbouwing van de kostenramingen, kostendeskundigen eerder in het project mee laten doen en de inhoud van offertes van onderaannemers (meer) onderdeel moeten zijn van de prijsvorming (proces). Ten slotte, het onderhandelen van prijzen moet niet als iets negatiefs worden gezien, maar als een middel om partijen scherp en eerlijk te houden. Uiteindelijk is transparantie belangrijk om het vertrouwen binnen het Bouwteam te behouden, resulterend in een goed gevoel en vertrouwen in de prijsvorming en de uiteindelijke prijs (de prijs van uitvoeringsovereenkomst).

Voor vervolgonderzoek wordt het volgende aanbevolen om te bestuderen. Ten eerste, het is nog onbekend wat de invloed kan zijn van verschillende Bouwteam modelovereenkomsten op de prijsvorming. In Sectie 2.2. is hier kort aandacht aan gegeven, maar dit zou een studie op zich kunnen zijn. Ten tweede, in dit onderzoek is een voorstel gedaan naar de risicoverdeling en het gebruik van de risicopot. Dit komt niet helemaal overeen met de gedachte van de opdrachtgever. Zoals het wordt aangegeven door de experts, de risicobeheersing en -verdeling blijft een lastig punt, ook binnen het Bouwteam en dus ook voor de prijsvorming. Ten derde, onderwerpen zoals het verschil tussen een Taakstellend Budget en Plafondbedrag of de stapelingen van de AKWR (algemene kosten, winst en risico) percentages, blijven lastig en de experts geven verschillende antwoorden hierop. Uit het onderzoek is gebleken dat dit onderwerp niet zwart-wit is en dat er geen concrete oplossingen zijn voor sommige problemen die zijn geconstateerd. Kortom, door het onderzoek zijn er nog meer vragen ontstaan en het wordt aangeraden om met vervolgonderzoek deze onderwerpen te bestuderen met beide partijen aan tafel, oftewel de opdrachtgever en opdrachtnemer (en misschien zelfs de consultant erbij, de derde partij). In dit onderzoek is er vooral gekeken vanuit het perspectief van een consultant, wat dus anders aangepakt zou kunnen worden voor toekomstig onderzoek.

Trefwoorden: prijsvorming (proces), prijsbepaling (proces), Bouwteam, modelovereenkomst, SSK, open-boek, gefaseerde prijsstelling, vroege aannemersbetrokkenheid (ECI), kostenraming, kostencalculatie

1. Introduction

Traditional procurement has been perceived as one of the root causes of the many problems within the construction industry. These problems vary from adversarial relationships between clients and contractors to issues with costs and quality of projects. This form of procurement was seen as being harmful to the trust development process and the lack of goal alignment between the contractor and client, which resulted in project delays, cost overruns and displeasure on both sides (Snippert, Witteveen, Boes, & Voordijk, 2015). Some research suggests that a shift towards better cooperation between client and contractor could solve such problems. Even in some cases, better solutions with this form are noted for single projects (Boes & Dorée, 2013). Besides this, the need for more cooperation between client and contractor is expanded by the current transaction constraints within the industry, such as time shortage and fixed budgets (Eriksson, 2008).

Nevertheless, procurement and tendering are necessary for every construction project. There are many ways to execute this, such as the use of contracts as DC (design and construct) or DBFM (design-build-finance-maintain). It is also possible to use approaches (not necessarily a contract but has still an appropriate contract integrated) and one of them is the Dutch 'Bouwteam'. This is a cooperation form, which is procurement with early contractor involvement. From practice, it was noted that for this approach a model agreement was needed, that regulates the cooperation between the client and contractor in the Bouwteam (Duijverman, 2021). This need was fulfilled by the 'VGBouw-model 1992' and this model agreement is being used to this day. However, the authors of the VGBouw-model thought that this model needed a revamp and created the 'Model Bouwteamovereenkomst 2021'. This is also noticed by others because the 2021 model seems like a renewal of the 1992 model instead of a complete overhaul. This is seen in the 2021 model, which refers several times to the older 1992 model. Besides these two models, there is one other known model, the 'Modelovereenkomst Bouwteam DG 2020'. With the initiative of Duurzaam Gebouwd and the five authors, all experts in this field, they came up with a new model agreement for the use in Bouwteam. The 'Modelovereenkomst Bouwteam DG 2020' is a helpful tool for the bilateral relationship between the client and contractor (Visser, 2020).

From practice, it is seen that the 1992 model is being used quite a bit and it is also seen that some projects have a derivative of this model (this is allowed). Since the 2020 model and 2021 model are quite new, these models are gradually being used more by the market. Besides these models, it is common that the contractor and client themselves set up a model agreement. Or better said, in some projects, none of the three models (or any derivatives of them) is being used[1], which leads to the conclusion that the contractor and client have an agreement on their own. Besides this, it is important to note that the Bouwteam aims and obligates for transparency. This results in open-book accounting for both sides, including cost estimations during the Bouwteam phase (Van der Pas, 2021).

Even though some of the aspects of procurement and tendering developed throughout time, the price formation process (in Dutch 'prijsvorming') is still unchanged (De Koning & Boes, 2020; Stoll, 2021). Besides this, it was shown that the market introduced two new model agreements that can be used by the contractor and client, which is also a sign of revamping the approach that is used for a Bouwteam project. As was mentioned, there is a shift towards more cooperation between the client and the contractor during the projects but there is also a need for more cooperation during the price formation process in the Bouwteam itself. Yet, both sides have a different approach for this price formation process in which there are differences in tackling the risks of the projects and the costs. This

[1] Vosman, L. (2020, November 19). Inventarisatie Lessons Learned Bouwteams. *Inventarisatie lessons learned*. The Netherlands: Witteveen+Bos.

difference in the (unchanged) price formation process does not seem to go hand in hand with the cooperation during the project, resulting in challenges and therefore hampering the cooperation between client and contractor (De Koning & Boes, 2020; Wondimu, et al., 2016; Van der Pas, 2021). Even though Bouwteam is a cooperative approach, in practice it seems that during the price formation process (throughout the whole Bouwteam phase) it is more about negotiating the costs of the project rather than aligning them. This way of working is suited and seen more in competitive contracts and thus complete the opposite idea of the Bouwteam approach. Therefore, the cooperation could be more successful if the price formation process will provide a situation in which the contractor and client align the costs instead of negotiating them. However, the difference in the price formation on the sides of the contractor and client is not well documented. The price formation consists of processes and techniques (e.g. cost estimation methods) that are being used during the Bouwteam and both sides struggle with their limitations regarding their processes and techniques (De Koning & Boes, 2020). Therefore, providing an assessment of what techniques are being used and what their limitations are, for both sides, will help to give an insight into what to focus on as a contractor and client during the price formation (process) in a Bouwteam.

1.1. Problem statement and research objective

In this subsection, it is tried to elaborate the problem more and show the full picture of the problem. Starting with the type of project, which is infrastructure projects. Within civil engineering, a distinction can be made between construction and infrastructure. For the given problem, the infrastructure projects are a more suited area to research since the use of Bouwteam is currently popular within this part of civil engineering (Van der Pas, 2021; Lenferink, Arts, Tillema, Van Valkenburg, & Nijsten, 2012).

Before going further on elaborating the problem statement, it is important to distinguish who the problem owner is. Simply stated, the owner of this problem is the client and contractor if they decide to choose the Bouwteam approach. However, to make it clearer for the research, the problem is seen from the perspective of an engineering/consultancy firm acting as a third party during a Bouwteam project. This is also easier to plan since the researcher is working with such a company, namely Witteveen+Bos. This is an engineering and consultancy firm that is delivering services on the topics of water, infrastructure, environment and construction. Nevertheless, looking from this perspective the researcher will try to determine the limitations of the processes and techniques, that are being used during the price formation by both the contractor and client. This could give an insight for the parties and indicate what to focus on for making the price formation (process), and thus the Bouwteam cooperation, more valuable and effective.

That mentioned, the problem statement can be given. The problem concerns the complete price formation process during the Bouwteam phase. It is important to mention that price formation is also present during the preparation and tendering phase but also during the realisation phase because costs are still made during the realisation of the project. However, the realisation phase is not included in the research and for the preparation and tendering phase, only the topics that are directly connected and important for the Bouwteam phase are analysed. So, this means that the preparation and tendering phase is not completely studied and that the research focuses only on the price formation during the Bouwteam phase. The reason for this is that, at first, both sides are on the same page since the total costs are roughly the same and the cost estimates are not that detailed during the preparation and tendering phase. Therefore, during this phase, there are not many conflicts or discussions. However, after starting the Bouwteam, a target budget or ceiling price is given to the contractor and with that in mind, a design is made and/or optimized. While designing, several design phases are passed, and design choices are made, which influence the price of the execution agreement (the price determined at the end of the Bouwteam). Besides that, costs are made during the Bouwteam phase

and along the way, the accounting does not stop (Van der Pas, 2021). All of this is included in the price formation during the Bouwteam phase and from practice, it is noted that if the design reaches the final phases, the price differences become more apparent, which could lead to discussions between the client and the contractor (Van der Pas, 2021). This has to do with the fact that within a Bouwteam, most of the time a target budget or a ceiling price is used. The client has calculated a price for the project at the preparation phase. However, in the tendering process, the client used key figures (Dutch: Kengetallen) while the contractor calculates it precisely after having the final designs. The differences in techniques and processes used causes difficulties in comparing the costs (items) and therefore could lead to negotiating instead of aligning, as the title of this research states.

All of this is summarized in the following problem statement:
"The differences in the techniques and processes used, for the price formation during the Bouwteam, causes difficulties in comparing the costs (items) and therefore could lead to negotiating the price instead of aligning the price during the Bouwteam. From practice, it is noted that these discussions about the price formation between the contractor and client can negatively affect the Bouwteam."

The research aims to find out why discussions arise during the Bouwteam cooperation and, especially, what the difficulties of the price formation are regarding the different techniques and processes used in a Bouwteam. It is assumed that if the difference between the price formations is better understood, reducing the discussions during a Bouwteam becomes easier and results in the improvement of the cooperation. This is done by assessing the processes and techniques and identifying their limitations, which could clarify how to improve the cooperation between the two parties. Based on the problem statement and research objective, questions for the research are set up, reported in Section 3.

1.2. Scope and research approach

The main scope of the research was already given in the problem statement, which indicated the price formation and the discussions about it. This results in a scope which is focusing on assessing the current price formation processes and techniques and gathering knowledge on how to solve the limitations of this price formation (thus not on soft characteristics). For this research, the Bouwteam is used as the scope for the study. Besides this, the scope is also only focusing on infrastructure projects since the problem that is introduced is more applicable to such projects.

Secondly, the scope includes all kinds of Bouwteam model agreements. It is expected that the newer models (2020 and 2021) will be used more over time thus resulting in more projects to be studied. However, the research is more focused on the actual use of the Bouwteam and its price formation, and not necessarily on the difference between the older and newer versions of the model agreements or how each model agreement (could) influence the price formation. Therefore, no difference is made between the different model agreements. This also implies for data collection. So, Bouwteam projects with the 1992 model are still used for data collection since the projects with the newer models are quite rare.

Shortly, an overview of the main research scope is given below in Table 1:

Table 1: Research scope.

In scope	**Out of scope**
Design and contract formation phase	Preparation and realisation phase
Price execution agreement	Total project price
Price formation techniques and processes	Soft characteristics of Bouwteam (price formation)
Main actors: client and contractor (seen from W+B consultant perspective)	Architects and different types of consultants (e.g. structural/technical engineering consultants)
Infrastructure projects	Construction (building) projects

1.3. Scientific and practical relevance

The relevance of this study is divided into two, practical and scientific. Firstly, the practical relevance, is that there is a need for a better picture of the price formation done by the contractor and client. This includes the processes and the different techniques that are being used, such as cost estimation methods (Van der Pas, 2021). From a practical stand of point, this clarification could give an insight on how to solve the discussions and even in some cases be eliminated. It is assumed that eliminating these discussions will increase the performance of the Bouwteam, having a positive effect on the outcome of a project, time and budget-wise.

As for the scientific relevance, several studies researched Bouwteam. These studies include the contractor's and client's perspective (Boijens, 2008; Nielen, 2010; Lagemaat, 2015; Nader, 2019; Van Riggelen, 2019; De Hoog, 2020; Timmermans, 2020; Van der Pas, 2021) and also the consultant's perspective (Grooters, 2018; Sewalt, 2019). All these studies investigated the different obstacles, challenges, success factors and opportunities of the Bouwteam. However, only the studies of Lagemaat (2015), Timmermans (2020) and Van der Pas (2021) have findings of the price formation.

Lagemaat (2015) researched the tension between price formation and cooperation in a Bouwteam. He focused on formal and social control, which is and can be used, to manage the uncertainties in price formation. However, the research did not focus on the techniques and process(es) used during the price formation. As for the study of Timmermans (2020), the research focused more on the risk management of the costs and only included one pricing technique (approach), the SSK. This research was a case study for the municipality of Hengelo and did not include an assessment of all other possible techniques and processes of the price formation during a Bouwteam. On the contrary, Van der Pas (2021) especially concentrated on the two-phased price determination (formation) process in Bouwteam projects. In this research, Van der Pas (2021) focused on the application of Bouwteam in the Netherlands and focused on how the contractor and client can successfully perform the price formation process. This research's result is a model of success factors for the price formation process, which include conclusions such as: "appropriate estimation method", "monitoring the pre-construction costs" and so forth. As with the study of Timmermans (2020), the study of Van der Pas (2021) mentions the SSK as a possible pricing technique but that is the extent to with the research findings are. There is no further assessment of other techniques or process(es) and if there is, as with the finding of the SSK, these are not in detail. So, it is still unclear what the "appropriate estimation method" is. Before finding such a pricing technique, the price formation of both the contractor and client should be outlined.

Concluded, it is known from the studies mentioned above that Bouwteam has its opportunities but also its obstacles. Throughout the years, the Bouwteam is well researched and in some cases, several studies investigated the price formation (process) in a Bouwteam. However, there is a lack of research regarding the techniques (schematics) used during the price formation and their limitations. So, there is no clear picture of how the contractor and client perform the price formation and what the differences are between these two different price formations (process).

1.4. Reading guide

As for the structure of the paper, the next section will start with a short literature review. In Section 2, the most important sub-topics are reviewed and noted. With this, a literature framework is also shown. In Section 3, the methodology of the research is presented which is followed by the results of the research in Section 4. After that, Section 5 will clarify the practical implications and limitations of the research. In Section 6, the conclusion of the research is drawn, with recommendations for future research. Lastly, in Section 7, the people that helped the researcher are acknowledged.

2. Literature review

In this section, the most important sub-topics of the research are shortly reviewed.

2.1. Bouwteam

First, the Bouwteam. This is a cooperation form in which the contractor is involved before the realisation phase of the project, hence early contractor involvement. This approach is based on two contracts. First, The New Rules 2011 (DNR) for the designers/consultants (Chao-Duivis, et al., 2018) and secondly for the contractor, with one of the Bouwteam model agreements (1992, 2020, 2021) or a derivative of one of these models. In the preparation and design phases, the contractor is an advisor and uses their experience and knowledge to create the best possible design, which is done together with the client. There are different reasons to choose for Bouwteam but one of the main reasons is the possibility to create a collaborative design with a high level of quality while being feasible.

This approach sometimes called a project delivery method, increases the relationship between the client and the contractor. With that, the client can state their needs and requirements easier throughout the different stages of the project, especially the beginning stages. Besides this, the risks of the project are talked about and allocated to the right party by discussing them together. This is also seen with the budget of the project, in which a target budget or ceiling price is present instead of a fixed price as with other contracts. However, a disadvantage of using a Bouwteam is that there is no competitive advantage during the price formation since the client is stuck with the same contractor from the start. So, the solution may not be the cheapest which urges the contractors to focus on efficiency instead of using innovations that could lower the price. Most of the time, the contractor will use proven solutions (Cobouw, 2019). However, with the right incentives, innovation is still possible.

Going back to the topic, it is important to distinguish in which part of the project the Bouwteam takes place. This is done in Figure 1, by showing the difference between traditional contracts and the Bouwteam approach which is the same as a two phases contract in this research.

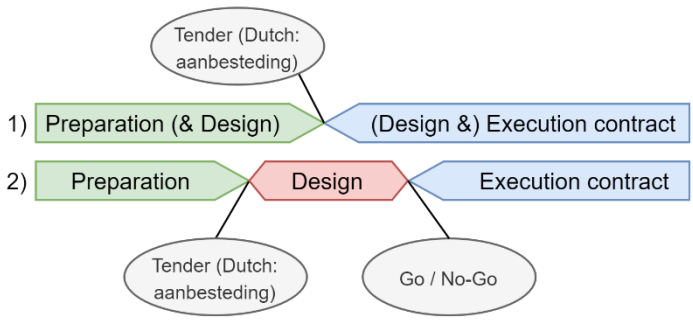

Figure 1: 1) Traditional tendering versus 2) two phase contracts, e.g. Bouwteam (Fijneman, 2020).

So, Figure 1 shows a difference in the process. The preparation phase is mainly done by the client (and advisors if needed) and one contractor is chosen with the tender to work further on the design, as a cooperation in a Bouwteam. So, the Bouwteam starts after choosing the contractor with the tender and is till the execution contract. Therefore, it is the whole design phase as shown in the red part of the figure above. Therefore, it is also called a two-phase contract since there are two different phases with their contract compared to the traditional contract. This two-phase contract includes two separate agreements, the first one being the design development and the second one being the realisation of the project. All of this results in a phased pricing process (Chao-Duivis M. , 2019). The phased pricing process is explained in more detail in Section 2.3.

However, it is also crucial to know what the position is of the Bouwteam in the building process itself. First, there are three main phases in the building process: 1) initiation phase, 2) design phase and 3) execution phase (Sijpersma & Buur, 2005). These three phases are identical to the phases in Figure 1, part 2). However, the design phase can be distinguished into four sub-phases, see Figure 2: structural design (SD), preliminary design (PD), final design (FD) and detailed design (DD). The position of the Bouwteam is as follows (Sewalt, 2019):

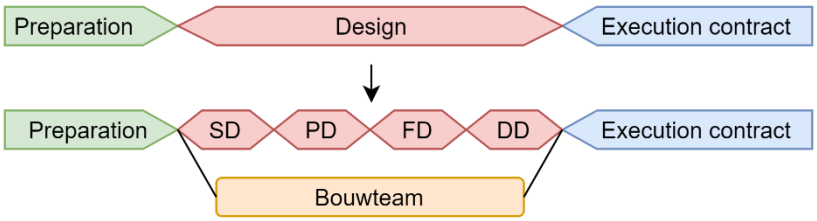

Figure 2: Position of the Bouwteam in the building process.

In practice, sometimes the client already includes a structural or preliminary design in the tender. So, this means that the Bouwteam focuses on the rest of the design phases. Also, it is possible to end the Bouwteam with a FD instead of a DD. All these scenarios depend on the client's requirements and wishes but also what type of project it is. Nevertheless, the visualisation in Figure 2 is taken as a base scenario but it is important to pay attention to possible scenarios as just mentioned earlier.

2.2. Bouwteam model agreement

In the Netherlands, there are three (or four) known Bouwteam model agreements, which are:

1. VGBouw-model 1992;
2. Model agreement Bouwteam Duurzaam Gebouwd 2020;
3. Model Bouwteam agreement 2021 (renewal of VGBouw-model 1992);
4. Derivatives of these models or the client and/or contractor made an agreement themselves.

There are some differences between these models. For example, the 1992 and 2021 models are accessible and therefore a bit easier to apply than the 2020 model. On the other hand, the 2020 model reflects how clients and contractors currently collaborate in projects better than the 1992 and 2021 models (Bouwmeesters Training & advies B.V., 2021).

Focusing more on topics regarding price formation, the 2020 model includes cyclical cost management during the Bouwteam phase better than the 1992 and 2021 models (Bouwmeesters Training & advies B.V., 2021). It could be even said that the 1992 and 2021 models do not include this, even though in practice it sometimes happens that at the end of the Bouwteam the predetermined target budget is not enough and that some revisions need to be made, resulting in difficult negotiations. Therefore, in the 2020 model more attention is given to monitoring the costs during the Bouwteam phase to prevent such scenarios at the end. Besides this, the risk register is included in more detail and better in the 2020 model (Küçük & Van Schouwenburg, 2021), including chances of risks occurring, control measures that need to be taken, remaining risks and more. This is helpful and important for the price formation because a bad allocation and estimation of risks and uncertainties can lead to discussions during the Bouwteam phase and/or problems during the realisation phase. Lastly, in the 1992 model the markup percentages for general costs, profit and risks were included, which is not seen in the other models. Besides determining the percentages in the agreement, an explanation was required on which costs were included in these markups.

There is no clear answer on which model agreement to use during a Bouwteam and if one of them results in a better price formation or not. The type of project can be decisive and it is a matter of taste. Also, from a legal point of view, there is no correct answer as to which one is the best [2].

