Technische Universiteit Delft

TU Delft

RISK FOR THE BOUWTEAM

Developing an empirical case-based model for risks, their allocation and control strategies when Bouwteams are used as Project Delivery Method.

MSc. Thesis

F.E. Correa Galdeano

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RISK FOR THE BOUWTEAM: Developing an empirical case-based model for risks, their allocation and control strategies when Bouwteams are used as Project Delivery Method.

By

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in partial fulfillment of the requirements for the degree of Master of Science in Construction

Management and Engineering at Delft University of Technology

to be defended publicly at the Faculty of Civil Engineering and Geosciences at the Delft University of Technology on Monday 30th, 2022 at 08:45 AM.

Student Number:	5014093
Project duration:	October 19, 2021 – May 30, 2022

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Preface

Dear reader. Before you lie the report *"RISK FOR THE BOUWTEAM: Developing an empirical case-based model for risks, their allocation and control strategies when Bouwteams are used as Project Delivery Method"*. This is the resulting effort of seven months of research undertaken as part of the requirements to obtain the MSc. Constriction, Management and Engineering at the Delft University of Technology.

The research was carried out at Witteveen+Bos, within the Collaboration and Tendering group, part of the Relational Contracting unit. Furthermore, there was a big input from the Construction Management group, which also contributed with the necessary data and knowledge to make this research possible. The different practitioners who were approached throughout the process expressed high interest for the contents relevant to this research and would suggest a potential for the underlying notions of its outcome.

This milestone marks a big step not only on my academical, but particularly on my personal life. But this could not have been possible without the support of a number of persons, to whom I am deeply thankful. First, my university graduation committee. Chairman Martijn Leijten, whose precise feedback and knowledge served as an inspiration and increased my ambitions to keep understanding the essence behind the concepts elaborated here. First supervisor Marian Bosch-Rekveldt, your effort has been priceless and from the start until the end of this process you have managed to point me always in the right direction. Your assertiveness and precision have shown me the path to untangle my thoughts, specially under those moments of confusion or doubt. Second supervisor Erfan Hoseini, the given feedback has been of immense help to improve the quality of the work done, and your suggestions about research and practical aspects worked always as anticipatory signs which I could have not foreseen otherwise. To my company supervisors, I want to thank Lonneke Cheung, for seen the potential in the research, and without your constant feedback, knowledge, and support, this would have not been possible. Furthermore, you have always brought clarity on my ideas and your conviction to help me achieving this objective remained firm throughout the whole process. Jorrit Bakker, your practical expertise has been an invaluable input and you have shown me what doors had to be knocked to get in the right place. To all of you, I thank you for sharing your knowledge and teach me priceless lessons. I hope to take all these and transfer them into my professional future.

On a personal note, I want to foremost thank my family, my mom, Herminia, my dad, Jorge and my sister, Jesica. Your borderless and unparalleled love have never let me think there was an inch of distance between us. Reaching this point would have never been possible without you. I want to thank my friends in The Netherlands; Natalia, Juan, Sebastian, Mariana, Jason, Sparsh, Yassmin, Andrea, Blanca, Paul, Vanesa, Monica, Kunal, Luisa and Sheehab, you have been the family who adopted me here and have made of this journey a one in which I have never felt alone. Your presence was always a light throughout the mistiest moments. Lastly, a mention to my friends from Argentina; Martin, Diego, Ignacio, Agustin, Joaquin, Manuel and Vale, who have always shown their support and kept cheering to pursue my dream and achieve my goals. You friendship has proven to be unconditional despite time and distance.

F.E. Correa Galdeano

Delft, May 2022

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Executive Summary

The construction industry has been, throughout time, heavily hindered by cost overruns and delays in the delivery of projects. This picture has only been magnified by the increase in size, complexity, and urgent demand for their delivery. Responding to this circumstance has taken different paths. One of these has been updating and improving how the relevant parties of a project interact to achieve the intended results. In this way, alternative delivery methods have emerged with different adaptations depending on the country's legislation and policies. A general acceptance has been gained over those systems where the parties interact more closely to reach a final product. This moves away from the classical division between Client and Contractor. Usually, the first takes a controlling role, while the second proceeds on the elaboration of the documents and works. The alternative approach requires from the participants a high component of collaboration.