2.3. Phased pricing

In Section 2.1, it was noted that the two-phase contract includes two separate agreements, which is for the (1) design and (2) the execution of the project. Consequently, the pricing of the project is also phased since these are seen as separate from each other. The phased pricing process is coherent with the preferred workflow that is represented in the MacLeamy curve (Davis, 2011). The diagram shows the relations between risk and uncertainty, cost of design changes, the traditional design and preferred workflow. All of this is shown relative to the project time which can be seen in Figure 3, see below. The line of the preferred design workflow is in line with the concept of a Bouwteam which is involving the contractor in the earlier stages and put more effort in the beginning stages, such as the design development, with the hope that less effort and costs are made in the later stages of the project.

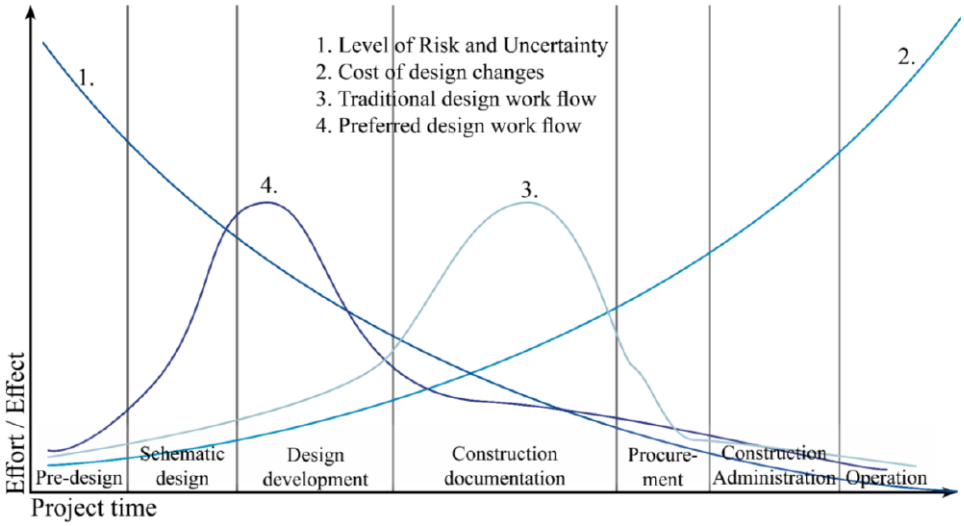

Figure 3: The MacLeamy curve (Van der Pas, 2021).

Moreover, the component that joins the design phase with the execution phase in the Bouwteam is the price of the execution agreement which is seen as a critical step (Chao-Duivis, et al., 2018). This is the step in which the contractor and client agree on the price of the second contract. A positive outcome of this step means that the same contractor of the design phase is involved in the execution (construction) phase and on the contrary if the client and contractor cannot agree on a price, a different contractor is found for the execution phase. However, to take advantage of all the benefits of using a Bouwteam (or ECI in some cases), it is preferred to keep the same contractor since this contractor knows the details and particularities of the design that is developed.

As for in which stages the price formation takes place, this is from the tendering phase (to be exact, consolidation phase, connecting the tender phase with the Bouwteam phase) till the contract formation of the execution phase. The reason for this is that the second contract formation is the endpoint of the price formation (process) since, at this point, the contractor and client agree on a price for the execution. This part of the price formation includes the procurement, design and price negotiation phases (Van der Pas, 2021).

[2] Hertstein, B. (2021, November 25). Drie modellen Bouwteamovereenkomst. *Game Changers congress Duurzaam Gebouwd:* https://www.gamechangerscongres.nl/nieuws/20211130-het-bouwteam-als-vehikel-voor-betrouwbaarheid-1

An important note to make is that the final price is different from the price of the execution agreement. The final price also includes costs made in the execution phase which is different compared to just the price formation (process) in the first phase (Van der Pas, 2021). For this research, the focus is only on the price formation itself and therefore, the (costs of) execution phase is excluded.

2.4. Price formation

It is mentioned that both sides have a different price formation process. The price forming consists of two parts: (1) the techniques or schematics that are being used, such as cost estimation methods or how a contractor calculates, and (2) the processes that take place. 'How to keep track of changes' and 'how financial decisions are made', are a couple of examples of different processes that take place during price forming. This concept is applicable for both the contractor and client, which gives us the following, in Figure 4:

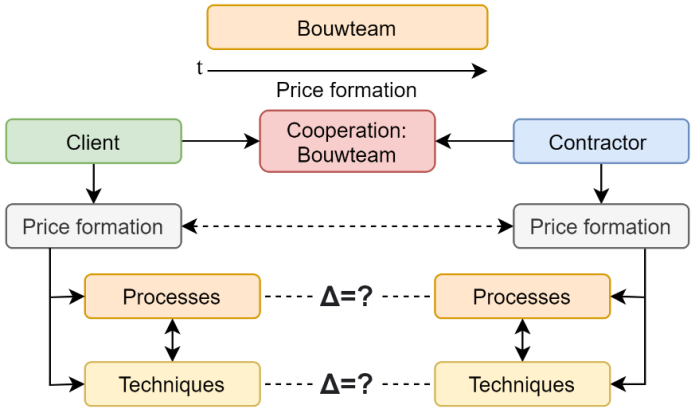

Figure 4: Price formation visualised.

Figure 4 shows that both sides have their price formation and are formed by the processes and techniques that are being used by the contractor and client. As it was stated in the introduction, the processes and techniques that are being used by both sides are not documented, which also leads to the lack of knowledge regarding the differences between the processes and techniques (shown as the delta in the figure above). This can cause uncertainties and questions on, for example, what to include in the cost estimates and what not to. For example, direct costs such as material and labour costs are most of the time straightforward and included by both sides. However, costs that are related to risks are harder to estimate and sometimes not clear and well presented in the cost estimation sheets (Timmermans, 2020; Wondimu, et al., 2016; Stoll, 2021; Van der Pas, 2021). Part of this has to do with the hard nature of this aspect but also because both sides tackle this problem differently. Also, whether the price formation is a continuous process during the Bouwteam or a stage process that takes place with each corresponding design phase, in which all cost estimates undergo a go/no-go moment at the end of each design phase, depends on how the contractor and client determined that before the start of the Bouwteam phase. Lastly, as can be seen in the figure, the processes and techniques are not something that can be seen apart from each other and therefore both topics are studied.

One of the cost estimation methods that is known and widely used by contractors is the Standard System for Cost Estimates (SSK). As far as is known, especially in the Netherlands, this tool is mostly used for cost estimation during the price formation process. The SSK is mostly applied to infrastructure projects. Besides this, it is also used by third parties, like consultancy firms. Using this system, estimates of investment and/or lifetime costs (maintenance costs) of projects can be made (CROW, 2019).

Besides this, the following different schematics/techniques are known: 1) the contractor calculates, so unit prices times quantities and 2) the client using key figures/estimates. From using key figures to

calculating is especially seen when going from the preliminary design (VO: 'voorlopig ontwerp') to the final design (DO: 'definitief ontwerp), in which the biggest cost differences become apparent[3]. Nevertheless, this is in line with what is presented in Section 2.5, which explains different pricing approaches. With the findings from Akintoye & Skitmore (1992), it can be assumed that the cost-based approach is representing the contractor that calculates. As for the client, the standard rate table-based approach seems to be the closest to the client that uses key figures or estimates. The difference in using key figures and calculating per unit is also distinguished in different literature. This is also known as the cost planning hierarchy (Winch, 2010), see below in Figure 5.

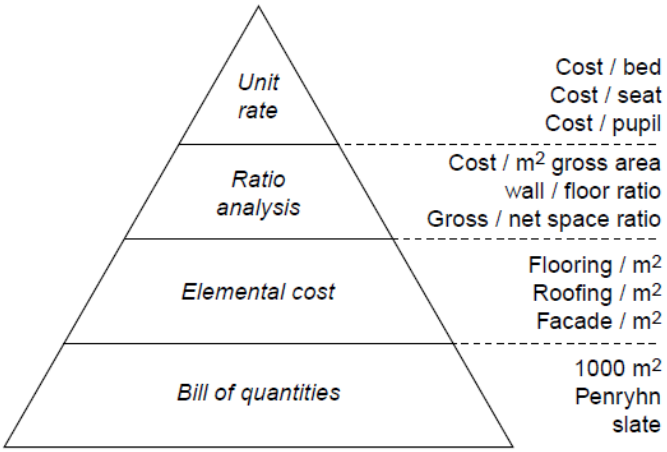

Figure 5: The cost planning hierarchy (Winch, 2010).

Comparing the statements given about the different schematics that are being used and the cost planning hierarchy, it can be concluded that when the contractor calculates it uses unit rate (top of the pyramid) which is the most detailed way of pricing a design/project. As for the client, when it estimates or uses key figures, it is considered that these are ratio analysis or elemental costs which is less detailed than the unit rate.

2.5. Pricing approaches

In the previous section, it was explained that price formation consists of techniques and processes that are linked to each other. The approach on pricing is based on pricing models that include the costs of the materials, services and the risks that are present during a project. In the construction industry, two extreme pricing models are known: (1) cost-based pricing and (2) market-based pricing (Mochtar & Arditi, 2000). Mochtar & Arditi (2000) state that all other pricing models (or strategies as they call them) are between these two models.

First, the cost-based pricing is based on establishing first the total costs of building the project and then adding a markup. This markup is most of the time the desired profit. However, it is stated by Mochtar & Arditi (2000) that there are two main problems with this model: (1) underpricing and (2) overpricing. Secondly, market-based pricing, which is completely the opposite of cost-based pricing. This model is based on the benefits that are created by the project for the client, which is relative to what the market has to offer for the client (Mochtar & Arditi, 2000). Hereby, the price is set in the market. The price can change based on the supply and demand conditions and after the market price is determined, the final price is adjusted to how the contractor deals with the project.

As Mochtar & Arditi (2000) states: "It is believed that most pricing used in construction is cost-based" (Mochtar & Arditi, 2000, p. 59). It is important to note that this paper is old and changes could have

[3] From interviews with the experts.

happened. However, on the other hand, it is well known that the construction industry is slow with changing and adapting, and the use of cost-based pricing seems to be still present and verified by more recent studies (Grineva & Shirochenskaya, 2019; Hanák, Drozdová, & Marović, 2021). The findings from the more recent studies are also in line with the main concepts that are reported by Akintoye & Skitmore (1992) and Mochtar & Arditi (2000). These older studies are one of the few, as far as the search capability of the researcher, which gives an overview of the main pricing approaches in the construction industry. Therefore, these studies are used to determine pricing approaches.

Nevertheless, the two models are visualised below in Figure 6 and should be considered during the research as the two extremes of the pricing models that are used during a Bouwteam.

Figure 6: Two extremes of pricing models (Van der Pas, 2021).

The same pricing models are reported in the article of Akintoye & Skitmore (1992). This article proposes a conceptual model of the contractor's pricing strategy. This article is important to understand the contractor' side better and how their revenue models look like. This is done by explaining first the pricing objectives, then the factors that influence the pricing decision, the pricing policies (approaches) that are used and lastly the pricing model.

First, the pricing objectives, which is categorized into three major types by Akintoye & Skitmore (1992) and used by Grineva & Shirochenskaya (2019) and Hanák et al. (2021):

1. Cost-oriented objectives;
2. Competition-oriented objectives;
3. Demand-oriented objectives.

Nevertheless, Akintoye & Skitmore (1992) and Grineva & Shirochenskaya (2019) note that most of the time, the contractor is focusing on the profit levels by concerning profit maximization or profit satisfaction. This is seen in practice since most of the companies use a cost-based pricing model and focus on a target return on investment (Akintoye & Skitmore, 1992; Grineva & Shirochenskaya, 2019).

Secondly, the factors that influence pricing decisions. These can be separated into four categories (Akintoye & Skitmore, 1992; Skitmore & Smyth, 2007):

1. Environmental factors, which determine the market situation in the construction industry;
2. Profitability, the trade-off between winning a tender and making a profit;
3. Cost estimating, mainly the design and construction variables;
4. Procurement method, concerned with the execution of the construction contracts.

Even though the focus is on the price formation itself, these are still important factors to take into consideration while doing the research. For example, the 'profitability' and 'cost estimating' factors are within this research the main topics that should be considered. As for environmental factors, these are less important since these factors include topics such as the geographic location of construction demand, the economic well-being of a nation and so forth. For this research, these topics are not considered since this is not within the scope of the study. As for the factor procurement method, this

includes the type of client, method of cost estimating, use of subcontractors and many more. These are essential factors to take into consideration as this influences the price formation (process).

The third step in the conceptual model is the pricing approach. In the first step, the main three pricing strategies were introduced. From these pricing strategies, Akintoye & Skitmore (1992) identified six pricing approaches that are relevant to the construction industry:

1. Cost-based approach;
2. Market-based approach;
3. Standard rate table-based approach – "… based on extracts from standard construction price books…" (Akintoye & Skitmore, 1992, p. 315);
4. Historical price-based approach – the price of previous projects is adjusted accordingly to time, location, variations in design and construction and the current economic conditions;
5. Subcontractors' bids-based approach – based on how much work the subcontractors get from the main contractor. If the main contractor subcontracts a lot, the less risk the contractor has but also the lower the mark-up on the total price of the contract;
6. Cover price – when the contractor has a lack of desirability of a tender or lack of time on preparing a detailed cost estimation.

It is noted that the contractor's pricing objectives and the perception of environmental factors determine which pricing approach is chosen by the contractor on bid pricing (Akintoye & Skitmore, 1992). The conceptual model of Akintoye & Skitmore (1992) suggests that the pricing objectives can be generally seen as profit maximization and profit satisfaction. So, for example, if the company has a policy that focuses on the target return on investment, this can then be classified as profit satisfaction. The same company then uses the cost-based pricing approach and adds a mark-up based on what the desired target return on investment is. This is a common way of working within the industry. Lastly, the same factors that influence the pricing also influence the allocation and estimation of uncertainties and risks. For example, if a contractor wants to minimize or spread the risk and uncertainties as much as possible, it will opt for a subcontractors' bids-based approach. Nevertheless, the topic of risks and uncertainties is treated in more detail in the next section.

2.6. Uncertainty and risk allocation

With construction projects, the estimation and allocation of risks and uncertainties are of importance since it is a high risk-prone business because of the uniqueness of each project within the industry, complex projects, long production cycles and many more (Laryea S. , 2008). One of the main problems with allocating and estimating risks is that the industry relies on intuition and unsystematic mechanisms. This is done by adding a fixed percentage or lump amount to the cost estimation of a project (Akintoye & Skitmore, 1992; Laryea S. , 2008; Laryea & Hughes, Risk and Price in the Bidding Process of Contractors, 2011). However, in practice, this does not seem to work since the common repercussions of risks are time and cost overruns, below standard quality and discussions between actors within a contract, such as a contractor and a client. Laryea (2008) states that the risk assessment is complex. Five approaches are already used for estimating and allocating risks (Laryea S. , 2008):

1. 'The umbrella approach' – having a large risk premium to the cost estimation;
2. 'The ostrich approach' – assuming everything will be alright and doing (almost) nothing;
3. 'The intuitive approach' – based on intuition supported by experience;
4. 'The brute force approach' – focussing on uncontrollable risk and try to control it;
5. 'The snowboard approach' – identifying risks beforehand and take accordingly corrective actions along the way by controlling factors that are in your hand.

Almost the same was found in the study of Laryea & Hughes (2011). This article reported three tiers of risk allocation: (1) creating a buffer with intuitive risk allocation, (2) including an allowance for the

allocated risk based on expertise and (3) the company's management determining a certain level of residual risk allowance based on expertise. These tiers are comparable to the intuitive approach since all tiers indicate the use of expertise and experience (Laryea & Hughes, Risk and Price in the Bidding Process of Contractors, 2011). Laryea (2008) states that in today's world, only the last approach (number 5) would be appropriate for a contractor by incorporating formal and analytical risk models into their bidding processes (or price formation in this case). These analytic risk models have shown their benefits and improvements in risk allocation and estimation (Lam, Wang, Lee, & Tsang, 2007; Farooq, Thaheem, & Arshad, 2018; Laryea & Hughes, How contractors price risk in bids: Theory and practice, 2008). Some examples of these approaches are probability theory, Monte Carlo simulation, mathematical theories such as fuzzy sets (Lam, Wang, Lee, & Tsang, 2007) and neural networks (Matel, Vahdatikhaki, Hosseinyalamdary, Evers, & Voordijk, 2019).

However, it should be noted that there are limited studies on how risk is allocated and estimated in the *entire* bidding/pricing process and besides that, the use of analytic models can sometimes be too complex and too time-consuming for the company (Laryea & Hughes, 2011). This is seen in practice since the use of published analytical approaches is low in the industry (Laryea & Hughes, 2008). Yet, both the contractor and client should actively take part in the risk allocation and estimation from the beginning of the project (Osipova & Eriksson, 2011).

So, from the findings above, it can be concluded that several studies published analytical risk models that can be used in projects, with proof of improvement in risk allocation and estimation. However, in practice, these are barely used and most of the contractors use their expertise to create "buffers" in their prices/biddings. For this research, it is important to analyse how the risks and uncertainties are priced during the price formation during a Bouwteam and if the use of analytical risk models is valuable. It is also important to document if the 'intuitive' approach is still the main way of estimating and allocating risks or if progression is made with the mentioned approaches.

2.7. Literature framework

The knowledge from the literature study is summarised in a literature framework. This framework also shows the relationships between the core concepts of the research. So, this literature framework also serves as the theoretical framework of this research (Verschuren & Doorewaard, 2010), see Figure 7.

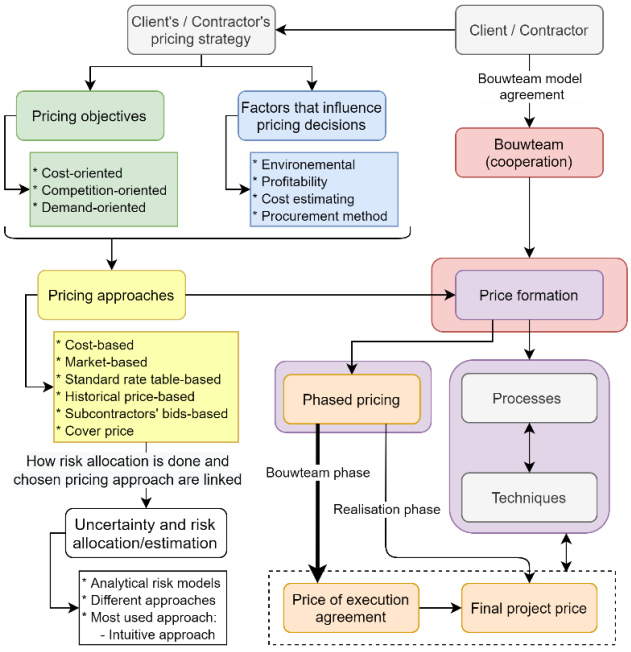

Figure 7: Theoretical framework.

The figure shows that the client and contractor are working together in the Bouwteam, which is the cooperation. However, both have their pricing strategy, which consists of the chosen pricing objective and the perception of the factors that influence the pricing decisions. These two determine the pricing approach that will be used during the price formation. Most of the time, the chosen pricing approach also determines how the allocation and estimation of uncertainties and risks are done. For example, if the cost-based approach is used, from practice it is known that a certain percentage of the project is allocated and estimated to uncertainties and risks. This is visualised in the left lower corner of the theoretical framework (Figure 7) and since this is not documented on how this is done in the Bouwteam, this part is included in the research and considered to be a part of the theoretical gap.

Nevertheless, from practice and literature, it is known that mostly the cost-based pricing approach is used by the construction industry. The literature indicates this especially for the contractor and since there is no literature found on how this is done by the client, the same is assumed for the client. This is taken as an assumption for the research, which will be tested with the chosen methodology. This is also considered as part of the theoretical gap since this is not validated. Also, it is important to note that there could be a variance in the application of the cost-based pricing approach. For example, the level of detail (e.g. work breakdown structure) that is chosen and calculated with. If possible, such details are also considered during the testing of the assumption.

Assumption: Based on the literature and practice, it is assumed that during the price formation of a Bouwteam, the cost-based pricing approach is used during the price formation by the contractor and client.

The price formation can be divided into two main categories, which is shown with the purple colour in the visualisation. Firstly, the processes and techniques used during the price formation by both the contractor and client. Secondly, the price formation is part of the phased pricing which has two phases. In this research, the focus will only be on the Bouwteam phase (1st phase) and not the realisation phase (2nd phase), as is visualised with the bold line. As far as the techniques and processes, it is used by both the contractor and client to come up with the price of the execution agreement.

The visualisation and documentation of the processes and techniques, testing of the assumption, and the documentation on how the risks are allocated are the answer for the current knowledge and theoretical gap of the price formation in the Bouwteam, as was explained in Section 1.3, which reports the practical and scientific relevance of the study.

3. Methodology

This section outlines the research questions and the research design.

3.1. Research questions

To achieve the research objective, the main question and five sub-questions are set up. The problem statement is translated into the following main question for the research:

MQ: *How can the contractor and client set up the price formation, in which both would agree on the price of execution agreement, for infrastructure works and services during Bouwteam cooperation?*

For this research, the topic can be divided into two groups, the contractor and the client. Price formation takes place on both sides and therefore it is needed to study them both. This leads to the following sub-questions:

1. What are the advantages and limitations of the pricing techniques[4] and process(es), currently used during the projects?
2. How are the different design phases and the price negotiation phase structured in the phased pricing process and how is the phased pricing process managed?
3. How are the risks and uncertainties of a project allocated and estimated during the price formation?
4. What should be considered when forming the price of the execution agreement?
5. How should the process of price formation look like in the context of Bouwteam cooperation?

For this study, qualitative empirical research is chosen to gain knowledge on what the current techniques and process(es) in the price formation are and what their limitations are. The reason for this is that the techniques and processes that are used, are best known by the experts that are involved during the price formation of a Bouwteam. These experts have mostly implicit knowledge, what should be obtained and then documented. Translating and documenting the implicit knowledge is done with conceptual models, which are developed in line with Verschuren & Doorewaard (2010).

To create conceptual models, a conceptual framework is proposed, which takes the sub-questions of this research into account. The conceptual framework, see Figure 8, is derived from the theoretical framework and forms the basis for the final framework. As shown in the conceptual framework, the different phases of the project are mentioned above. The focus is on the part 'price formation' and 'contract formation phase'. These parts of the framework are specified by analysing case studies, which is explained in the following sections. The protocol for setting up and validating the conceptual framework and models is included in Appendix A (Verschuren & Doorewaard, 2010).

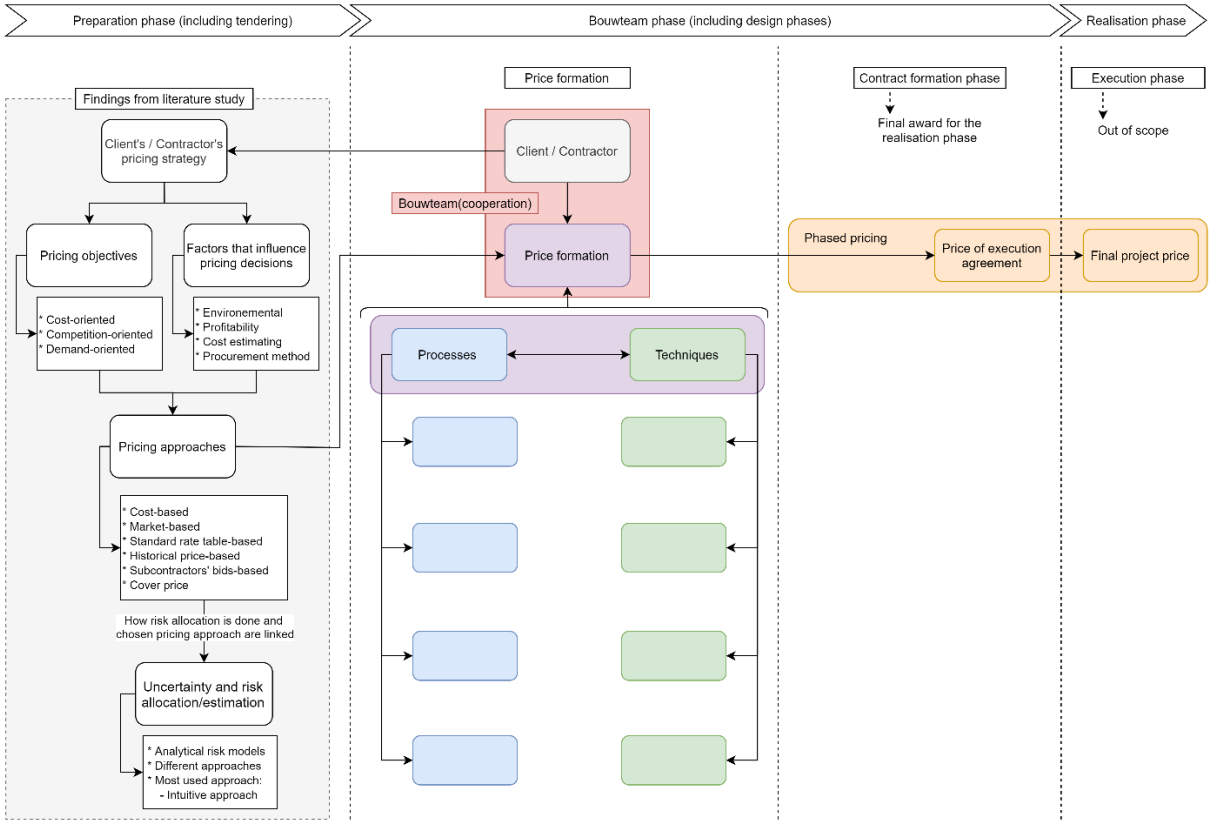

Figure 8: The conceptual framework.

[4] Refers also to the pricing approaches that can be used to determine the costs of a project, see Section 2.5.

3.2. Research design

In the preliminary phase of the research, most of the literature for the research topic was studied and used to form the theoretical framework and create the conceptual framework. To document the price formation processes and techniques, in other words, filling in the conceptual framework, mainly two methods are used: (1) case studies in which the Bouwteam approach was used and (2) qualitative data collection with the help of surveys (Verschuren & Doorewaard, 2010; Yin, 2016).

After setting up the conceptual framework, three exploratory conversations are held with experts from the field, who have experience with Bouwteam projects and their price formation (process). As was concluded from the literature review, there is a lack of documentation of the processes and techniques that are used during the price formation. These conversations, which are set up as a semi-structured interview form, are used as a starting point for the needed findings to address the practical and scientific relevance, and to test the conceptual framework. This forms the basis for the next phases.

Subsequently, four case studies are analysed by document analysis and asking questions to the relevant contact person of the project (case). The data extracted with these methods are used to form two visualisations of the case: (1) the chronological project process and (2) the price formation itself and its interactions. These visualisations are validated with the relevant contact persons, who worked on the project themselves and are experts in the field. After analysing, visualising and validating each case separately, the cases are compared and the most important elements of the price formation are noted. Compared to the desk and literature research, the case studies are more about the depth rather than the breadth of the acquired knowledge (Verschuren & Doorewaard, 2010).

During the comparison analysis, an overview is made of the different price formation elements. This step is performed to find out what needs to be asked during the interviews. While analysing and comparing the cases, it is possible to note clear elements, instruments or patterns of the price formation. However, the case study alone is not enough to understand why certain elements or instruments are part of the price formation. Therefore, the findings of the case study (including conceptual models) are used to formulate the predefined questions of the interviews. These questions are meant to validate the findings from the cases and go into further detail and explanation. For this, semi-structured interviews are used since the subject is known but there is the possibility that the knowledge acquired till this phase is still limited to setting up the correct predefined set of questions. With this approach, the interview is given a direction regarding the topic but the experts have still the freedom to mention or address certain topics of the price formation based on their knowledge and experiences, which are not covered by the predefined questions (Verschuren & Doorewaard, 2010).

However, with this open approach clear interview instructions are needed in order to make sure that: "… (a) the research topics indeed will be brought up during the interview, (b) the expressions of the interviewee are unambiguous and to the point, and (c) the interview results of all the respondents are comparable." (Verschuren & Doorewaard, 2010, p. 141). Considering the intertwined topic, the amount of implicit knowledge to be treated during the interviews, and to make sure that these three points are met, the interviews are followed up by a questionnaire. This questionnaire contains more detailed questions about the price formation (thus less open questions compared to interview), which is based on the same groups used for the interview setup and is the same for all interviewees.

After processing and analysing the findings from the interviews and questionnaires, the main and sub-questions of the research can be answered. The answers to these questions are visualised and summarized in the final framework (generic model), which has the same basis as the conceptual framework in Figure 8 and is validated by experts. The research design (framework) is visualised in Figure 9, which is formed in line with Verschuren & Doorewaard (2010) and Yin (2016).

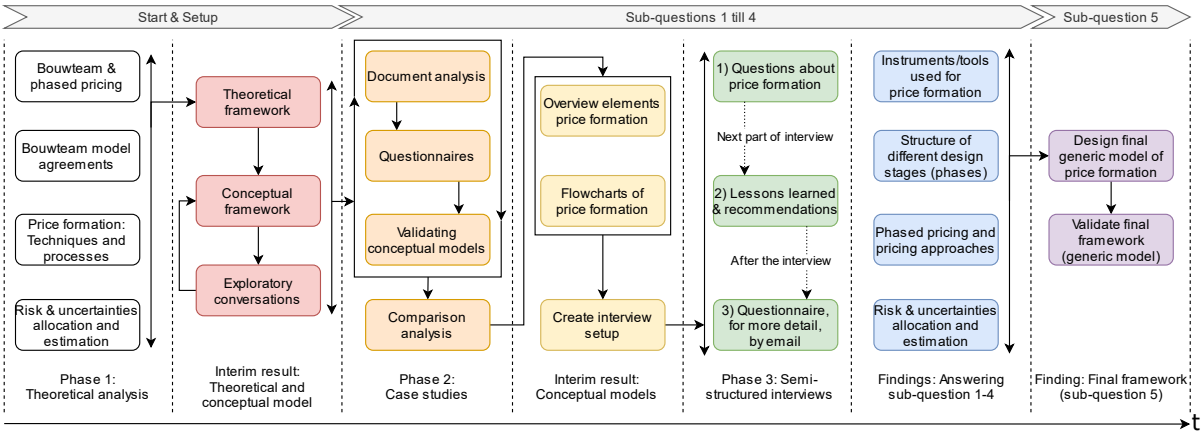

Figure 9: Research design/framework

3.2.1. Data collection

In this section, the data collection is explained in more detail. The selection criteria for each data collection method are reported in Appendix B.

First, the desk and literature research, which is covered during the preliminary phase of the research and is noted as theoretical analysis in the research design. This phase has the benefit to gather a large amount of data quickly and increasing the breadth of knowledge regarding the topic (Verschuren & Doorewaard, 2010). The selection criteria for desk and literature research are included in Appendix B.1.

After the literature review, the conversations are used to form a basic understanding of the price formation and to validate the conceptual framework that will be used throughout the rest of the research. Besides this, these conversations are used as pilot interviews to test the interview setup for phase 3, the semi-structured interviews. At the end of the conversations, the participants are asked to give feedback, which is considered for phases 2 and 3. The questions and the conversation setup can be seen in Appendix C. For the conversations, three parties (four persons) participated. These participants met the selection criteria, mentioned in Appendix B.2.

The following participants were selected for the conversations, also mentioning their expertise:

1. Contract manager from the client (11 years of experience);
2. Contract manager from the contractor (12 years of experience);
3. Two experts from a subsidiary of a water board: project manager (25 years of experience) and department manager (35 years of experience).

After the conversations are held and the feedback is processed, including the feedback on the conceptual framework, four cases have been analysed (Stake, 2006). The criteria for the cases are noted in Appendix B.3. For the case study, four Bouwteam projects were selected, in which the company of W+B was also part of and these are:

1. Dike reinforcement;
2. Retaining walls (in Amsterdam);
3. Bicycle bridge (with a bio-based deck);
4. Repair pipeline pumping station.

In Table 2, important data of the cases are given. In some cases, there is a lack of information, which is labelled as ‘unknown’.

Table 2: Overview of all cases and their information.

Case	#1	#2	#3	#4
Experience client BT[5]	No	No	No	Unknown
Experience W+B BT[6]	Yes	Yes	Yes	Yes
Experience contractor BT	No	Yes	No	Unknown
Execution contract[7]	UAV-GC (2005)	UAV	UAV-GC	UAV-2012
Basis of BT agreement[6]	Unknown	VGBouw 1992[8]	VGBouw 1992	Unknown
Start of BT agreement	11 Dec. 2019	5 March 2018	4 April 2017	9 Dec. 2019
Date of execution agreement	12 July 2021	25 July 2019	Unknown	14 Dec. 2020
Lead time BT (1st phase)	19 months	17 months	Unknown	12 months
Price of execution agreement	~195% of TB[9]	€3,675,000.00	€6,5 - €7 M	€499,456.62

After going through more than 20 Bouwteam projects in the database of W+B, a large number dropped out immediately because (1) these projects did not reach the end of the Bouwteam phase, (2) or were tenders that did not go through or (3) projects that were noted as a Bouwteam in the database but, these were projects that used a different contract form. After this elimination round, eight cases were left and for each case, the contact person was approached. Five of these contact persons answered back and only four of them were able to provide documents, which are the four cases shown in Table 2. Since these projects met the criteria, these projects were selected for the case study.

The findings from the case studies are noted. As was mentioned in the research design, after the case study an overview is made with the different price formation elements seen in the cases (besides the conceptual models). These elements of the price formation can be divided into different groups because some elements belong together and cannot be seen separately from each other. Grouping these parts makes it easier to conduct the interviews, making it possible to ask questions per group. With the grouping of the elements and the findings, predefined questions are formulated for the interviews. These questions are meant to validate the findings from the cases and go into further detail. The questions and the interview setup can be seen in Appendix D. For the interviews, eight employees from W+B participated, with different backgrounds and thus different perspectives on the price formation (e.g. risk, costs, management perspectives, etc.). These employees met the selection criteria, mentioned in Appendix B.4.

The following participants were selected for the interviews, also mentioning their expertise:

1. Contract, procurement and tendering advisor/manager (25+ years of experience);
2. Contract, construction costs and claim and conflict advisor/manager (40+ years of experience);
3. Contract and (sustainable) procurement advisor/manager (7 years of experience);
4. Project and risk manager, with designing and engineering experience (25 years of experience);
5. Engineer and design leader, now project leader/manager (14 years of experience);
6. Project manager, with tendering and cost estimation experience (17 years of experience);
7. Claim and conflict advisor/manager, (construction) cost advisor (42 years of experience);
8. Project director and supervisor, cost calculator/estimation (36 years of experience).

After conducting the interviews, the data is processed and analysed. During this, it is checked if the questions of the questionnaire are answered. If so, the answers are filled in by the researcher and the

[5] BT = Bouwteam.
[6] In all four cases, W+B was working on the project on behalf of the client.
[7] Derived from (Vosman, 2020).
[8] A derivative of the 1992 model.
[9] TB = Target budget, also known as 'Taakstellend budget' in Dutch. It was asked to keep this confidential.

questions that are not answered, are sent to the interviewee as a questionnaire (see Appendix E). The interviewees were given at least two weeks to respond and, in some cases, reminders were sent. The result was that five out of the eight questionnaires were filled in and returned to the researcher.

3.2.2. Data analysis and validation

The data is mostly qualitative. There are multiple ways of analysing this data but for this study, the data analysis is based on the book of Hartmann (2017) and Löfgren (2013). The data analysis proposed by Hartmann (2017) and Löfgren (2013) is during the research supported by the books of Verschuren & Doorewaard (2010) and Yin (2016). Hartmann (2017) divides the analysis into three parts: data reduction, data display and drawing a conclusion (Hartmann, 2017). As far for Löfgren, he proposes six steps on how to analyse transcripts of interviews, which are (Löfgren, 2013):

1. Make notes;
2. Labelling relevant pieces;
3. Decide which codes are the most important and group them by creating categories;
4. Label categories and which are the most relevant and how they connect to each other;
5. Options (decide if there is a hierarchy, difference in importance of categories, visualise);
6. Write the results.

These two methods complement each other and are the base for the analysis of the qualitative data. So, step 1, 2, 3 and 4 is the part ‘data reduction’. Secondly, step 5 is ‘data display’ and lastly, step 6 is ‘drawing conclusion’. This method is used during all phases: conversations, desk and literature research, case studies, interviews and validation with experts. However, it is important to note that the findings are updated with each phase being completed. By going through the phases, more accurate and correct knowledge is gained, which improve the analysis’ findings and thus the answers to the research questions.

The same is done with the visualisation of the cases. The basis of the conceptual model, in line with Verschuren & Doorewaard (2010), is taken and developed by first reducing the data of the documents that are received and then displayed in a model/flowchart. This is then validated by the contact person of the project and if needed, changes are made and a conclusion is drawn.

For the answers of the interviews and questionnaires, a methodology inspired by the Delphi method was used. First, each question of all interviews was individually processed by applying steps 1 till 4 of Löfgren (2013). After that, the first answer (first interview) of the first question was taken as an interim conclusion. This conclusion was put up against the next answer (second interview) of the same question and by comparing them, an interim conclusion was drawn. This was done for each question till all eight interviews were processed and analysed, resulting in the end conclusion after the last interview and completing steps 5 and 6 of Löfgren (2013). This is done for each question and resembles the Delphi method, by reaching a consensus from multiple rounds of interviews (Dalkey & Helmer, 1963). However, since there is a lack of analysis and feedback of the experts in between the rounds, this cannot be categorized as a Delphi method and is therefore mentioned as ‘inspired by’.

Lastly, the final framework is validated by two experts. Both experts were not a part of the case study or interviews and both work also at W+B. One of them is an expert in Bouwteam projects and is also one of the co-authors of the Bouwteam model agreement 2020 (DG). The other person is an expert in construction costs and is the head of the group ‘cost management and advice’.

4. Results

This section contains the results of the research and therefore also the answers to the sub-questions. The number of the subsection corresponds with the number of the sub-question, so subsection 4.1. answers sub-question 1 of the research, and so forth.

The analysis of the cases was carried out for the whole Bouwteam phase. In other words, the realisation phase was not considered. In addition, a few points from the tendering phase have also been included in the results, because some of them have an influence on the Bouwteam model agreement but also the starting point of the Bouwteam phase.

Firstly, the project is visualised chronologically per case. In this visualisation, the most important points are noted here, which also mainly have to do with price formation. Then, in the second figure, the interactions in the price formation are shown. The basis for the second visualisation, the interactions in the price formation, is the conceptual framework that was shown in Figure 9. The results of the case study, the conceptual models of the cases, can be seen in Appendix F. The results of all the cases have been compared with each other and it has been examined which elements occur. This was mentioned as the 'overview' in Section 3. This is shown in Table 3, which indicates which elements are present in their relevant cases. It is important to note that not all the sub-topics are present in each case. Rather, this is a summary of all elements seen in the four cases and their price formation (process).

Table 3: Overview of main elements in price formation.

Main elements	**Case #1**	**Case #2**	**Case #3**	**Case #4**
Concept estimate during the tendering phase	?	X	X	X
Open-book (estimate)	X	-[10]	X	X
Integral risk session	X	X	X	X
Integral risk register	X	X	X	X
Methods used for risk register (only seen RISMAN)	X	-	X	-
Contractor estimates (the offer)	X	X	X	X
Clients review the calculation/estimation (the offer)	X	X	X	X
Contractor calculates (unit prices times quantities)	X	X	X	X
Use of SSK-systematic	X	-	X	X
Specification items substantiated with MAMO[11]	X	X	X	X
Specification items conform RAW-systematic	-	X	-	X
Specification items determined by the contractor	X	X	X	X
Substantiation unit prices with quotes	X	?	X	X
Use of target budget[12]	X	-	-	X
Use of ceiling price[13]	-	X	X	-
Substantiation of cost estimates or calculations	X	X	X	X
Contractor & client jointly draw up specification items	-	X	-	-
Minimum PD or FD (design) phase for quantities	X	X	X	X
Consultations between the contractor and client	X	X	X	X
Discussions about the draft offers → price matching	X	-[14]	X	X

X = Applies tot he relevant case - = Does not apply to the relevant case ? = Unclear

[10] Open-book was not applied, however the contact person indicated that it should have been used.
[11] MAMO stands for Materiaal (material), Arbeid (labour), Materieel (equipment), Onderaannemers en stelposten (subcontractors and provisional posts). This is linkable to use of RAW-systematic.
[12] Target budget is set by the client as a goal, but deviation is possible if well substantiated.
[13] Ceiling price is what the client maximum wants and will pay, deviation is not possible even with good substantiation.
[14] In the end, there was more negotiation than aligning the costs (bad Bouwteam experience).

The elements of the price formation were categorised before the interviews and verified during the interviews. During the interviews, the experts noted several additions and changes. Resulting in the following five groups and (all possible) sub-topics for the price formation (process) in a Bouwteam:

1. The starting point of the price formation:
    a. Starting point of the Bouwteam model agreement, concept estimate, target budget, ceiling price, open-book agreements, 'AKWR' percentages, integral Plan of Approach.
2. The design phases:
    a. VKA (preferred alternative (design)), optimising design, minimum design for Bouwteam phase, construction method, determining and reviewing quantities.
3. Instruments for price formation:
    a. Estimating costs, calculating costs, RAW-systematic, quotes, MAMO, cost report(s), SSK-systematic, pricing approaches, open-book (budget/estimate).
4. Risks and uncertainties:
    a. Integral risk session, integral risk register, risk-pot, methods (e.g. RISMAN), analytical risk models, intuitive approach, chance of risks occurring, liability and responsibility.
5. Consultations, discussions and price mating:
    a. Review by client (or on behalf of client), scope changes, discussions about: unit prices, risks and risk allocation and markup percentages (general costs, risks and profit).

Besides verifying the groups and sub-topics, the experts were asked if it was possible to rank the groups based on how essential they are for the price formation. The ranking of groups differs per expert but what often comes up (thus essential) are the starting points for the Bouwteam and the price formation (group 1), scope demarcation (groups 1 and 2), transparency/open-book (groups 1 and 3) and how all of this works out with the risks (group 4). Group 5 is ranked lower because it is indicated that this is not that troublesome if the team goes through the Bouwteam properly.