As a scheme where the Contractor is involved from an early stage of the project, the Dutch construction industry has used for a long time the Bouwteam agreement. However, the original drafted model was lagging from the updates implemented into the country's legal framework. This situation resulted in two independent organizations releasing their interpretation of this concept. The resultant developed agreements give a good perspective on the activities to be done by the different parties during its implementation. However, even when they request to include a risk file within the project's documents, these do not provide a clear insight into two important aspects of the Risk Management practice, namely the Allocation and Control of the risks among the participants. This is the starting point of this research, which was driven using the following main research question:

How can the allocation and control of risks be incorporated when Bouwteams are used as a Project Delivery Method?

The study consisted of three phases that helped derive an answer to this research question. The first was a literature review, which helped build a conceptual framework around the concepts of Project Delivery Methods and Risk Management methodologies, both in its application in the infrastructure sector and in The Netherlands. This also helped introduce a definition of Risk for the Bouwteam, which is understood as *the effects that can compromise the deliverables expected of using a Bouwteam as a Project Delivery Method or how such deliverables are achieved*. Defining this concept was essential for the second phase of the research project, the Empirical Study.

During the second stage, a multiple case study was carried out in which a *multi-method* approach was chosen. This way, different data gathering techniques were implemented. The development of this research was done with the contribution of Witteveen + Bos, an engineering and consultancy firm with presence in the Dutch construction market for over 75 years. The support and vast expertice of the company was key to get closer to data of projects using the Bouwteam models during this second phase. In three out of the four projects under review the firm was involved. The remaining fourth project was used to understand possible differences in the approach and expand the view over additional types of project. The results were obtained by analyzing the documentation collected from the cases and using interviews with thirteen participants of the projects in question.

The allocation of risks is essential as it will assign the responsibilities that each party will afford throughout the project. To control the risks, the participants can define and implement measures, which include processes or actions to prevent the risks from occurring or decrease the impact on the objectives of the project. The objective of this research was to incorporate aspects of risk allocation and control by developing a model that can help identify hot spot areas of risk for the design phase and propose a set of control strategies that effectively help tackle these risks. As a result, from the

cases, it was possible to formulate a set of 30 Risks for the Bouwteam, which were grouped into 8 Risk Groups. Furthermore, it was possible to outline what principles and criteria are needed to decide upon the allocation of these risks between the participants. The model sets principles for the allocation, rather than a fixated allocation per risk group as by doing so, it could help the participants to evaluate the appropriate division for the risks under the specific conditions of the project. Besides defining these criteria, it was found that implementing a scheme of shared risks could bring benefits for the participants during the phase of design.

The resulting analysis from the empirical phase concluded with a preliminary version of the risk model, integrated by the three individual elements mentioned before. The review of this model consisted of an expert session to evaluate the individual elements of the model and judge its applicability in practice. Furthermore, it made possible to understand what could be the benefits and obstacles of implementing this model in a Bouwteam setting. Finally, the input of the experts was used to make some adaptations to that preliminary model and provided the necessary insight to understand the conditions needed to integrate its elements when this Project Delivery Method is in use. The research concludes with a final model (Figure 1) and a roadmap for its implementation (Figure 2) consisting of procedural aspects and a set of contractual provisions needed, which together works as the blue print to incorporate the allocation and control of risks before and throughout the design phase.