Also, the most important relationships between the groups were asked. What emerges above all are the links between groups 2, 3 and 4 (quantities and costs, plus the associated risks). In other words, how the design influences the calculation and the interaction between the design phases and the risks, which in turn influences what is calculated. This is all linked to the specific budget (group 1) that is determined by the client, which is reflected upon in the consultations and discussions (group 5).

4.1. Pricing techniques and processes

In the previous section, the categorised elements of the price formation were shown, including the techniques and processes used for the price formation. This section focuses on the techniques and processes by also mentioning their advantages and limitations.

First, all the techniques and processes that were seen in the case study are categorised in Table 4. In some cases, an element can not be solely seen as a technique or process and in these cases, the most applicable group is chosen. For example, the 'AKWR' percentages, in other words, the markup for general costs, profit and risks. The determination of these percentages, based on the total direct costs, is a process but also a technique since it is also possible to determine this differently. For example, with a fixed amount.

Table 4: Techniques and processes used for price formation.

Techniques	**Processes**
Concept estimate	Scope demarcation
SSK-systematic	Designing (+ optimisation)
Target budget	Estimating/calculating costs
Ceiling price	Cost estimation substantiation

Open-book principle	Open-book agreements and use of it
Risk allocation methods (RISMAN)	Risk management & distribution
Analytical risk models (Monte-Carlo)	Integral risk session
MAMO (unit prices)	Integral risk register
Design methods (e.g. SE, BIM, etc.)	Consultations, including tuning
RAW-systematic	Assessment of draft offer
Client estimates	Independent 3rd party advice
Contractor estimates (early stages)	Keeping track of design log
Contractor calculates (later stages)	Plan of Approach, incl. project start-up (PSU)
(Jointly) risk pot	Determining 'AKWR' percentages
Quotes (from subcontractors)	Demand specification (in Dutch 'VS')
Pricing approaches	Setting up Bouwteam model agreement

Price element tender
Regarding the mandatory price element during the tendering phase, the target budget or ceiling price is seen for the realisation phase and (hourly) rates (fixed amount) for the Bouwteam phase. In some cases, the target budget or ceiling price is supported with a concept estimate. This is including cost items and is, therefore, more detailed than a fixed amount.

Determining the markup 'AKWR' percentages
The percentages are almost every time determined at the beginning of a project, thus during the preparation phase that also includes the tendering. Otherwise, it is requested as quickly as possible with the first possible 'request for change process' (in Dutch, Verzoek tot Wijziging-proces, VtW). The client does not want to keep this blank till the end of the Bouwteam (Van der Pas, 2021). It is noted by the experts that determining the 'AKWR' percentages beforehand leads to low percentages, which the contractor makes up for during the Bouwteam phase with higher unit prices.

Open-book principle
The full use of the open-book principle differs, in some projects completely and some (totally) not. However, it must be said that the quotes from subcontractors are often delivered but they are hardly explored in more detail (so about the content, how the price is built up). So, the open-book principle is not fully used here. In addition, it is seen that open-book is only used during the price formation phase, while it can be also used earlier. In other words, during designing phases.

Target budget or ceiling price
As seen in Table 3, both were used in two of the four cases. In practice, the use of a target budget or ceiling price differs, which is up to the client. A target budget is seen more as a goal, in which deviation is possible if its well substantiated. As for the ceiling price, it is what the client maximum wants and will pay for the project, in which deviation is not possible (if there are no scope changes). It differs from project to project if the target budget or ceiling price is given as a flat amount or in more detail with certain cost items.

With the use of a target budget, it is mentioned by the experts that it can sometimes be too non-committal and therefore hamper the project's performance or results. Besides this, it is mentioned that a target budget could be used for projects in which the solution t is already reasonably known.

As for the ceiling price, the experts indicate that it could be used for projects in which the solution is not known and needs to be designed from the start, together by the client and contractor. However, it is also mentioned that the client focusses sometimes too much on the given budget. If this is the case, the experts question what the added value of the Bouwteam is.

SSK-systematic
In three of the four cases, the SSK-systematic is used as the main technique for price formation. This is also encouraged by several experts and considered to be one of the best options. Also in some cases, it is used to determine the target budget or ceiling price in the beginning, which is then further elaborated upon. Sometimes, the contractors may still find it difficult to make an SSK-estimate/calculation, which is mentioned by one of the experts.

On the other hand, if a specification item (read 'bestek') is made, this can be priced which is more straightforward for the contractor. If this is the case, one of the experts has the opinion that the SSK-systematic does not have that much added value (even for projects with many installations). However, in all cases, it can be used for the client's reservation of a risk pot.

RAW-systematic
It is situation dependent on whether the RAW-systematic is used. However, it is mentioned by the experts that it is useful for comparing and reviewing cost estimates since it is a known standard by both parties. However, if the Bouwteam does end up with a RAW specification, the experts note that sometimes the client and contractor do fall back into old behaviour. If a RAW specification is used, it must be considered that there are no deductible quantities and very few provisional posts.

MAMO (Material, labour, equipment, subcontractors and provisional posts)
In practice, it is often seen that the contract or project managers, from both the contract and client sides, discuss the unit prices during the consultations in the Bouwteam phase. A couple of examples of the content of these consultations are production standards (e.g. how much concrete can be poured per hour), the differences in the cost estimates of both parties (e.g. specific cost items that stand out) and so forth. The experts note that the managers from the client side generally use prices of reference (older) projects as a comparison during the consultations. On the other hand, if discussions about price differences arise, the main contractor mentions most of the time that this is the best price that they can get because it is based on quotes from the subcontractors.

Besides this, the experts note that prices of material and equipment should not lead to many discussions because these are often standard prices (happens sometimes anyways). Lastly, the experts remark that as a company like W+B (in relation to working for the client), it is important to remain critical whether you understand everything (in this case, the prices) because the client takes your word as absolute. As the experts mentioned, most of the time the clients do not have enough knowledge or experience about how a price is built up (content MAMO) and therefore rely on third parties like W+B.

Quotes
The work and tenders (quotes) from subcontractors are currently not an important part of the Bouwteam because the discussions are too little about the content. This also holds for the 'multiple' markup (AKWR) percentages. Besides this, there are some other points:

- One of the experts mentioned that the purchasing process (with indexation) must be reviewed since, in practice, this leads to discussions;
- The contractor has often difficulty with properly checking the quotes from subcontractors and verify properly if these are realistic.
- Lastly, it is seen in Bouwteam projects that small differences in prices (cost items) are discussed. The experts note that discussing only unit prices can cause to forget the total price and create a focus only on absolute numbers instead of the content.

Estimating/calculating the costs
In practice, there is a difference in estimating and calculating the costs. Generally speaking, estimating the costs happens in the earlier stages and calculating the costs, which is in more detail, happens in

the later stages. This is considered to be natural and works efficiently, as is mentioned by the experts. As the Bouwteam phase progresses, more information is obtained and some things become more certain, such as finalising designs and so forth.

Substantiation of cost estimates/calculations
There are shortcomings in the substantiation of the cost calculations. In the beginning phases, there is insufficient attention paid to the cost-determining choices because assumptions or starting points are not sufficiently established. This provides insufficient substantiation for the cost development throughout the Bouwteam phase. As a result, the differences between design phases are not properly documented and pointed out.

Other
As can be seen, not all processes or techniques are treated in the paragraphs above and the focus was on techniques and processes that directly influence the price. Elements such as risk session and register, design methods such as Systems Engineering, Plan of Approach and so forth, are considered to be standard in all (Bouwteam) projects and are already applied in practice. This does not mean that they are perfectly applied but in the following (sub)sections, some of them are treated in more detail.

Advantages and limitations

In the section above, some of the advantages and limitations of the techniques and processes were already mentioned. This part goes more into detail, especially for the limitations.

As for the advantages, it can be summarised as the following by the experts: open and transparent consultations about the price ensures a good 1-to-1 comparison, which does require that contractor and client make good use of the open-book principle (Van der Pas, 2021). This creates the opportunity to jointly create a smart design and minimize the risks as much as possible because of the flexibility of a Bouwteam. This ensures an efficient process and leads to a better price.

However, there are still some limitations and the experts mention three main limitations: (1) unit prices (especially productions), (2) the shift in the ratio of direct and indirect costs with a Bouwteam compared to traditional contracts and (3) the risks (allocation and estimation), the risk pot and how whether this is all within budget or not. But it is stated by several experts that in practice, discussions about the quantities and unit prices happen. The experts' opinion is that this should not be the case because these are hard facts and this needs to be solved together by convincing each other (including the discussion about productions). Most experts agree that the main limitation of this problem is that in practice, the construction cost experts (on a technical level) are too late part of the Bouwteam phase. Currently, this is done at a contract management level by the contract or project managers.

Other limitations and discussions mentioned by experts, regarding the techniques and processes, are:

1. Discussions are too little about the content (of unit prices) and too focused on small details;
2. Indirect costs, which is tricky to figure out with all the subcontractor quotes;
3. Construction cost experts are part of a project too late (Van Riggelen, 2019);
4. Sometimes endlessly discussing risks and the design (Van Riggelen, 2019), at a certain is too much. Longer Bouwteam means also higher costs;
5. Expectations of the price formation must be sharper and better established in the preparation/tendering phase (Van Riggelen, 2019);
6. With a Bouwteam a 'tuition' is paid, not everyone is familiar with this or has experience with it (Van Riggelen, 2019), which also influences the price formation;
7. Contractors sometimes take into account that there will be negotiations with the client. So, they jack up their prices beforehand.

Pricing approaches

For the price formation, cost-based, market-based and subcontractor's bids-based are used as pricing approaches. Besides these three, which were noted as a result of the case study, the experts added the use of key figures. In other words, standard rate table based. With this, the assumption made in Section 2.7 is tested and refuted since it is not only a cost-based pricing approach.

With the use of different pricing approaches, the experts mentioned some points of attention. First, having clear at what level unit prices are going to be included, which makes it easier to discuss. Secondly, the quotes from subcontractors must also be part of the consultations and this must be done by experts who have experience and knowledge about 'MAMO' because only adding up individual items of the estimates does not provide insight into the complexity of the work (e.g. with phasing). In addition, the essential differences in cost items should be discussed and not insisted on discussing the small differences. Otherwise, the total price can be forgotten. For all the points mentioned, it does not matter which pricing approach is being used for calculating or reviewing the price. The only point to consider is that with a market-based approach, a snapshot of the prices is made.

Lastly, it was asked if the use of different pricing approaches could lead to discussions or problems, which resulted in divided opinions. The one side indicates that it is already going well in the current way and should not cause any problems if it is substantiated in sufficient detail and apply the open-book principle. The other side indicates that (1) there could be a collision with the combination of market and cost-based, because of the snapshot that is created with the market-based approach, (2) the contractor thinks they have the best option with quotes but most of the time the client is not happy with it because it does not match their reference projects and its costs (the client compares differently) and (3) sometimes the contractor does not realize that the subcontractors hand in quotes that are too high, so the combination of cost-based with subcontractors bids-based can also cause discussions. Whether using different pricing approaches can cause problems depends on the type of project and what kind of people are working on it. It is important to check in which situation the project falls and whether it meets the points listed above for both situations (i.e. situation no problems or problems).

4.2. Design phases and price negotiation phase in phased pricing

This section reports how the different design phases and the price negotiation phase are structured in the phased pricing process and how it is managed.

Design phases

In case 1, there were four design loops and lastly a final assessment before going into the price negotiation phase. In each design loop, first, the design was optimised and then the risk register was updated. Based on this, the contractor estimated the price which led to a draft offer. This draft offer was then reviewed by different parties. This loop was done four times and with each loop, more detail was added to the design, cost estimation and risk register. All of this can be categorised as a continuous price formation process that is managed with four stage-gates. After the fourth loop, there was an intensive final assessment and some price tuning, which were part of the negotiation phase (shown as contract formation phase in Appendix E.1.).

Secondly, case 2, was completely different compared to case 1. In this case, after the detailed design was finished, a draft offer was made by the contractor. This draft offer was reviewed and the feedback was shared in a couple consultations. It became clear that the contractor and client were not on the same page. So, the client gave the contractor a chance to come up with a final offer, which was part of the price negotiation phase (shown as the contract formation phase in Appendix E.2.). This did not result in a positive outcome, in which the client responded with a ceiling price for the second and last final offer. The contractor made a second and final offer, which was accepted by the client. From this,

it can be concluded that the price formation took more place during the price negotiation phase and not during the designing, with a lack of stage-gate moments as was seen in case 1. As the contact person of this project indicated, it was a failed Bouwteam and both the contractor and client did not end with the result they wanted (even though the contractor got the project awarded).

Thirdly, in case 3, a variant and material study took place. After each study, a SSK-estimate was included. After choosing the variant and materials, some parts of the project were designed till the preliminary design and some till the final design. Also, after the designing phase, an integral SSK-estimate was set, determining the investments costs of the project. During all of this, interim cost estimates were made and reviewed by W+B on behalf of the contractor. The last integral SSK-estimate resulted in consultations with some discussions about some quantities and unit prices. However, a middle ground was found and the prices were tuned, which was part of the price negotiation phase (shown as contract formation phase in Appendix E.3.). In short, this project had a continuous price formation (process) with stage-gates, linked to the variant study, material study and the designing phases. As with case 1, the price formation in this case was done more during the design phases rather than the last phase in the Bouwteam, the price negotiation phase.

Lastly, case 4, is a project that ended up with a traditional 'bestek' following the RAW-systematic. The reason for this was particularly interesting since this part of the project was tendered as a Bouwteam, which was part of a bigger project that was tendered traditionally. That is also the reason why they made the switch from the SSK-systematic to an 'Addendum specification items (bestek)' with the RAW-systematic during the Bouwteam phase. Nevertheless, as with cases 1 and 3, this project also included a SSK-estimate with the ending of each design phase. In case 3, a variant study resulted in a preferred alternative and this was further designed. A SSK-estimate was made for each part of the design, resulting in an integral SSK-estimate. As was said earlier, from the SSK-systematic a switch was made to the RAW-systematic, resulting in the draft offer of the contractor. In the price negotiation phase, a few discussions had taken place about some unit prices. After this, some price tuning was done and the project was awarded to the contractor. So, after the variant study, this was also a project that had a continuous price formation (process) with stage-gates (fewer checkpoints compared to cases 1 & 3).

As for other findings, the experts note that the biggest choices are made with the structural design and preliminary design. A more detailed design than the structural design would make the price formation process easier because a higher level of detail in the design means a smaller risk profile and smaller bandwidths (the final design (in Dutch 'DO') is mainly elaboration for the bandwidths).

Lastly, as is shown in Table 3, all Bouwteam projects ended at least with a preliminary design and most of the time with a final design. However, it is important to note that the design could be split into parts and that some parts go further in detail than others, which is already common practice.

Price negotiation phase (contract formation phase, see also Appendix F)
As for the price negotiation phase, which is seen as the contract formation for the realisation phase, three out of the four cases showed non-adversarial consultations and discussions between the client and contractor. In these cases, discussions about the unit prices were present. Most of the time, the client and contractor were able to agree on the price by substantiating it and explaining it to each other. This is mainly done one on one but in some cases, substantiation from third parties, like the subcontractor or an independent party, was used. All of this is already common practice.

However, in case #1 it was seen that at the end of the Bouwteam, a final assessment in a form of Q&A rounds was used. These were in total four rounds, in which the client could ask questions to the contractor (around 500 questions). The contract manager of the contractor of this project noted that this was quite an intensive review process but resulted in both parties being satisfied with the price

and the Bouwteam cooperation. However, it is important to note that this was also the biggest project out of the four cases, which explains the number of questions. Nevertheless, an interesting approach to end the Bouwteam and its price formation.

On the other hand, one of the cases revealed that in some cases adversarial discussions do happen in a Bouwteam cooperation. In this case, during the last draft offers of the contractor and thus the price negotiation phase, the client appointed a ceiling price for the final offer since the draft offer did not match the promises of the contractor that were made at the beginning of the Bouwteam. This shows that if the Bouwteam and its price formation is not well monitored, it could lead to adversarial situations and discussions at the end.

The advice of the experts

At the beginning of this section, the cases showed how the different design phases and the price negotiation phase are structured in the phased pricing process. In the next sections, the advice of all experts is included on how to structure and manage the design phases and the price negotiation phase.

Starting with which design the Bouwteam phase should be started. Most of the experts believe that at least a structural design (in Dutch, 'schets ontwerp') should be given to the contractor at the start of the Bouwteam if the client has a design for the project. According to the experts, this ensures that the contractor knows what input of knowledge is expected. To the question 'Till which design should be worked on in a Bouwteam?', most experts answered up to the final design. However, depending on the project this can differ per part, and it is possible to elaborate/design more or less (also depending on which contract: UAV vs UAV-IC). This should be checked and explored further during the Bouwteam phase while managing the risks and in coherence with the risk register. The most important thing that all the experts mention is that the design, which is a result of the Bouwteam, has a clear scope and the price of which is realistic regarding the respective design.

As for how the design phases should be structured in the phased pricing process, all experts believe and advise that the price formation (process) and the design phases should run in parallel with certain checkpoints (Van Riggelen, 2019). It is mentioned by one of the experts that it is not necessary to agree on a price with each checkpoint and it should be ensured that the checkpoints are not at the expense of the design process. Therefore, the experts propose that the price formation should be done in parallel (stage-gate process linked to the design phases) for the main design choices, and at lower levels, this is less necessary. However, it is noted that this only holds if a design log is used and monitored in which all design choices are noted (so, continuous process). In addition, they believe that it is important to have cost experts at the table as early as possible because in the preliminary design it is still possible to make (design) choices that can ensure to stay within budget. The cost experts are the most qualified persons to advise on this and not the project or contract managers, which is often seen in practice.

This is followed up by if the quantity statement, which is derived from the design, should be determined together or not. The experts indicate that it could be done together, by the client and contractor, but preferably not. Because if the contractor does this, the risks of it are with him, which is preferred in this situation. Also, as a client, there is the possibility to carefully review it, which is already happening and seems to work fine in practice.

With the come up of different and more digitalised design methodologies, it was asked if design methodologies such as Building Information Modelling (BIM), systems engineering (SE), parametric design and so forth, could influence the price formation (process). The answer to this was, in short, not that much. However, more use of these design methodologies could perhaps lead to a smaller chance

of deviations and thus discussions. For example, SE supports controlling the process (already used in practice) and BIM helps with the realisation of integrated projects (also used in practice), which makes the complexity more transparent. All of this is helpful for the price formation and make it more traceable in which situations which design choices are made and by whom. Nevertheless, this also holds for other contractor forms and not only for a Bouwteam approach.

The experts note that there is no need to have discussions about the quantities that come out of the design if the scope definition is clear and a successful Bouwteam is realised. However, it needs to be made sure that the situation of the contractor (money-driven) and client (quality-driven) does not clash, which could prevent the parties from achieving an optimal design. The same applies to the reviewers of the designs, who should not impose a different design choice without discussing it. This is sometimes seen in practice and should be taken into account. Besides this, bandwidth for the cost estimates for each design phase is sometimes used in practice and the experts advise to continue with this and make sure that this is jointly determined, making it clear for everyone. As a result of which, the quantities and bandwidths thereof are examined in a more structured way.

Lastly, for the price negotiation phase, it is mentioned by one of the experts that this phase (contract formation for the realisation phase) should not be a phase in which both parties have discussions about unit prices, quantities or other facts. This should be done during the price formation itself and if the price negotiation phase is reached, only small alignments for some prices should be made, resulting in an agreement of the contract price (the price of execution agreement).

4.3. Risk and uncertainties allocation and estimation

It is noted by the experts that the risk and uncertainties allocation and estimation are one of the hardest parts of the project. It was asked which risks have a greater influence on the price formation, the objective or subjective risks. The answer to this was the objective risks, which are mainly uncertainties about the area. So, these risks have a greater influence on the price formation and therefore outweigh the subjective risks, which are about attitude and behaviour of the Bouwteam but also the mutual dependence of the parties (e.g. soft characteristics).

As for changes in the scope, it is noted by the experts that this could and does happen in practice, but it is self-evident and not that relevant for the price formation. If it happens, it is already common practice that the deviations are registered to provide insight into the consequences. So, also for the consequences on the costs and calculations that already have been done. This could lead to some problems with the budget but if the scope changes, the experts note that most of the time the budget does not remain the same. To make sure that such situations are not kept hidden and resulting in bigger problems afterwards, the experts remark that the members of the Bouwteam must dare to mention things and say them to each other, without being trivialized by the other.

Tools for risk allocation and estimation

In the literature review, see Section 2, it was noted that most of the risks and uncertainties (and their prices) are determined intuitively. This was confirmed by all experts but also noted by them that it should be this way and that in current practice, it is done efficiently. So, it is the main way of allocating and estimating the risks and uncertainties. However, some of the experts do note that it could be in conjunction with methods, such as RISMAN, and preferably with the entire project (team).

One of the methods is the analytical risk models, such as Monte-Carlo simulations. It is mentioned by the experts that this can be used for complex projects, which is done in some cases, and for the probabilistic calculation of SSK estimates. In addition, it is for determining the content of the conversation and bandwidths, which will help to facilitate discussions about risks and uncertainties. In

this case, expert judgment is used to settle the discussions. However, the experts note that in smaller projects analytical risk models are not that often used.

On the other hand, the use of the RISMAN method is seen in two of the four cases and the only one that has been seen in the case study. This method is also the only method or tool that is mentioned by most experts. Nevertheless, this method can be used to form a structure to map out all risks (creating the correct focus) and to get a picture with the pricing of risks. However, the experts note that this is not complete because of the many assumptions made with the RISMAN method. Therefore, the experts advise that risk management should be done with everyone and the technical team should process this in the cost estimates, which is already done in practice.

One of the other tools mentioned by the experts and seen in the case study is the joint risk pot. All experts see this as an usable tool during the Bouwteam if both parties cannot control the risk(s). In this case, which happens in practice, the client should be aware of duplication (multiple) risk markups as it is already being taken advantage of by contractors. Therefore, the experts note that it is important that this is determined together in consultation and that the risk pot also covers situations such as calamities and unforeseen circumstances. Lastly, one of the experts mentions that a risk pot is theoretically a good concept but whether this is desirable depends on the complexity of the project after the Bouwteam phase, which is not in the scope of this research.

Discussions

The main discussions about risks and uncertainties are, according to the experts, a result of poor scope demarcation and risks distribution. It is indicated by the experts that this can be prevented by continuously working with risks and not doing a (risk) session now and then, as is seen in practice (Timmermans, 2020). In other words, the risks must run along with the designing (phases) and according to the experts, this could be improved on. Besides this, it is mentioned that the duplication (multiple) risk markups are also one of the more important points of discussion. Also, if a joint risk pot (or similar concept) is used, one of the experts remarks to not use the RWS' concept of the 'risk buffer'. Lastly, a couple of experts note that it must be kept in mind that the composition of the price itself is one big risk, and therefore considered to be a hard task to do.

Risk management and distribution

In practice, the general rule for risk management and distribution is that it is best to place the risks with those who can control them the best. This must be an interpretation of the client, contractor and engineering firm (so risk management must lie with everyone), whereby the expectations of risk management must be clear to everyone within the Bouwteam. This is something that already happens in practice, for example with the use of risk sessions and risk register. For example, in case 3, it was seen that a risk manager was appointed to keep track of the risk sessions and register. Also, as with cases 1 and 3, all of this was done together with an active and flexible risk register. However, risk management and distribution are still a difficult part of the project, as is stated by the experts.

Some experts elaborated on this topic and proposed risk management and distribution in a form of a sliding model, which is flexible in a continuous process during the Bouwteam phase (Van der Pas, 2021). This model has the following basis and 'slides' from start to end in chronological order:

1. Determine the risks and risk control measures, put a price tag on this;
2. For the risks after control measures, determine the contractor's risks and its price;
3. Again, after control measures, determine the client's risks and its price;
4. Lastly, again after control measures, determine the risks that cannot be beard by both parties. The price that is determined for these risks, is the joint risk pot.

During the Bouwteam phases and designing, the distribution of these risks could change and therefore also its price. The prices of the risks after control measures (points 2 and 3) are for the contractor and client themselves and if these risks do not occur, they keep 100% of the determined pot. The joint risk pot, the last step (4), is mainly meant for the realisation phase because risks and uncertainties always remain, even after reaching the final design and minimising the risk profiles. If this risk pot is not used at the end of the realisation phase, the experts recommend that this could be split 50/50 between the contractor and client.

With this concept, the experts note that the parties should be honest with the determined risk control measures and what this means for each party. It is important to keep uncertainties as small as possible, which can be supported and recommended by the experts, with studies (e.g. test trenches and groundwater checking) at reasonably limited costs.

4.4. Price of execution agreement

In this section, the factors and elements that need to be considered when forming the price of the execution agreement are formulated. This is determined with the documentation of the price formation, done in the previous subsections (Section 4 till 4.3), and with the opinions of the experts.

Starting point

According to the experts, the following must be present at the start of the Bouwteam: a target budget or ceiling price with substantiation (concept estimate) and a Plan of Approach (PoA). The PoA is including what the process looks like regarding risk management and price formation, open-book agreements, with a (clear) definition of scope, at minimum a structural design, draft contract (for realisation) and if possible, a (reference) risk register. This means that the expectations of each other must be clear and correct, which also applies to the coordination between the scope and the budget.

Price element tender

Unit prices were not mentioned or even advised against by the four (out of the eight) experts but if it is used, at least it should be done with the open-book principle. However, it is possible to do it with complex projects by providing several references (reference design, planning, phasing, etc.). This will partly help to shorten the tendering procedure. Ultimately, the experts note that the most important thing about giving a target budget or ceiling price is that it is a realistic amount and not that the client gives a lower budget than they have calculated themselves. In this case, the client creates their own (reserve) pot, while the budget the contractor works with is unrealistic. The experts note that this phenomenon is a common practice by the client and should be avoided if a Bouwteam approach is used.

Concept estimate

Most of the experts note that the concept estimate is important (use key figures when little information is available) but the contractor should be given a chance to check whether it is realistic. The experts indicate (also the experts from the conversations) that the SSK-systematic can be used to form the concept estimate and this should also be the substantiation of the target budget or ceiling price (see next paragraph) that is determined by the client. By giving the contractor the chance to check it, the contractor has something concrete to review and it is ensured that the contractor must and will feel responsible for the available budget. In addition, one of the experts mentioned that it must be considered that the client normally does not want to give this information in detail because of its sensitivity. The same expert proposed an idea and said that this can be solved by leaving out the sensitive information and including the following in the concept estimate: direct costs, indirect costs (AKW minus the R, thus markup percentages) and risks (in the Bouwteam). So, the costs and the risks of the client are kept out (which they keep to themselves) and therefore also the sensitive information.

Target budget or ceiling price

In short, in a Bouwteam it should be opted for a target budget (4 out of 8 experts) without being too noncommittal and thus creating urgency for the contractor to stay within the target budget (thus sending a strong signal to the Bouwteam, and thus creating the idea that experts #5, #7 and #8 propose with a ceiling price). In other words, the project should not take on a life of its own and the contractor should feel responsible for the budget. In addition, one of the experts is more neutral and proposes two situations: (1) target budget should be used for projects where the solution is already well known and (2) it is possible to use a ceiling price for a project where a solution needs to be created from the ground up. However, some experts note that mistrust in the Bouwteam can be created if a ceiling price is used because the client will focus too much on this ceiling price. If a ceiling price is implemented, the question then arises why a Bouwteam approach is used since according to a couple of experts it is not (that) compatible with the Bouwteam concept. The most important thing here is, whether a target budget or ceiling price is used, as is stated earlier and by the experts that the client will not give up a lower budget than they have estimated beforehand and thus create their reserve pot.

Open-book and organisational aspect

According to all experts, open-book is necessary for transparency between parties and mutual trust is very important here. To support this and make structured use of it, some experts recommend indicating the expectations for the bandwidth of the cost estimate for each design phase. Other experts mention that it is also important to check the relationships between the main contractor and the subcontractors. Sometimes it may be that the main contractor makes a loss on a project, but the subcontractors (who are sister companies) make a good profit. It is therefore important that the organisational aspect is included in the open-book agreements, in which the quotes from subcontractors are also part of the open-book principle. In short, the main contractor must be able to explain what his (organisation) chain looks like and how it is managed and monitored (Lagemaat, 2015).

Determining the markup 'AKWR' percentages

As was stated in Section 4.1, the markup percentages are going to be determined at the beginning of the project no matter what (Van der Pas, 2021). However, a couple of experts noted that it would be beneficial for the project to do this at the end of the Bouwteam phase. One of the experts proposed a middle ground and said that it can be kept as it is already done but a recalibration can be done at the end of Bouwteam. In this way, it is ensured that the client gets this information at the beginning (otherwise it is perceived as too dangerous) and with the recalibration, it becomes possible to check whether the ratio between unit prices and percentages is realistic. However, a couple of experts mention that determining the percentages at the front could be a bit more specific than only a flat amount as is happening now but this depends on the project and project phase. Also, this should be in line with the risk distribution. For example, if all risks are mitigated then the risk percentage should not be high. The same applies to engineering in the Bouwteam phase and with the designing party under the UAV-GC or DNR contracts. Many risks lie with the designers, so this should also translate into a higher percentage. These percentages can also lead to other discussions about design costs and implementation costs. One of the experts notes that these costs are often blown up by the contractors.

It was mentioned by the experts that low determined indirect costs at the front can lead to high unit prices, so also discussions. However, experts remark that it should not lead to discussions but consultations (as seen in case 4 for example) if it stays within the known margins of the sector. To prevent this, one of the experts proposes an idea to include the 'stacking of multiple' AKWR percentages in the Bouwteam model agreement. However, even if this is done, staff costs, the profit

margin of the contractor, substantiation of percentages and the shifting of the direct/indirect costs are still points of discussion.

Three methods for price formation

To reach the price of execution agreement, the price formation during the Bouwteam phase can be done in three ways:

1. The contractor estimates/calculates and the client reviews;
2. The client estimates/calculates and the contractor reviews;
3. Both the contractor and client estimate/calculate.

From the cases and the opinions of the experts, the choice goes to the first and third ways of doing the price formation. The second choice, in which the client estimates and the contractor reviews, has not been mentioned once or seen in the cases. It has been stated several times by experts that the client usually has no idea, for example, how unit prices are built up and that they lack the knowledge and experience to fully estimate or calculate a project by themselves. So, this option should not be used. Ultimately, all the experts agree that it is important that this choice is determined together in advance, during the setup of the Bouwteam model agreement.

The option chosen should then be in line with what was presented in Section 4.2, which reported how the price formation should be in parallel with the design process and phases (seen in 3 out of the 4 cases and supported by experts). For this, checkpoints should be used that are linked to the design phases (again, seen in the cases and supported by experts). So, the structural design, preliminary design, final design and detailed design are seen as checkpoints and it is possible to have smaller checkpoints in between, depending on the situation. According to all experts, each design phase should end with a cost calculation, including substantiation, which could be used for the next design phase to reflect upon. Critical performance indicators (KPIs) can be used for this reflection, which should be determined together at the beginning with the setup of the Plan of Approach. This means that, based on what is seen in the cases and what the experts propose, the price formation is recommended as a stage-gate process. However, within the design phases themselves, it is important to keep track of what design choices mean for the cost of the project. So, even though the price formation is linked with the design phases, it is still advised by the experts to be a continuous process.

If this is done correctly and consistently, all experts mention that the price negotiation phase should not be difficult for the contractor and client, and only require some small alignments.

Agreement on the price

The experts believe that the client should not try to get a lower price and continue with the realisation phase if the contractor's final offer in the Bouwteam phase is under the target budget or ceiling price, which is logically substantiated and in conjunction with the risk register. In addition, all experts agree that it is important that a price has been reached consistently during the Bouwteam, which should ensure that both parties have a good feeling about the amount that has been determined. As some experts note, it is important here that the parties do not regard their amount as absolute and that they are open to the other's claim (of the price). Finally, it is advised by one expert (experience from contractor's and client's perspective) to agree on the price at least two months before the realisation, avoiding hasty work at the end that could negatively influence the result.

However, in practice, it is seen that the parties may not agree on the price of the final offer. In this case, the experts note that an independent third party should be approached, which both parties should agree on beforehand. This is already common practice and they could advise on the hard (unit) prices. If there are still discussions about why things have been or are being done, the experts say that

the client and contractor must go back to the technical team. However, this step back should never be taken according to all experts. So, in this case, one of the experts mentions making use of a provisional post if necessary (Timmermans, 2020). In addition, the reviewing of cost calculations by percentage difference is discouraged by almost all experts, despite the possibility of using it as a tool to get a sense of whether the parties are on the same order of magnitude. It is sometimes seen in practice and if used, according to the experts, the percentage difference should be a maximum of around 10%. However, if there is a final design (or more detailed, detailed design), the percentage should be a maximum of around 5%.

4.5. Price formation process visualised

The last sub-question of the research was about how the process of price formation should look like in the context of a Bouwteam cooperation. In this section, this sub-question is answered by developing the final framework, which is a generic (flowchart) model for the price formation. First, based on the experiences and knowledge of the experts, some recommendations are given for the price formation (process). These are divided into recommendations for the client and the contractor.

The recommendations for the client:

- Organize the process in such a way that the target budget is sufficient for the project;
- Think about whether you as a client want to monitor the costs or let the contractor do this;
- Good (cost) experts can say something about the cost estimates/calculations in detail, preferably in the Bouwteam phase as quickly as possible;
- As a client, do not go into too much detail and insist on minor unit price differences;
- More presence within the Bouwteam, including in the price formation process;
- As a client, delve deeper into the costs, to better understand and track the price formation;
- Make use of incentives, such as the bonus-malus idea, to motivate the contractor more.

The recommendations for the contractor:

- Determining the tasks and responsibilities and being in line with the client;
- Not consciously jacking up prices to absorb own setbacks (part of entrepreneurship);
- As a contractor, do not try to get your profit at the end with additional work;
- Understand the prices of the subcontractors better and what that means for the total price;
- Being aware that as a contractor, he is in some sort of privileged position (1-on-1 (pricing)) and should not take advantage of it.

Going back to the title of the research, negotiating versus aligning the prices, the experts have the same opinion and indicate that clarity must be created for each other, including the expectations the parties have of each other. This is accompanied by openness and transparency, which is seen as one of the most important aspects of the Bouwteam and for the price formation (process). It is important that in the beginning both parties agree on the budget and be consistent with what has been estimated or calculated and why it has been estimated or calculated.

Also, consultations and price monitoring during the Bouwteam ensure coordination between the parties. In addition, one of the experts mentions to look also at low unit prices besides high unit prices and not focus too much on small differences or details. However, as a couple of experts suggest, it must be kept in mind that negotiating is not always something negative and can even be used in certain situations to make sure both parties agree distinctly with each other about what will be done and how much it will cost (without being adversarial). So, the experts remark to make sure that there is no more commotion about the price, which should be preferably the case around two months before the realisation phase starts. In other words, there is already an agreement about the price, which prevents

parties from making concessions or putting aside differences. Otherwise, these will come back up later during the realisation phase and still create problems.

Generic model

For the generic model, the conceptual framework in Section 3 is taken as a basis, see Figure 8. During the case study, four of these models were developed, see Appendix F. The knowledge from the case study, which is four representations of the current price formation (process), is used together with the propositions, ideas and recommendations of the experts to create a generic model that proposes how the price formation (process) should look like in the Bouwteam cooperation. This generic model (final framework) is developed, which incorporates almost everything that has been treated in the previous sections in one visualisation for the price formation (process) in the Bouwteam. This can be seen in the following figure, see Figure 10. A Dutch version of the same model is included in Appendix G, see Figure G1. The model should be read from left to right, in which the second section of the model is an extension of the main model (first section). In the third section of the model, a legend and abbreviations are included for clarity. In the next paragraphs, the model is explained.

First of all, the consolidation phase. As was reported in Section 1.2, the tendering phase was not included in the research. However, after a contractor is chosen, a phase is started before the Bouwteam starts. This is called the consolidation phase and the place to set up the Bouwteam model agreement and give the concept estimate to the contractor, as was explained in Section 4.4. This can be considered as the starting point for the price formation because as is proposed in the model, the concept estimate should be checked and accepted by the contractor.

After this, which is already common practice, the PSU happens and an integral Plan of Approach is set up. As shown in the model, this leads to a ‘loop’ inside the price formation (bold lines in the middle of the model) and the risk session, which is connected to the risk register. This loop is the most important part of the price formation, in which the designing, estimating and calculating the costs, substantiation of the calculations and the consultations (tuning) happen. This happens throughout the different design stages and continues till the determined design, which is proposed by the experts to be the final design (FD) and in some cases the detailed design (DD). After the last loop is gone through and the last draft offer is given by the contractor, it is advised to have a final assessment which is a form of ‘Q&A rounds’. This was seen in case 1 and the contact persons of this case mentioned that it worked great. This does not mean that it will work every time but it creates a structured moment for having discussions, that are already taking place in practice. Besides this, it should be considered that it could be flexible for each project. For example, for smaller projects, one round is possibly enough and for bigger projects, three or four rounds could be needed (seen in case 1 with 4 rounds). Coming back to the loop, all the work that the contractor does should be reviewed by the client, as is shown in purple in the model.

As for the magnifying glass, this shows the three different situations to calculate the costs of the project (pricing techniques used). In cases 1 and 3, it was seen that it started with the SSK-systematic and ended with the same systematic. As for case 2, it started with the RAW-systematic and ended with it. As for case 4, it started with the SSK-systematic and ended with the RAW-systematic. It is situation dependent which option is chosen but the experts note that the SSK-systematic from start to end is the most used and most applicable for the Bouwteam. Nevertheless, in all three situations, it is common practice that the costs are estimated in the earlier stages of the Bouwteam and calculated in the later stages, as more information becomes available and thus fewer risks and uncertainties.

Outside of the main loop, some other processes are happening. As can be seen on the left side of the loop, design methods can be used for the designing process, as is already happening in practice.

Besides this, the design log, unit prices and quotes of the subcontractors are included. As can be seen in the model, a box is put around these three blocks and connected with the ‘open-book’ block. This refers to the open-book principle and the transparency that the experts talked about, which is important for the Bouwteam cooperation itself but also for the price formation. This also holds for the cost estimations and calculations that are made by the contractor.

Looking at the right side of the loop, one of the hardest but also an important part of the price formation is visualised, the risk distribution and allocation. As shown in the ‘risk distribution’ block, explained at the end of Section 4.3, this connects to the cost calculations because the distribution and the risk allocation/estimation influences the price that is determined. This is continuously linked with the risk register and as mentioned by the experts, to be kept updated throughout the whole Bouwteam phase actively and not only with (a couple of) risk sessions. The risk register and distribution should be always connected. For example, if a risk is mitigated, it could affect the distribution and thus also the costs of it. Lastly, which is important to note, for the risk distribution it is not necessary to make use of all four parts of the sliding model. The sliding model was proposed by an expert and supported by the other experts but also with in mind that, for example, for some projects, a joint risk pot is not needed because of little to no risks or uncertainties. It is situationally dependent and therefore, it is mentioned to start with identifying the risks and its control measures and after that, it could be investigated if the second, third or fourth part of the sliding model is needed. As the experts state, the risk distribution should be done together by the client and contractor.

Lastly, the contract formation phase, or as some call it the price negotiation phase. It is important that with the final assessment, the contractor and client are already mostly in line when it comes to the price. As the experts advise, the contract formation phase (for the realisation phase) should be used to make the last alignments and give the possibility for the recalibration of the markup ‘AKWR’ percentages. The experts state that if big and important discussions (adversarial) arise in this phase of the Bouwteam, it is most of the time because of something that did not go well during the earlier phases. Nevertheless, the Bouwteam ends with the price of execution agreement if the client accepts the price of the contractor. On the contrary, if it is rejected, a new tender could be started and the work done by the contractor during the Bouwteam phase could be used for this. However, as all experts state, this should not happen and is not wished by the contractor or client.

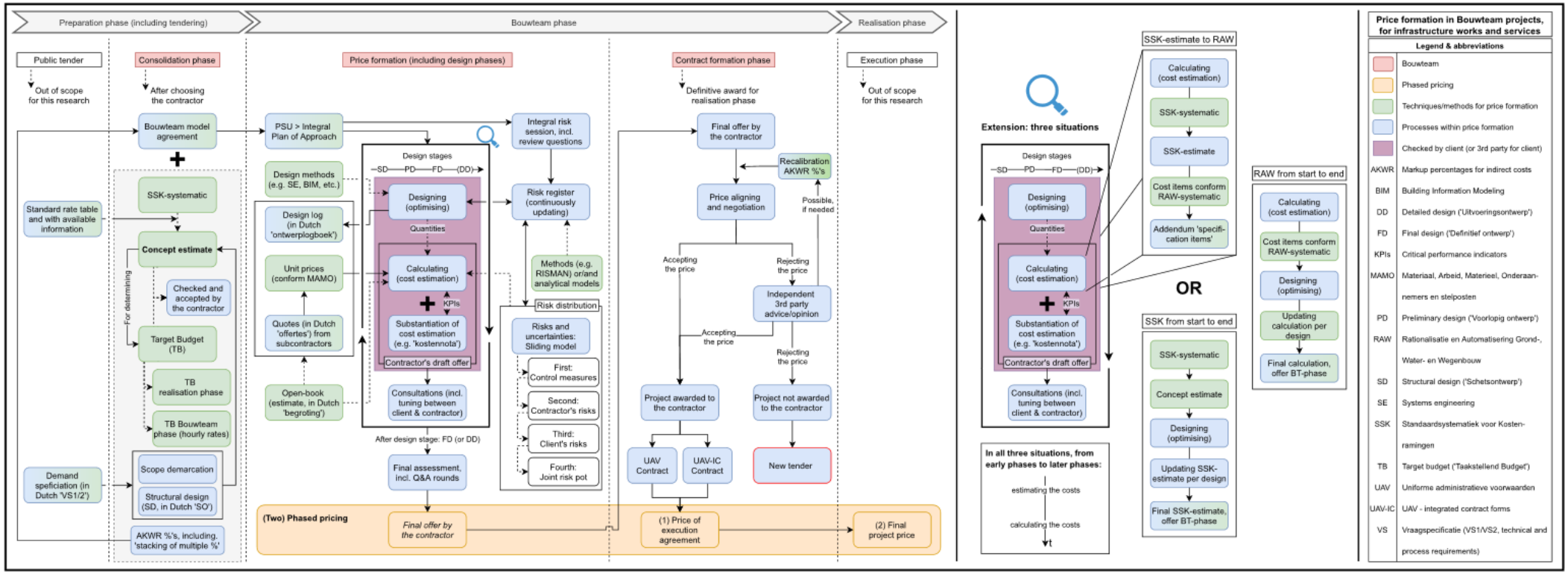

Figure 10: Generic model price formation (final framework).