Following the conclusion and answer to the main research question, a set of recommendations were presented, which were divided into two parts:

a) Recommendations for practice

- Use the early interactions between the project participants to establish the risk environment and how to proceed with the risk management practices. Create awareness of the proper formulation of risks between those involved in the identification exercises.
- Use not only successful project cases to understand aspects that should be improved in the use of this agreement. This could give more insight into additional risks and tailor the risk management process to the Bouwteam setting.
- Implement this model into a project. Particularly in one that could be in its early conception phase. Use it as a pilot test to measure the effectiveness of the process and address the practical limitations of its use.

b) Recommendations for further research

- Replicate a similar study for *large* size projects and test as a form of hypothesis those propositions and the conclusions drawn from this study remain valid regardless of this variable.
- Explore the advantages and barriers of implementing this model, including the Contractor's perspective for the validation.
- As not all the data retrieved from the cases was capsized in answering the research question, there are elements in these sets that could be further used on other studies. An example could be trying to develop a metric that links the maturity of the design and the desired level of risks, to further establish when is optimal to move in the execution phase using this parameter as a reference.
- Conduct a study to address how economically efficient is the use of this project delivery method in comparison with a traditional approach.
- Explore how to measure the effects of individual control measures over the total risk response plan, or its further propagation to decrease the overall risk profile. And how this can be monitored in an efficient manner while projects are running.
- Explore the most efficient way of implementing a shared risk scheme in relational based project delivery methods.