5. Discussion

This section discusses the results of the case study and interviews, including the generic model. This is followed by noting the limitations of the research.

5.1. Discussions of results

The findings of the research resulted in a suggestion for the price formation (process) in a Bouwteam, which is visually shown in a generic (flowchart) model. All of this is based on a literature review, a case study and semi-structured interviews but there are still points of discussion. As several experts pointed out, determining the costs of a project is not a science. For example: "If ten people determine the price for a project, ten times something different will come out."[15]. Therefore, the suggestion for the price formation, shown in the generic model in Section 4.5, should be considered as a guideline or tool for further Bouwteam projects and not as something that must be followed by the parties.

Firstly, in the consolidation phase, it is advised to include the possibility of stacking multiple markup percentages (AKWR) in the Bouwteam model agreement as an article. Together with the recalibration of the markup percentages in the contract formation phase, it is assumed by some experts that this problem can be tackled. However, it is noted by several experts that this phenomenon is common practice, and no changes are made to this day. The reason it has become a topic of discussion is because of the use of open-book principle, which reveals this problem more clearly. This goes along with the problem that the ingrained mistrust in the sector will not go away (Boijens, 2008; Sewalt, 2019; Van Riggelen, 2019), which is not beneficial for the discussion about the markup percentages and especially not when this is included in the Bouwteam model agreement (Lagemaat, 2015) and recalibrated at the end of the Bouwteam.

Secondly, it is unclear if the use of a certain Bouwteam model agreement influences the price formation. In Section 2.2, the differences between the three known model agreements were highlighted. For example, the 1992 model required an explanation on which costs were included in the markup percentages, which is in line with one of the experts saying that the flat percentages should be substantiated more than how it is currently done. On the other hand, the 2020 model includes the risk register in more detail and better than the other models. This seems to be helpful for the Bouwteam and its price formation because all the experts noted that determining the risks and the costs of it are one of the hardest parts of the project. Also, the 2020 model included cyclical cost management during the Bouwteam phase, which is the basis for the generic model proposed by the researcher. Shortly, it seems that the 2020 model is more in line with the proposed generic model than the 1992 and 2021 models. However, this does not mean that the 2020 model should be chosen and be paired with the generic model of this research because there is no clear evidence if one of the model agreements results in a better price formation or not. Also, as was mentioned, there are derivatives of these models and it is unknown how these are set up and what their content is, and what this means for the Bouwteam but especially for the price formation (process).

Thirdly, a lot has been recommended regarding the budget, which is linked to the concept estimate and the target budget. As was seen in the interviews, the opinions of the experts are divided on if a target budget or ceiling price should be used for a Bouwteam, which is also seen in the study of Riggelen (2019). The middle ground was found by the researcher by recommending a target budget without being too noncommittal and thus creating urgency for the contractor to stay within the budget as is done with a ceiling price. Also, it is advised to support this budget with a concept estimate. This raises several questions and the most important are if the client wants to make their concept estimate

[15] From interview with expert 1, see Section 3.2.1.

(and thus information) available to the contractor and if this information is made available to all tenderers because of possibly sensitive information. To tackle this situation, it was proposed to leave out the sensitive information in the concept estimate and only make the concept estimate available for the contractor that has been chosen for the Bouwteam. However, since this idea has not been discussed with anyone from the client, it is currently unknown if this is something that could be applied. As it stands, the client makes these decisions, and it is not researched what this means for the legal aspects of the procurement and tendering phase. Besides the target budget for the realisation phase, a target budget based on hourly rates was included for the Bouwteam phase. As is noted by the experts, the contractors tend to include profit margins in their unit prices, which begs the question if this could be the same case with the hourly rates and if so, how this is going to be managed and monitored. Also, the existing difference between the hourly rates of the contractor and consultant is becoming more apparent (Boes, personal communication, 2021)[16] and therefore a potential cause for discussions. The use of hourly rates could also influence the target budget of the realisation phase, which is determined by the contractor but is unclear to what extent this would affect it.

Lastly, a risk distribution was proposed, including the use of a risk pot. With this concept, it is not needed to use all four parts of the sliding model. For example, it could be the case that a joint risk pot is not needed because of the low risks of a project. Ultimately, all of this should be jointly determined by the contractor and client. However, this concept is not fully developed, and it is still unclear if this is the right solution for the allocation and estimation of risks. As is mentioned by most of the experts, determining and distributing the risks is not that straightforward. Besides this, it seems that the client (Rijkswaterstaat) has a different opinion and idea about this topic since they propose their own 'risk buffer' concept with their two-phase contract. The experts' opinion about this risk buffer is not positive and they even find it contradictory to the Bouwteam concept.

5.2. Limitations

The proposed generic model for the price formation is supported by literature, four cases and eight semi-structured interviews. However, there are still some limitations to this research. Firstly, it should be noted that all four cases were from the database of the company W+B. Besides this, the four cases differ in the type of project and price range. Also, in some cases, the availability of data was more for some projects than others. All of this considered, it can be said that all the data is from the same organisational environment, and it could be the case that the current practice in the sector is not fully captured in this research. Therefore, further research in different organisations and cases is required.

Secondly, as was said, determining the price of a project is not a science. Each expert has a different opinion on what the correct way is on certain topics, which sometimes does not result in a clear solution, for example with risks and its distribution. Also, the experts for the interviews were all from W+B. This means that the data is mainly from the consultant perspective and not the contractor' or client's perspective, which are the main parties of a Bouwteam. In this research, a couple of conversations were held with the client and contractor. However, these conversations were used as pilot interviews and not part of the data collection for the development of the generic model. Also, it is out of proportion compared to the eight experts because only one contractor and two clients were contacted for the conversations. So, in further research, the client and contractor should be more part of the research.

Lastly, price formation is not a science and as mentioned by the experts, soft characteristics still do play a role in the price formation (Nader, 2019; Van der Pas, 2021), which is hard to measure (Van

[16] Also mentioned by experts at a congress (2021, November 25). *Game Changers congress Duurzaam Gebouwd:* https://www.gamechangerscongres.nl/nieuws/20211130-het-bouwteam-als-vehikel-voor-betrouwbaarheid-1

Riggelen, 2019). So, it is hard to come up with one clear solution and it is only possible to cross out the bad possibilities, as attempted in this study.

6. Conclusion and recommendations

In this section, the main question is answered, and recommendations are given for further research.

6.1. Conclusion

The study tried to find an answer on how the contractor and client can set up the price formation, in which both would agree on the price of execution agreement, for infrastructure works and services during a Bouwteam cooperation. This is done by first documenting the current price formation (process) and combining the opinions of the experts. The result is a generic (flowchart) model for the price formation, see Figure 10, which is also the answer to the main question of this research.

To sum up, the research draws the following main conclusions:

- Provide a concept estimate for the start of the Bouwteam, using the SSK-systematic;
- Price formation should be a continuous process, with checkpoints linked to design phases;
- Better substantiation of cost estimates/calculations, also showing difference per design phase;
- Involving (construction) cost experts as soon as possible in Bouwteam (organisational aspect);
- Subcontractors' quotes must become more part of the conversation, especially content-wise.

To conclude, negotiating should not be seen as something negative but as a tool to keep each other sharp and honest. Ultimately, transparency is important to maintain trust within the Bouwteam, resulting in a good feeling and confidence in the price formation and the final price.

6.2. Future research

First, the presented generic model should be compared with other Bouwteam projects, which are both similar and different infrastructure projects as seen in the case study of this research. The verification and validation of this model, which should be done in a different organisational context, could provide useful insights towards the soundness and generalisability of this research. Also, if possible, implemented and used for Bouwteam projects in their preparation phase. The generic model should be used as a guideline or tool, in which partners should be found to go through a real-life project. This can be started on a small scale and the results can be used as a practical validation for the model.

Secondly, further research should study what the influence is of a chosen Bouwteam model agreement on the price formation. In this study, the derivatives of these model agreements should be considered. Lastly, it is important to note that a qualitative study is done for a quantitative matter as the topic is about monetary value. In the interviews, claims have been made that a Bouwteam could result in a lower project cost or that time and cost overruns are (partly) prevented. However, if it is possible, it should be researched if this is the case by comparing similar (infrastructure) projects that have been completed in the traditional way (contract) and with a Bouwteam approach. This could give insights into if the price formation done in a Bouwteam leads to a better price.

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Appendix

This section contains appendixes.

Appendix A – Setting up and validating a conceptual model

Verschuren & Doorewaard (2010) is used for setting up the conceptual models, which is as follows.

Step-by-step plan (quoted from the appendix of Verschuren & Doorewaard (2010)):

1. "Determine in a theory-oriented project the variable Y that needs a causal explanation, and, in a practice-oriented project, depict the variable Y that needs to be improved (= the dependent variable).";
2. "Determine or derive from literature a variable X which presumably has a strong effect on Y (= the independent variable).";
3. "Determine whether there is one or more variable(s) P, (Q, R) that has/have an additional influence on Y, apart from variable X (= additional independent variables).";
4. "Determine - when appropriate - whether there is/are one or more variable(s) U (V,W) that as (an) intervening variable(s) make(s) part of the effect that X and eventually P,Q,R has/have on Y.";

"The result of these four steps is the *generic conceptual model."*

5. "Carry out a literature study in order to determine which variables there are within the domain of each of the core concepts of the generic conceptual model.";
6. "Select, by means of preliminary research/ from the variables that resulted from Step 5, which of them will be included in the project. The result of these steps is the *specific conceptual model.";*

"After having reduced the size and the complexity of the generic conceptual model in a specific conceptual model, you determine in Steps 7, 8 and 9 which of the other effects should be included in the conceptual model."

7. "Determine - when appropriate - which core concept(s) *Z* should be added to the model having an interaction effect. Add these variables and the appropriate arrows to the model.";
8. "Determine - when appropriate - which core concepts) should be added to the model, having a direct and/or indirect feedback effect. Add these variables and the appropriate arrows to the model.";
9. "Verify - when appropriate - whether confounding factors exist which may cause a spurious correlation. The proper way to do this is to verify, for each relationship in the conceptual model, whether there is another variable which has a strong effect on both variables that are involved in the relationship. Add this confounding variable to the model.";
10. "Formulate the assumed causal relationships (= hypotheses and/or expectations) between the variables in the model and add the symbols [+] and [-] to the arrows in the specific conceptual model. Note that if both or one of these variables is of a nominal order, one cannot indicate the direction of the relationship.".

As part of the case study, steps 1 till 4 are performed before analysing the cases (projects). It is assumed that this is possible with the preliminary research that already has been done. After the cases are analysed, steps 5 till 10 follows. By completing each step, the two conceptual models are set up. With these findings, the interview phase is started and during the first part of the interview, the elements of the conceptual models are verified (especially steps 7 till 10) and validated with the help of the experts.

Lastly, there are no conceptual models of the price formation, of the Bouwteam or other contracts, in the literature which can be used to validate the conceptual models that are created during the research. Therefore, experts in the field are approached and asked. The reliability and validity of the conceptual models depend on the researcher's understanding of the topic and the input of the experts (Verschuren & Doorewaard, 2010), which are the interviewees in this research.

Appendix B – Selection criteria for data collection methods

In this appendix, the selection criteria for the used data collection methods are reported.

Appendix B.1 – Desk and literature research

The following criteria hold for collecting information with desk and literature research:

- Academic website sources such as Web of Science, Scopus, Emerald, Research Gate etc.;
- From university repositories, such as TU Delft and the University of Twente;
- Keywords: Bouwteam, ECI, price formation, price determination, phased pricing, execution price, pricing approaches, risk estimation/allocation, model agreement, design phases;
- Try to avoid older articles/studies, search for as recent as possible;
- Other reliable sources such as Cobouw.

Appendix B.2 – Conversations

The selection criteria for the participants of the conversations were:

- Exploratory conversation (a form of a semi-structured interview since the subject are known but there is the possibility that the knowledge acquired till this phase is still limited;
- Duration of the conversation should last between 45-60 minutes;
- The findings from the conversations should form a basis for understanding the price formation, which could be used during the document analysis and validate the conceptual framework;
- Participants can be experts from outside the W+B company;
- Participants have experience with Bouwteam (or similar type of project, e.g. two-phase);
- Participants have experience with price formation (process) and phased pricing;
- Conversations are done online because of the pandemic.

Appendix B.3 – Case study

The selection criteria for the cases were:

- Bouwteam project or similar to, such as two-phase model variation of ECI. The projects should also be the type of infrastructure works and services;
- There is no focus on one specific type of project within infrastructure works and services (e.g. road construction) since this makes it easier to find the required number of cases;
- The case should include both parties (perspectives), contractor and client;
- Complete price formation (process) including the execution agreement price, which can be completely analysed;
- Based on the available cases, select projects which are the most recently completed since this will be the closest representation of the current practice;
- Contract(s) and documents (e.g. evaluation report) regarding the projects should be available;
- Contact persons or project managers/leaders of the cases should be available to contact for the interviews, questionnaires and validation of the conceptual models.

Appendix B.4 – Interviews

The selection criteria for the interviews were:

- Semi-structured interviews since the subject are known but there is the possibility that the knowledge acquired till this phase is still limited;
- Duration of the interviews should last between 45-60 minutes;
- The findings from the interviews should answer sub-questions 1 till 5 (of the research);
- Interviewees are experts from the company W+B;
- Interviewees have experience with Bouwteam (or similar type of project, e.g. two-phase);
- Interviewees have experience with price formation (process) and phased pricing;
- Interviews are done online because of the pandemic, if possible, at the office.

Appendix C – Conversation setup and questions (in Dutch)

This section contains the setup for the conversations. The setup is used as a guideline for the conversations. The rest of the setup and questions are in Dutch.

1. Opening – 5 minuten

De volgende punten zijn besproken:

- Introductie van onderzoeker;
- Vorm van gesprek = semi gestructureerd interview;
- Vragen toestemming voor het opnemen.

Voordat ik verder over het onderzoek vertel, mogelijkheid geven om introductie te geven

- Wat is uw ervaring met Bouwteam?
- Wat voor functies heeft u in een Bouwteam project gevuld?

2. Doel – 5 minuten

De prijsvorming binnen het Bouwteam is het hoofdonderwerp waar ik naar onderzoek doe. Uit praktijk blijkt dat er (later) in het Bouwteam discussies ontstaan over de prijzen en hoe de prijzen zijn opgesteld. Hierbij worden de prijzen meer onderhandelt dan afgestemd, wat niet de bedoeling is met de samenwerking binnen het Bouwteam. Dit heeft ook deels te maken met het openboek principe.

Om de oorzaken van de discussies te kunnen vinden, wil ik eerst met de verschillende cases een conceptueel model maken van de prijsvorming binnen het Bouwteam (van beide kanten, OP en ON). In dit model wil ik de gebruikte technieken (de raming methode(s)) en processen bepalen en dit documenteren door ook een flowchart van te maken. Dit model zal ik dan met behulp van interviews valideren en verder navragen. Uiteindelijk is het de bedoeling dat ik de verschillende tekortkomingen/uitdagingen kan vinden van de prijsvorming van de OG en ON. Zo hoop ik de oorzaken van de discussies te kunnen vinden.

Hoofdvraag: *Hoe kunnen de opdrachtnemer en de opdrachtgever de prijsvorming, waarin beiden eens zijn over de prijs van uitvoeringsovereenkomst, voor infrastructurele werken en diensten opzetten tijdens een Bouwteam-samenwerking?*

De volgende visualisaties laten zien:

- Onderzoeksopzet;
- Conceptueel framework.

3. Vragen – 45 minuten

Verdeeld in drie onderdelen.

3.1. Onderdeel 1 – Valideren van conceptueel framework

Vragen over conceptueel framework:

- Kunt u zich vinden in de vijf groepen, en de sub-onderwerpen, voor de prijsvorming?
    a. Onduidelijkheden;
    b. Toevoegingen;
    c. Veranderingen.

3.2. Onderdeel 2 – Prijsvorming

Techniek: ramingsmethodieken: Standaarden of methoden die gebruikt worden om de prijzen te bepalen.

Processen: Processen die behoren bij de gebruikte technieken, dus dingen zoals manier van werken, afstemming, afspraken en communicatie met tegen partij, vastleggingen van prijswijzigingen.

Vinden van de technieken en processen die gebruikt worden met de prijsvorming:

- SSK is bijvoorbeeld één van de bekende technieken die gebruikt wordt, zijn er andere technieken die gebruikt worden die u weet uit ervaringen?
    - Voor- en nadelen, discussiepunten.
- Welke processen ziet u vooral in Bouwteam projecten uit uw eigen ervaring?
    - Voor- en nadelen, discussiepunten.
- Wat wordt wel en niet meegenomen in de raming, en in hoeverre detail?
- Is een taakstellend budget nog relevant met een Bouwteam?
- Waar lopen jullie als partij tegen aan, met de gebruikte technieken of processen?

Testen van de aanname, zie Sectie 2.7.:

- Uit eigen ervaring, welke prijsbenadering wordt er gebruikt in een Bouwteam van de aangegeven zes?
    - Cost, market, standard-rate table, historical, subcontractors' bids and cover price.

Uitzoeken welke aspecten en factoren meegenomen moeten worden met de prijsvorming:

- Wat zijn de belangrijkste elementen/punten die meegenomen moeten worden door de opdrachtgever tijdens de prijsvorming?
    - Denk aan essentiële stappen en randvoorwaarden voor de prijsvorming;
    - Uitgangspunten voor prijs variabelen.

De verschillende ontwerpfases en onderhandelingsfase in de gefaseerde prijsstelling:

- Hoe spelen de verschillende ontwerpfases een rol in de prijsvorming?
- Hoe is de prijsvorming proces in combinatie met de ontwerpfases gemanaged?
- Wat zijn discussiepunten die jullie met dit onderwerp meemaken?
- Waar lopen jullie als partij tegen aan, wat betreft dit onderwerp?

Uitzoeken hoe risico's en onzekerheden toegewezen en geschat worden:

- Hoe worden risico's en onzekerheden heden vastgesteld?
    - Intuïtief of analytische modellen?
- Hoe worden er prijzen gehangen aan de risico's?
- Is er met dit ontwerp discussiepunten?
- Waar lopen jullie als partij tegen aan, wat betreft risico's en onzekerheden?

Uitzoeken hoe open-boek wordt gebruikt en toegepast:

- Wat verstaat u als OG/ON wat betreft open-boek?
- Hoe wordt de verplichting van open-boek toegepast?
- Hoe wordt de prijs met open-boek bewaakt/gemonitord?
- Zijn er discussiepunten met het gebruik van open-boek?
- Waar lopen jullie als partij tegen aan, wat betreft dit onderwerp?

3.3. Onderdeel 3 – Lessen geleerd en aanbevelingen

Lessen die geleerd zijn:

- Positieve punten
- Negatieve punten

Aanbevelingen voor de prijsvorming in toekomstige Bouwteam projecten:

- Voor de opdrachtgever
- Voor de opdrachtnemer
- Als samenvattende en terugkomende op de titel van de thesis, wat is uw ervaringen met dat de prijzen onderhandelt worden i.p.v. afgestemd? Klopt dit, zo ja, wat betekent dit?

4. Laatste opmerkingen – 1 à 2 minuten

Mogelijkheid geven aan geïnterviewde voor haar/zijn laatste gedachten.

5. Feedback – 1 à 2 minuten

Feedback van geïnterviewde aan de interviewer, wat betreft:

- Inhoud, opzet, tips (voor volgende interview/keer) en tops.

6. Afsluiten – 1 minuut

Graag wil ik u bedanken voor uw tijd. Als u de transcriptie van dit interview wilt ontvangen, kunnen we dit per e-mail aan u schaven. Als er vragen zijn kunt u ze nu stellen of anders per e-mail als u later nog vragen heeft.

Appendix D – Interview setup and questions (in Dutch)

This section contains the setup for the interviews with (eight) W+B employees. The setup is used as a guideline for the interviews. The interviews will last approximately one hour and take place via Microsoft Teams (due to COVID-19 measures). The rest of the setup and questions are in Dutch.

1. Opening – 5 minuten

Tijdens de opening worden de volgende punten besproken:

- Vragen van toestemming voor het opnemen (audio en/of video);
- Introductie interviewer (afstudeerder), het interview en onderwerp/titel afstudeeronderzoek;
    - Onderdelen interview:
        1. Vragen over prijsvorming, verdeeld in groepen;
        2. Geleerde lessen en aanbevelingen, samenvattend;
        3. Vragenlijst, opsturen na het interview.
- Mogelijkheid geven voor de geïnterviewde om haarzelf/zichzelf te introduceren:
    - Vragen naar ervaring met Bouwteams en welke rollen ze hebben vervuld;
    - Vragen naar ervaring met prijsvorming.

2. Doel – 5 minuten

Het vinden van de oorzaken van de discussies, die zich plaatsvinden tijdens de prijsvorming binnen Bouwteams. Hierbij wordt er gekeken naar de technieken/methodes en procesessen van de prijsvorming. De hoofdvraag is als volgt:

Hoofdvraag: *Hoe kunnen de opdrachtnemer en de opdrachtgever de prijsvorming, waarin beiden eens zijn over de prijs van uitvoeringsovereenkomst, voor infrastructurele werken en diensten opzetten tijdens een Bouwteam-samenwerking?*

De volgende visualisaties laten zien, met een korte toelichting:

- Onderzoek aanpak → te veel vragen dus verdeeld in twee: interview en vragenlijst;
- Literatuur/theoretische framework;
- Canvas conceptueel model → Vermelden van definitieve framework (generieke model);
- Voorbeeld prijsvorming interacties, case 4 inclusief visualisaties in dit geval.

3. Vragen – 45 minuten

De vragen, van onderdeel 1, zullen gaan over de volgende vijf groepen:

1. Startpunt van de prijsvorming;
2. Ontwerpen, structuur ontwerpfases en hoeveelheden;
3. Instrumenten gebruikt worden voor de prijsvorming;
4. Risico's en onzekerheden;
5. Discussies en prijsafstemming.

3.1. Onderdeel 1 – Hoofdvragen prijsvorming (35 minuten)

Introductie en uitleg van de vijf groepen en sub-onderwerpen ervan. Dan overgaan naar vragen:

2. Kunt u zich vinden in de vijf groepen, en de sub-onderwerpen, voor de prijsvorming?
    a. Onduidelijkheden;
    b. Toevoegingen;
    c. Veranderingen.
3. Welke van de vijf groepen zijn naar uw mening meest essentieel voor de prijsvorming, waar moet de meeste aandacht aan gegeven worden?
    a. Volgorde, indien mogelijk, van meest belangrijk tot minst en waarom.

4. Wat zijn de (belangrijkste) verbanden/relaties tussen de vijf groepen en waarom?
5. Waar zitten de belangrijkste discussies of spanningsvelden, met betrekking tot de prijsvorming, in het Bouwteam?
    a. Is dit te categoriseren in één of meerdere van de vijf groepen?
    b. Zo ja, in welk van de vijf groepen komen de meeste discussies naar voren en waarom?

Testen van de aanname (prijsbenaderingen):

- Aanname: "De meeste prijsbenaderingen van projecten zijn 'cost-based', oftewel het calculeren van de kosten met een mark-up (percentage) voor winst. Echter is er uit de vier gestudeerde cases de volgende prijsbenaderingen naar voren gekomen:
    i. Cost-based: Calculeren van kosten met mark-up voor winst
    ii. Market-based: Prijzen baseren op marktconformiteit
    iii. Subcontractors' bids-based: Gebaseerd op offertes van onderaannemers

6. Wat is uw mening over de bevindingen van de casussen, komt dit overeen met uw ervaring en kennis?
7. Wat zijn de aandachtspunten, en waarom, als je gebruik maakt van deze (verschillende) prijsbenaderingen?
8. Is het voor de prijsvorming problematisch (kan het discussies opleveren) dat er verschillende prijsbenaderingen gebruikt worden?
    a. Zo ja, hoe en waarom?
    b. Zo nee, waarom niet?

9. Hoe kan je de risico's(beheersing) het beste verdelen, wat ten gunste zal zijn voor de prijsvorming, en wat zal dit betekenen voor de prijsvorming?
    a. Tot welke niveau in de raming moeten de risico's en onzekerheden opgenomen worden en wie moet daarvoor aansprakelijk en verantwoordelijk zijn?
10. Wanneer zijn jullie, de OG en ON, eens over de prijs van uitvoeringsovereenkomst tijdens de prijsafstemming?
    a. Is dat bijvoorbeeld, voor de prijs, bij een bepaald verschil in 'x' percentage?
    b. Als jullie niet eens zijn, hoe kan je het beste eruit komen (inzet onafhankelijke kostendeskundige)? Hoe zet je een escalatiefase het beste in?
11. In hoeverre en hoe beïnvloedt de gekozen contractvorm, van de realisatiefase, de prijsvorming binnen het Bouwteam?

3.2. Onderdeel 2 – Geleerde lessen en aanbevelingen (10 minuten)

Vragen over de geleerde lessen, om alles kort samen te vatten:

12. Wat zijn, volgens uw ervaring, de positieve punten van de prijsvorming in Bouwteams?
13. Wat zijn, volgens uw ervaring, de negatieve punten van de prijsvorming in Bouwteam (als geheel) en dus de belangrijkste lessen voor in de toekomst?
14. Welke (specifieke) aanbevelingen wilt u meegeven aan de volgende partijen binnen het Bouwteam:
    a. Opdrachtgever;
    b. Opdrachtnemer.
15. Samenvattend en terugkomend op de titel van de thesis: Hoe zorgen we ervoor dat er meer afgestemd wordt in plaats van onderhandeld?

3.3. Onderdeel 3 – Survey

Opname zal teruggekeken worden, de vragen die al beantwoord zijn zullen uit de vragenlijst gehaald worden en de rest zal opgestuurd worden naar de geïnterviewde. De geïnterviewde kan dit dan zelf invullen en de ingevulde vragen checken. Daarna kan het teruggestuurd worden naar de interviewer.

4. Laatste opmerkingen – 1 à 2 minuten

Mogelijkheid geven aan geïnterviewde voor haar/zijn laatste gedachten.

5. Feedback – 1 à 2 minuten

Feedback van geïnterviewde aan de interviewer, wat betreft:

- Inhoud, opzet, tips (voor volgende interview/keer) en tops.

6. Afsluiting – 1 minuut

Bedanken voor haar/zijn tijd en aangeven dat ze van de interviewer de notities/transcriptie van het interview zullen krijgen ter verificatie.

Appendix E – Questionnaire (in Dutch)

Onderdeel 3 (van interview) - Specifieke vragen per onderdeel

1.1. Startpunt (strategie) prijsvorming

1. De prijs moet volgens de aanbestedingswet meegenomen worden, maar dit hoeft niet een vaste prijs te zijn (kortom, prijselement moet onderdeel zijn van de gunningscriteria). Hoe geef je hier tijdens de aanbesteding op een goede manier vorm aan, wat het beste zal zijn voor de prijsvorming in een Bouwteam, en waarom?
2. Welke onderdelen (of wat) moeten in ieder geval, voor de prijsvorming, aanwezig zijn met de start van de Bouwteamfase?
    a. In hoeverre is een concept raming belangrijk en nuttig (of ten goede) voor de prijsvorming (proces) in de Bouwteamfase?
3. Is een taakstellend budget (nog) relevant met een Bouwteam?
    a. Zo ja, waaruit zou het taakstellend budget moeten bestaan (in hoeverre in detail) en waarop zou het gebaseerd moeten zijn, en waarom?
    b. Zo nee, waarom niet?
4. Zou er gebruik gemaakt moeten worden van een plafondbedrag/budgetplafond (dit is anders dan taakstellend budget)?
    a. Zo ja, wanneer en waarom?
    b. Zo nee, waarom niet?
5. Heeft u opmerkingen over de vaststelling van de AKWR-percentages (staartkosten)?
    a. Hoe kan dit het beste vastgesteld worden, wat het beste zal zijn voor de prijsvorming en samenwerking?

1.2. Ontwerpen, structuur en hoeveelheden

6. De bouwteamfase kan gestart worden met ontwerpen in verschillende fases (bijv. SO, VO of DO). In hoeverre beïnvloedt dit de prijsvorming en hoe?
    a. Heeft het voorkeursalternatief daar nog een invloed op, en vooral hoe?
7. Welk ontwerp (DO/UO), tijdens het Bouwteam, is minimaal nodig voor een rationele prijs(vorming), en waarom (of maakt dat niet uit)?
8. Hoe geef je vorm aan de prijsvorming/prijsbeheersing tijdens de verschillende ontwerpfases in het Bouwteam, en waarom?
    a. Moet de prijsvorming achteraf of parallel met de verschillende ontwerpfases, waarom?
    b. Moeten de OG en ON, tijdens en aan het einde van het ontwerpen, samen de hoeveelhedenstaat vaststellen, en waarom?
9. Heeft u een mening over (meer gebruik van) andere ontwerpmethodieken, zoals parametrisch ontwerpen, BIM, Systems Engineering (SE) en dergelijke? Heeft dit of zal het invloed hebben op de (huidige) prijsvorming?
    a. Zo ja, hoe en waarom?
    b. Zo nee, waarom niet?

1.3. Instrumenten prijsvorming

10. Wordt het open-boek principe volledig benut, volgens uw ervaring, voor de bewaking/beheersing van de prijs?
    a. Zo ja, hoe?
    b. Zo nee, waarom niet?
11. In drie van de vier casussen is er gebruik gemaakt van SSK-ramingen. Ziet u de waarde hierin en zou het meer gebruikt kunnen/moeten worden?

   a. Zo ja, waarom en wanneer?
   b. Zo nee, waarom niet?
12. Wat bepaalt volgens u of een SSK-raming gebruikt zou moeten worden of niet?
13. Heeft u opmerkingen over instrumenten zoals RAW of gebruik van MAMO (materiaal, arbeid, materieel, onderaannemers en stelposten)?
   a. Heeft u in uw ervaring discussies gezien die te maken hebben met deze instrumenten?
14. Welke discussies ziet u vooral naar voren komen met het gebruik van offertes voor de onderbouwing van eenheidsprijzen?
15. Ziet u tekortkomingen in de huidige manier van toelichtingen op de ramingen/calculaties (onderbouwing per post, bijv. met een kostennota document)? Zo ja, waarin?

1.4. Risico's en onzekerheden: rol van risicodossier

16. Hoe kan het beste omgegaan worden met (onduidelijke) veranderingen in de scope (of punten dat zijn vergeten) wat betreft de prijsvorming?
17. Klopt het dat de meeste risico's en onzekerheden intuïtief (dus met de ervaring en impliciete kennis van de expert) worden bepaald (inclusief de kosten/prijzen ervan)?
   a. Zo ja, is dit een goede aanpak en waarom?
   b. Zo nee, hoe dan wel (zie ook volgende vragen)?
18. Wanneer moet er gebruikt gemaakt worden van analytische modellen (bijv. Monte-Carlo) met het bepalen van risico's en de kosten ervan?
19. Hoe belangrijk zijn (bekende) methodieken (bijv. RISMAN) voor het bepalen van risico's en hoe effectief is dit voor de prijsvorming, waarom?
20. Is een gezamenlijke risico-pot (risicoreservering) gewenst voor de prijsvorming?
   a. Zo ja, in welk situatie?
   b. Zo nee, waarom niet?
21. Wat weegt zwaarder voor de prijsvorming, objectieve of subjectieve risico's en waarom?
   a. Objectief: onzekerheden over areaal, oftewel tekort aan informatie.
   b. Subjectief: houding en gedrag + wederzijds afhankelijkheid.
22. Heeft u nog opmerkingen over aansprakelijkheid en verantwoordelijkheid van (het dragen van) risico's en onzekerheden? Komen hierin nog belangrijke discussies naar voren?

1.5. Discussies en prijsafstemming

23. In de casestudies is vooral gezien dat de OG de ON toetst en niet dat de beide partijen zelf ramen/calculeren en dit met elkaar vergelijken. Wat vindt u hiervan en wat betekent dit voor de prijsvorming?
24. Wordt er tijdens de overleggen (discussies), volgens uw mening en ervaring, de (eenheid)prijzen meer onderhandeld of afgestemd? En waarom denkt u?
25. Wat zijn de belangrijkste/meest voorkomende discussies tijdens de prijsvorming? (vervolg →)
26. Heeft u opmerkingen over discussies die kunnen ontstaan voor de volgende onderwerpen?
   a. Hoeveelheden (ontwerp).
   b. Staartkosten, AKWR-percentages, met onderaannemers in gedachte.
   c. Risico's en onzekerheden.
   d. Open-boek (begroting).
27. Tijdens de prijsafstemming wordt er vaak gekeken naar het verschil tussen de raming/budget van de OG en de aanbieding van de ON. Dit wordt meestal uitgedrukt in percentages en er zijn verschillende meningen over wat de maximale 'x'% verschil moet zijn voor het gunnen van het werk aan de ON. Hoe bepaal je dat en wat is volgens uw mening een geschikt percentage hiervoor, en waarom?

Appendix F – Conceptual models of case study

This appendix contains the visualisations of cases 1 to 4 (in Dutch). There are two visualisations per case: (1) project process in chronological order and (2) the interactions in the price formation (process).

Appendix F.1 – Case 1: Dike reinforcement

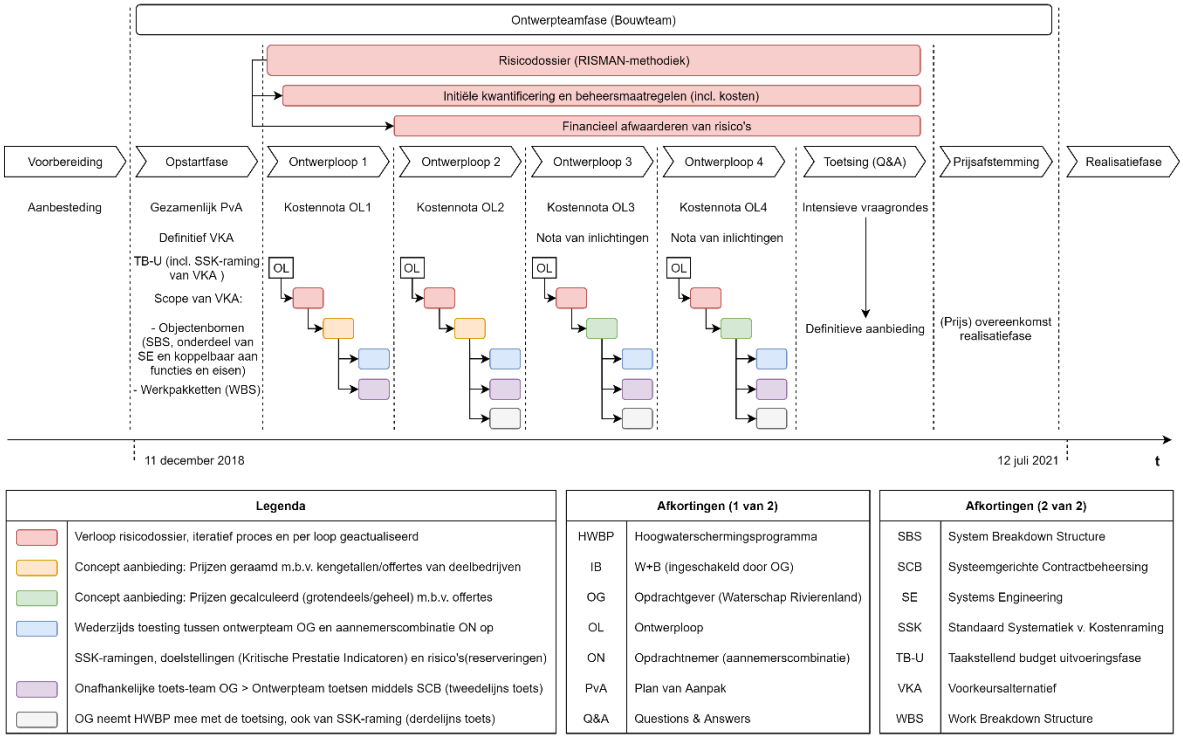

Figure F1: Project process case 1.

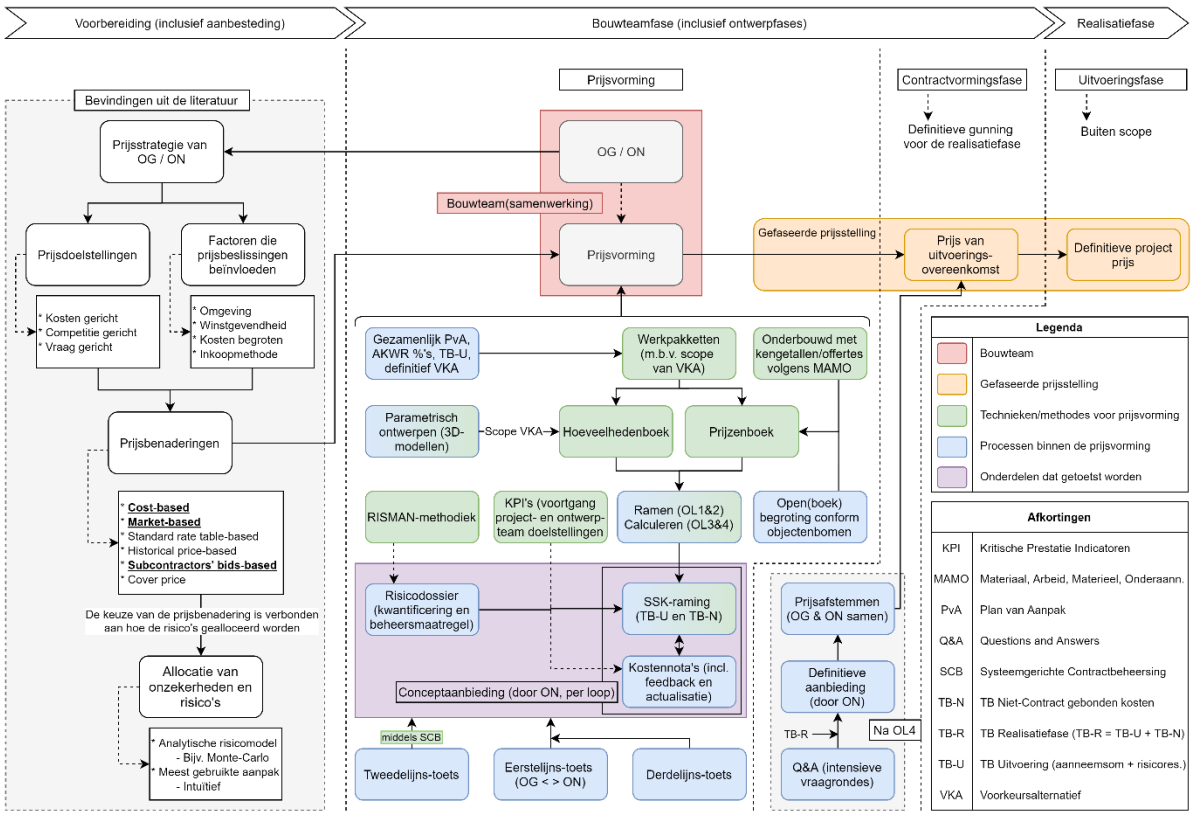

Figure F2: Price formation (process) interactions case 1.

Appendix F.2 – Case 2: Retaining walls (in Amsterdam)

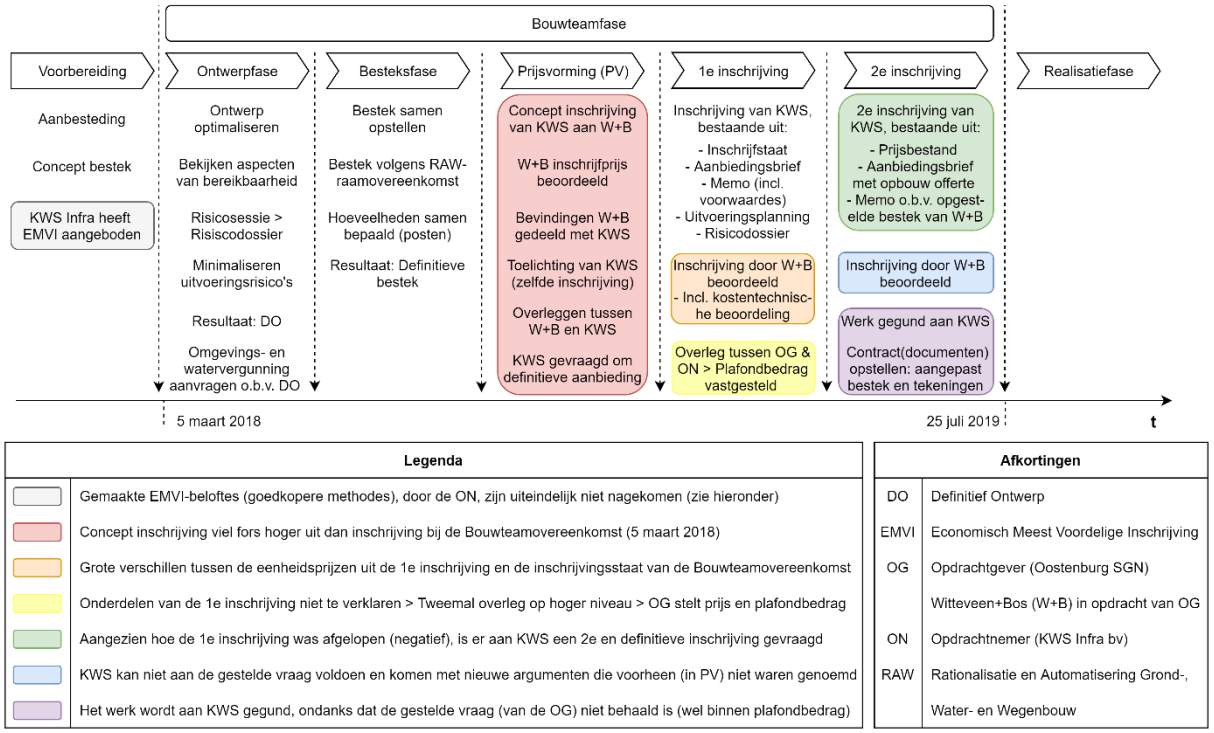

Figure F3: Project process case 2.