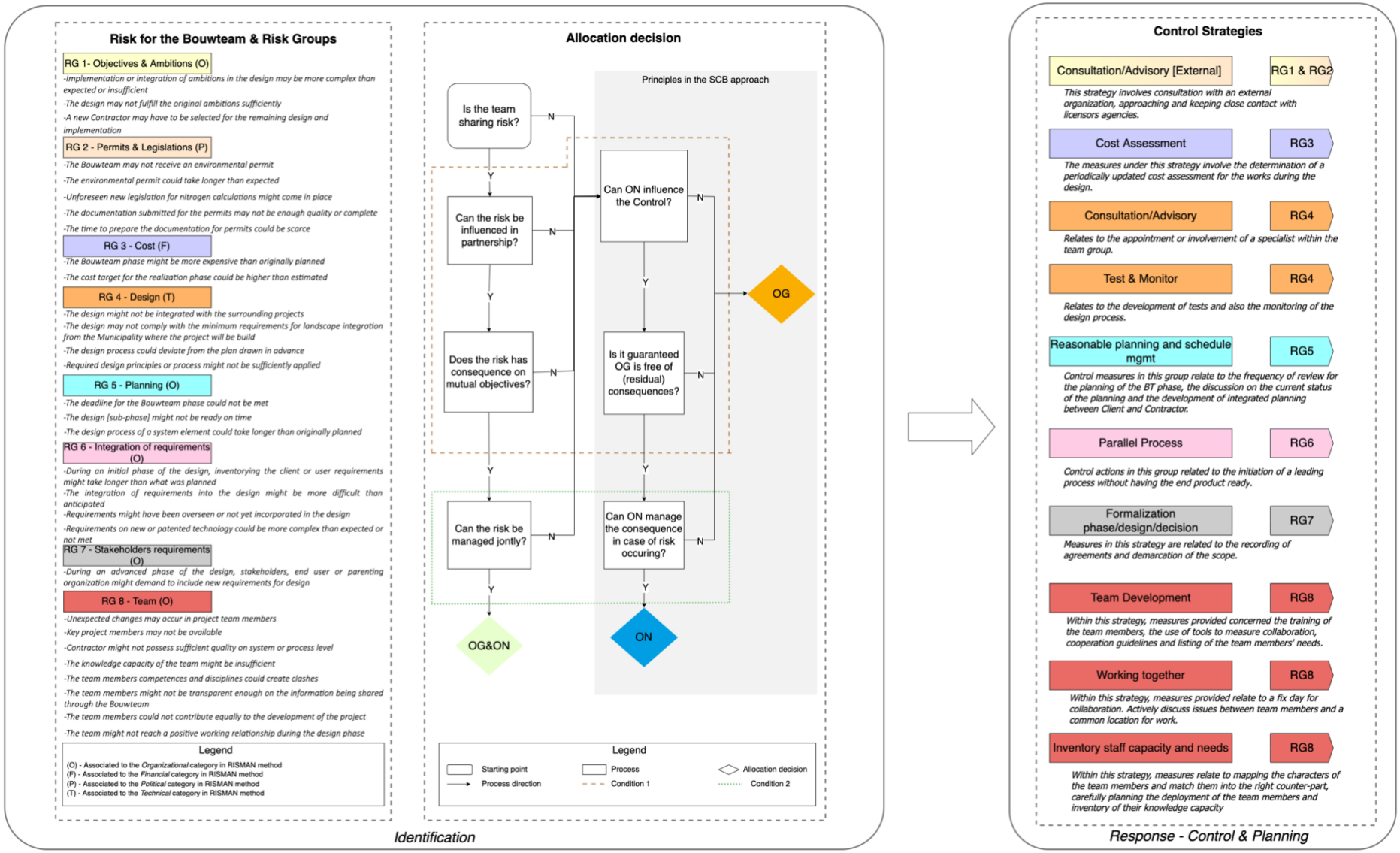

Figure 1 - Risk Model for Bouwteams

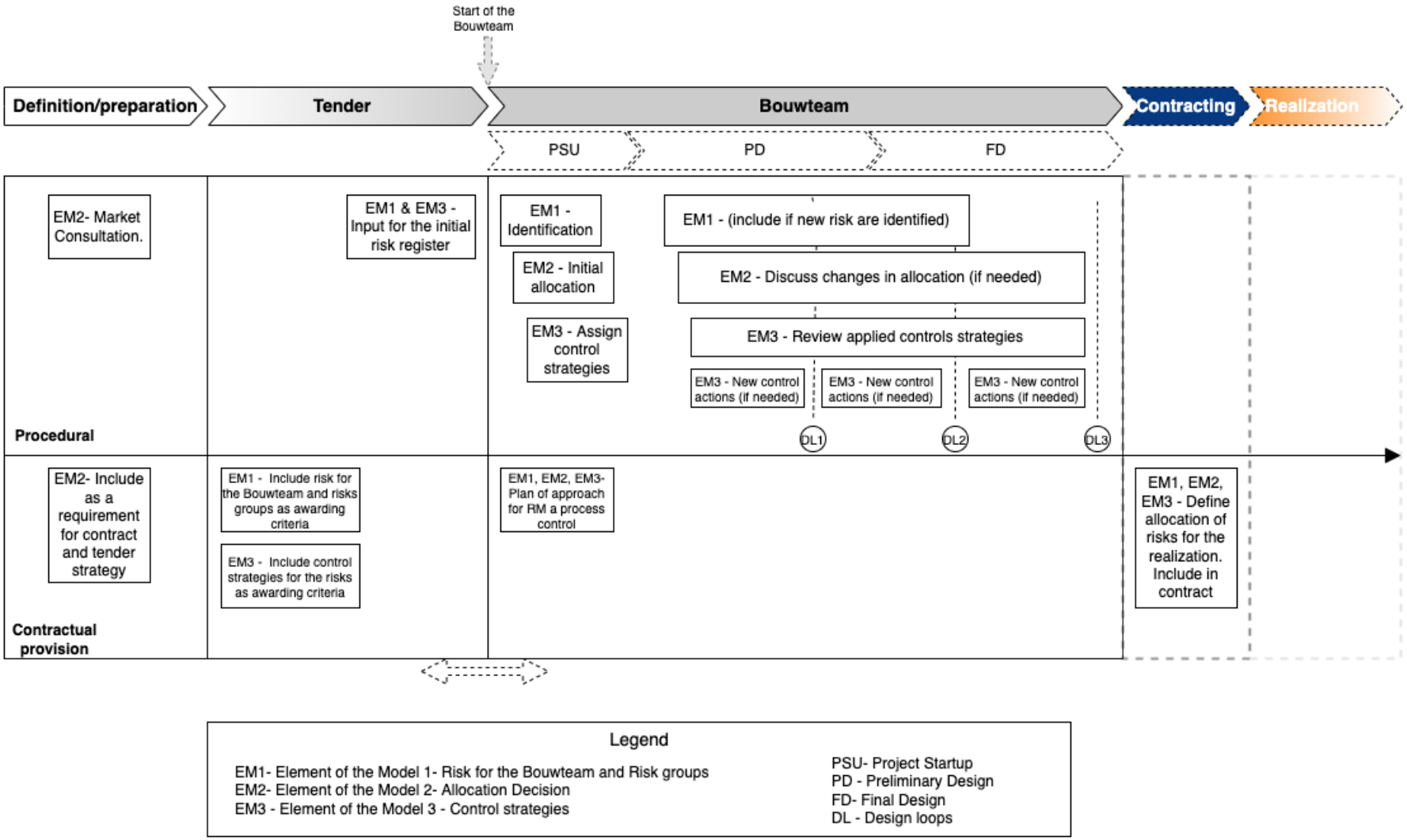

Figure 2-Roadmap for implementing the Risk Model for Bouwteam

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List of abbreviations

Abbreviation	Dutch	English	Explanation
DNR2011	De Nieuwe Regeling 2011	TNR-The New Rules 2011	When applied, the general terms and conditions lay down rules for a consultant or a contractor's contractual relationship.
UAV 2012	Uniforme Administratieve voorwaarden voor de uitvoering van werken en technische installatie werken 2012	UAC 2012- The Uniform Administrative Conditions for the Execution of Works and Technical Installation Works 2012	The terms and conditions are most commonly used for building contracts in The Netherlands. Management can be done in-house or by a third party.
UAV-GC 2005	Uniforme Administratieve Voorwaarden voor Geïntegreerde Contractvormen 2005	UAC-IC 2005: The Uniform Administrative Condition for Integrated Contracts	A set of general terms and conditions that lay down the legal relationship between the client and the contractor.
VGBouw 1992	Model Bouwteamovereenkomst 1992	Model Building Team Agreement 1992	
DG2020	Modelovereenkomst Bouwteam DG 2020	Model agreement Bouwteam DG 2020	
KBN2021	Koninklijke Bouwend Nederland model bouwteamovereenkomst 2021	Royal Building Netherlands model Bouwteam agreement 2021	
PvE	Programma van Eisen	POR- Program of Requirements	The PVE must contain the information that makes it possible to substantiate design decisions and take them correctly as possible in one go. Therefore, it has only functional specifications.
VO	Voorlopig Ontwerp	PD- Preliminary Design	The Preliminary Design is the first spatial and aesthetic elaboration of a presented project.
DO	Definitief Ontwerp	FD- Final Design	After discussing how the design will be adjusted, all comments and remarks are incorporated into the design, and a final materialization is set up.