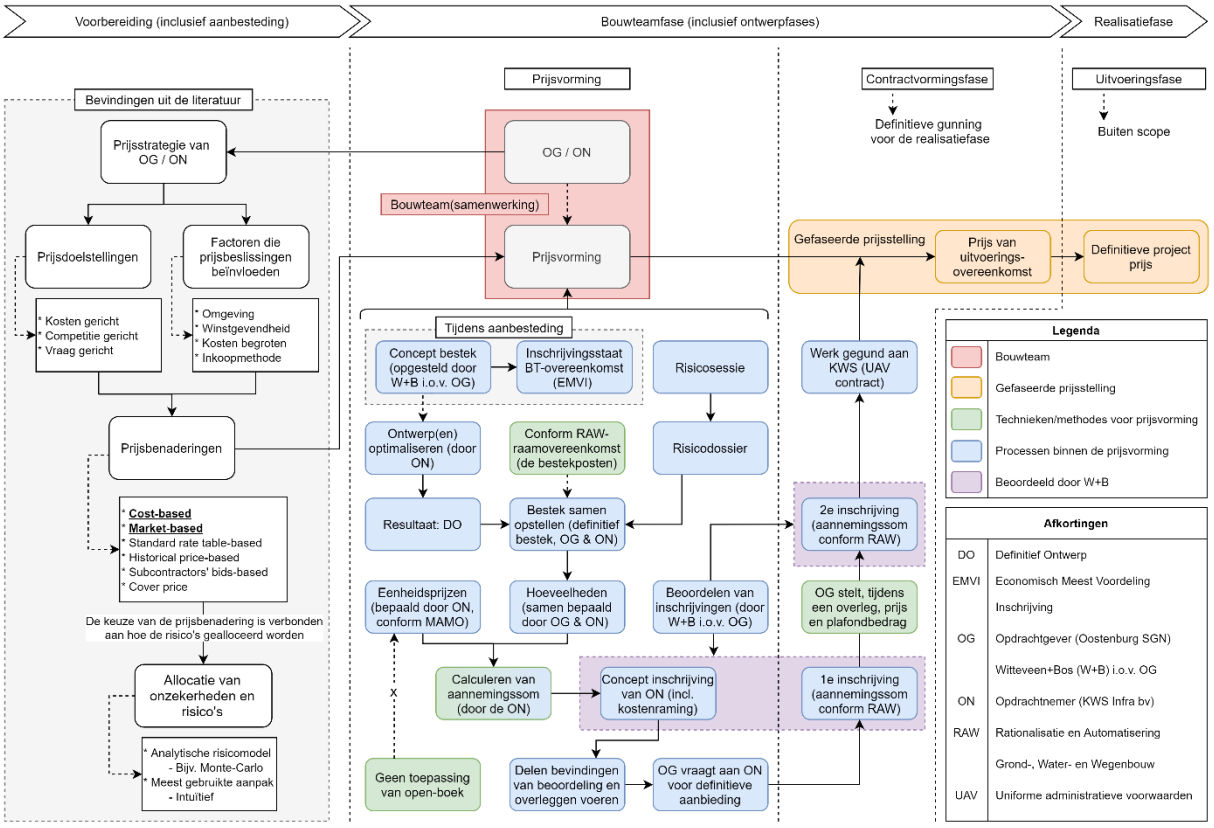

Figure F4: Price formation (process) interactions case 2.

Appendix F.3 – Case 3: Bicycle bridge (with a bio-based deck)

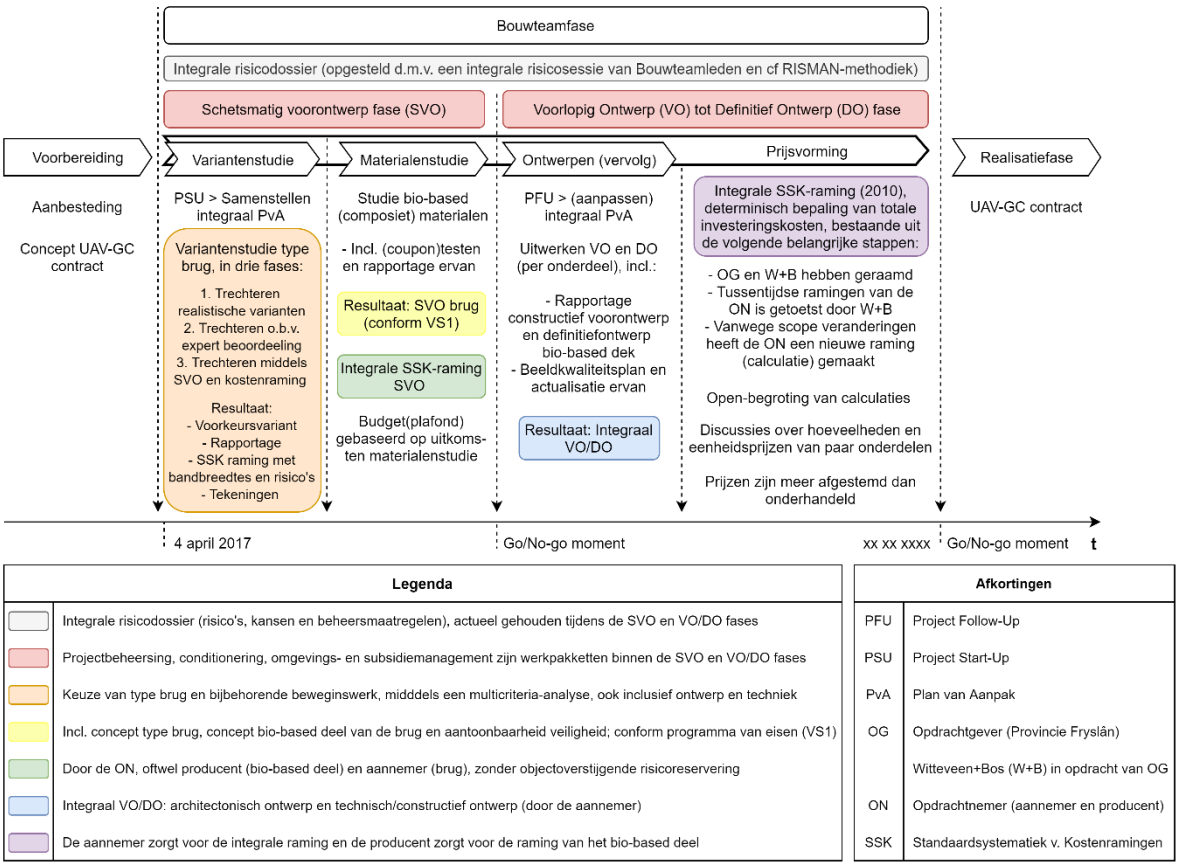

Figure F5: Project process case 3.

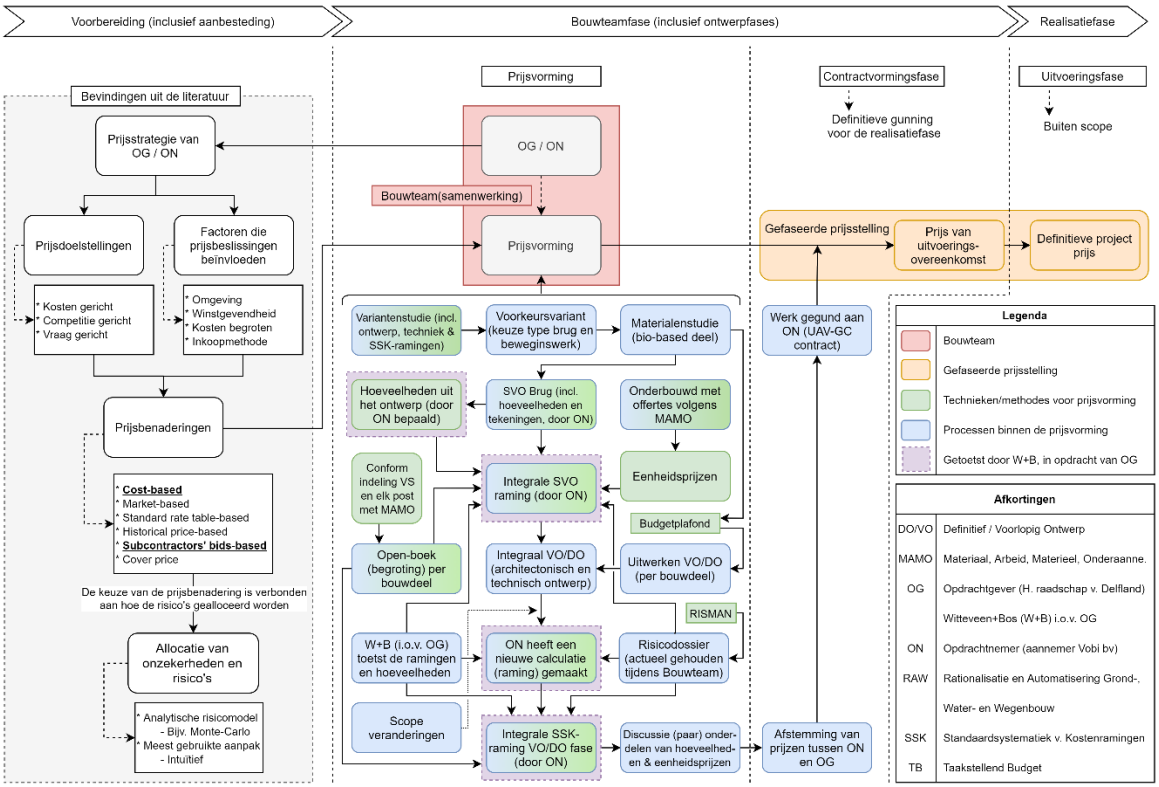

Figure F6: Price formation (process) interactions case 3.

Appendix F.4 – Case 4: Repair pipeline pumping station

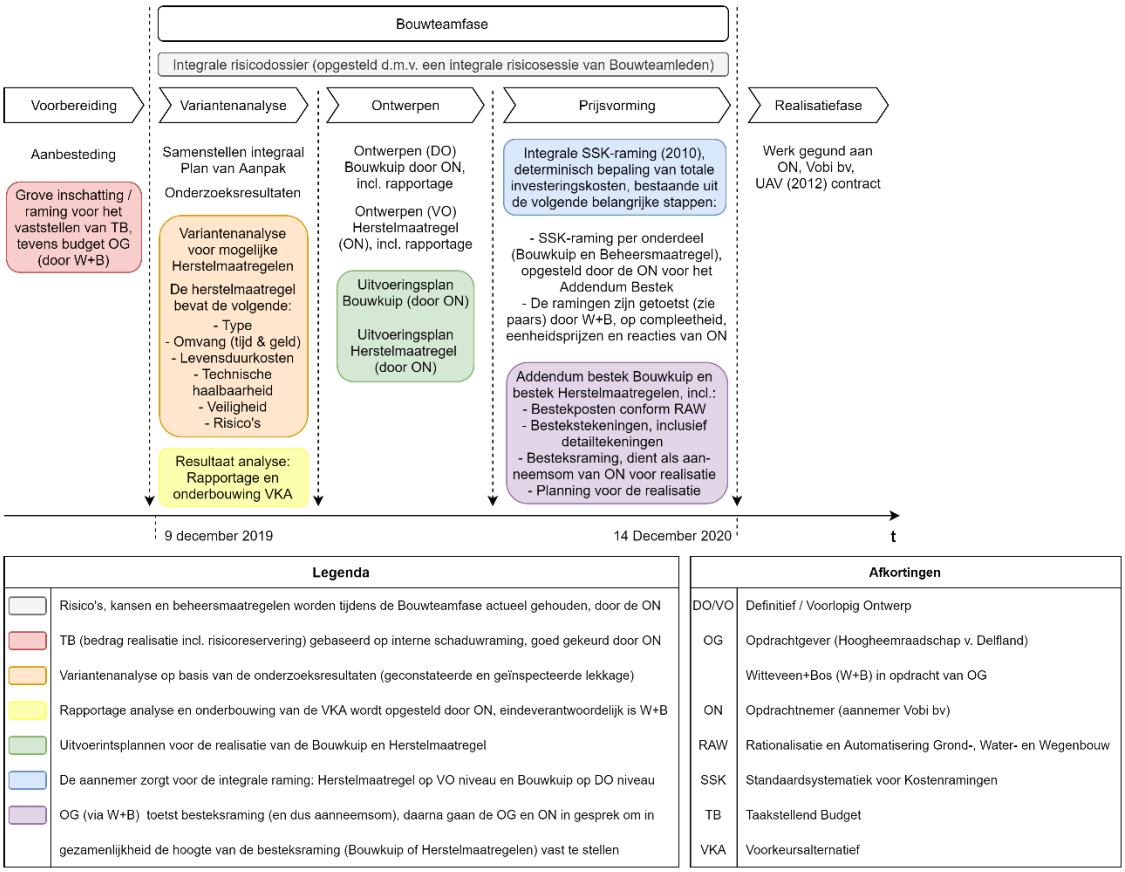

Figure F7: Project process case 4.

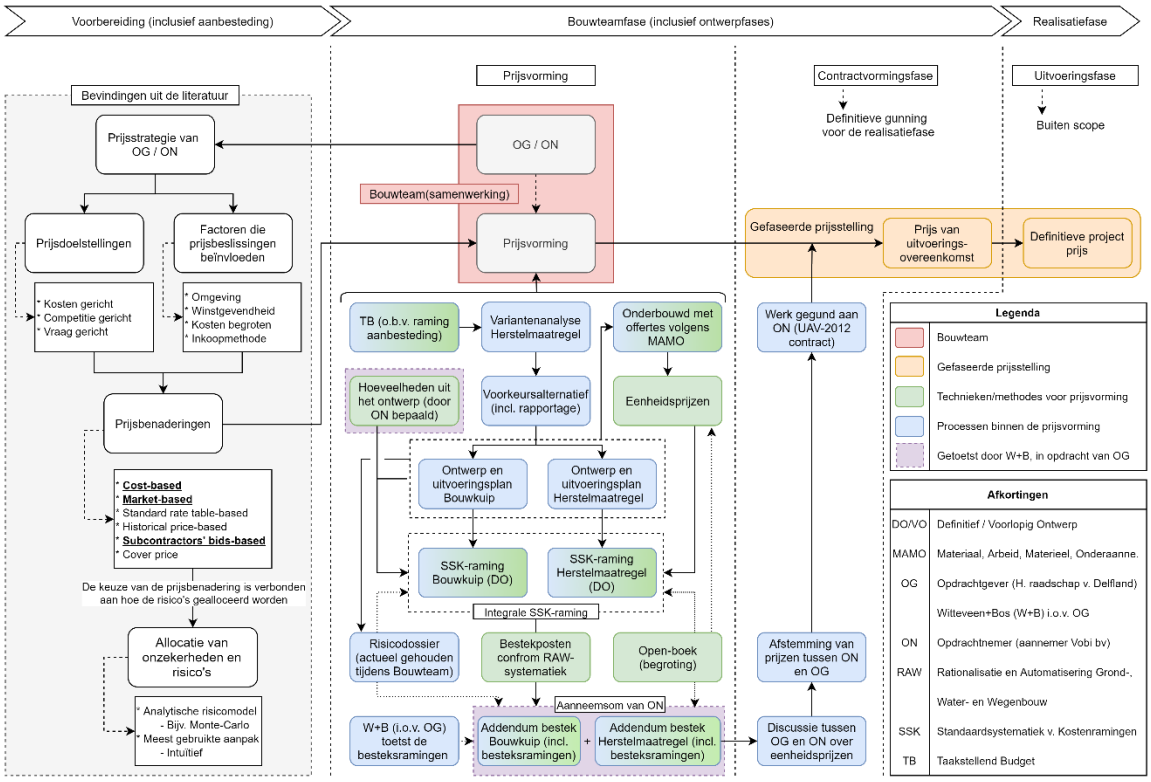

Figure F8: Price formation (process) interactions case 4.

A short explanation of the models

These figures are in Dutch since the documents that were analysed were also in Dutch. Nevertheless, the two figures are shortly explained. As was mentioned, the preparation phase of the project is not included but in case #4, a rough estimate was provided by the client during the tendering phase. This is important for the price formation during the Bouwteam phase since this rough estimation is used as a basis to build further upon. This rough estimation is also the backbone for determining the target budget, which is given to the contractor to keep track of during the design phases. As is shown in Figure E7, after the start of the Bouwteam the contractor made a variant analysis but W+B had the final responsibility. This shows the dynamic of letting the contractor do the work and give the freedom to use their expertise and knowledge but making sure that a consultancy firm, like W+B, verifies their work on behalf of the client. This also holds for the design phases but also the price formation (process). After designing, the contractor made an integral cost estimate based on the SSK-systematic. Lastly, in this project, they ended up with a traditional 'bestek' following the RAW-systematic. The reason for this was particularly interesting since this part of the project was tendered as a Bouwteam, which was part of a bigger project that was tendered traditionally. That is also the reason why they made the switch from the SSK-systematic to an 'Addendum specification items (bestek)' with the RAW-systematic.

Appendix G – Generic model (Dutch version)

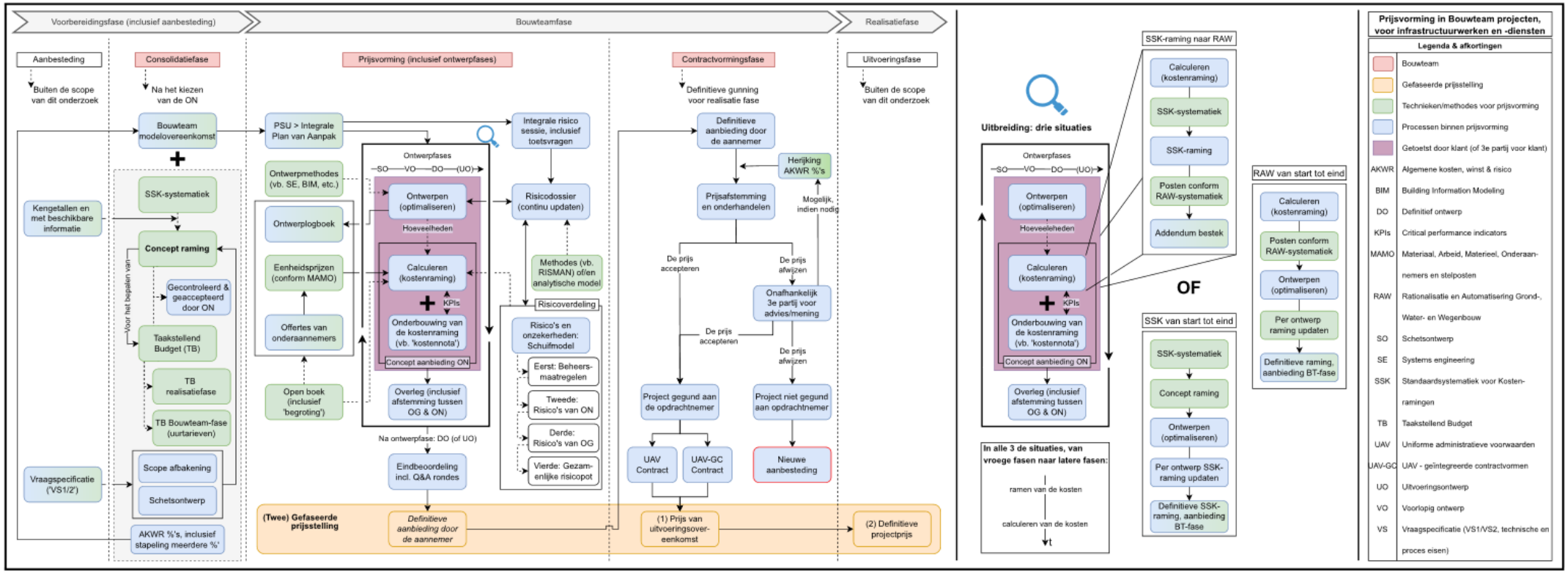

Figure G1: Generic model price formation in Dutch (final framework).