UO	Uitvoeringsontwerp	ID- Implementation Design	This phase in the construction process comes after the final design and before the work preparation phase. These drawings are final design drawings, specification drawings, and detailed drawings. The ID consists of a graphical part in which the plans are presented and a written part. The written portion is the specifications that belong to the relevant construction project.
PDM	-	Project Delivery Method	A system for organizing and financing design, construction, operations, and maintenance activities to deliver a good or service.
GWW (-sector)	Grond-, Weg- en Waterbouw *(sector)*	Ground, Water, and Hydraulic	Comprises disciplines such as the construction of dykes, bridges, canals, earthworks, dredging, hydraulic engineering, and road construction
OG	Opdrachtgever	The Principal-The client	Contract law – Person/Entity who gives an assignment.
ON	Opdrachtnemer	The Contractor	Contract Law- The party that accepts an assignment.
IPM	Integraal projectmanagement	Integrated project management	The IPM organization assigns a specific role to each process. This creates the 5-role model. The 5 roles are primarily fulfilled by 5 different people.
W+B	Witteveen+Bos		Engineering and consultancy firm with
PvA or IPvA	Plan van Aasprak	(Integrated) Plan of approach	An integrated plan of approach describes the way in which the project team will meet its objectives. It usually consists of at least chart of the team, the cooperation agreements, the consultation structure, a further division of tasks and responsibilities.
SCB (approach)	Systeemgerichte contractbeheersing	System-oriented contract management	Uniform working method and agreements used to guarantee the quality and transfer responsibility.
MEAT	-	Most Economically Advantageous Tender	In MEAT, tenders are not assessed on price alone. An approach is used to assign worth to qualitative aspects such as sustainability.

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Introduction to the research

Projects can be defined as temporary endeavours undertaken to create a unique service or result (Weaver, 2010). These realizations are born and developed under uncertainty, a situation that escalates with their size, complexity, and duration (Flyvbjerg et al., 2003). Due to the continuous growth in size over the last years, building and infrastructure projects have become more vulnerable to risks (Hertogh & Westerveld, 2010). Risks are latent throughout the whole life cycle of a project (C. B. Chapman & Ward, 2003; Murray et al., 2011), and therefore their impacts can have multiple forms and scales depending on which stage they arise (Gerkensmeier & Ratter, 2018).

In a sector where cost overruns and delays are rife matters (Flyvbjerg, 2007), the use of Design-Bid-Build or 'traditional approach' as a project delivery method has proven to be inconvenient when the size and complexity excel among the main characteristics of projects (Uhlik & Eller, 1999). Because of this, in The Netherlands and other countries, alternative project delivery methods have gained relevance over the last years, between which the Early Contractor Involvement can be found (Lenferink et al., 2013). This contractual form especially suits situations in which the uncertainty is too high to calculate a price in the tendering phase and when the involvement of the contractor and other experts is critical for the design and production of knowledge (Lenferink et al., 2012).

When asked which contract form aids in avoiding failure costs, half of the market parties surveyed in a study responded that Bouwteam contracts contribute to project feasibility in the design phase (Chao-Duivis, 2012). The Bouwteam or Design Team is a Dutch version of the ECI delivery method. In these, the client, contractor, engineering firms, and consultants are present during the first of two phases, called the design phase. This assembly allows the participants to reach the project's design in a multidisciplinary partnership, bringing the experience and expertise of the various members to the team (Chao-Duivis et al., 2018). In this way, the time for information transfer is shortened, enhancing the constructability of the designs and preventing unexpected discussions during the implementation of works (de Koning, 2020).

1.1 Problem Definition

While contractors possess advanced knowledge of the constructability, materials, and affinity for the best practices to implement in-place, designers are characterized by the power to envision an idea. They portray this into an organized set of specifications, calculations, and bills of quantities so that the former can materialize the concept. With the increased complexity of the requirements and characteristics of projects, the traditional procurement approach does no longer meet the needs of a fast-paced building environment, urging for alternative delivery systems that can also guarantee integration and improved collaboration (Ahmed & El-Sayegh, 2020; Blayse & Manley, 2004; Rutten et al., 2009).

Over the last two decades, different public administrations worldwide have been looking for means to tackle this situation. The contractor's involvement in the initial stage of the project has been raised as a solution by scholars (van Valkenburg et al., 2008). The McKinsey (2019) report appointed that using two-stage contracts can help reduce overall risks, lower tender costs, and achieve a lower price for the clients. Although this can adopt several forms depending on the administration and the regulatory frame that precedes the project (Wondimu et al., 2020), in the Netherlands, a form of Early Contractor Involvement is the Bouwteam (Chao-Duivis, 2012).

Within the Bouwteam contracts, we can distinguish the classical standardized model introduced in 1992 VGBouw and two newly introduced agreements forms. The first of these two is the Bouwteam DG 2020, developed by Duurzaam Gebouwd (DG), the platform for decision-makers in the

construction and real estate sector of The Netherlands; and the second is the Model Bouwteamovereenkomst 2021, released by the Koninklijke Bouwend Nederland (KBN), the Dutch association of construction and infrastructure companies. One of the main differences in these latest developed models is the possibility to connect on to the realization phase with the integrated set of conditions UAV-GC 2005 (v. 2020) (Hertstein, 2021). This option was not possible in the initial agreement except when major changes were introduced, and were included by the demanding needs of the construction industry. Because of the new features added to the models, a strong interest is placed in analyzing those projects making use of the integrated set of conditions UAV-GC as the link for the realization phase.

As the objective of these contracts is to reduce the uncertainties in the project's execution phase, the assessment of risks during the first phase is critical in achieving the purpose of this delivery method. Although the Bouwteam model developed by DG and KBN gives a good perspective on the activities to be carried out throughout the execution of the agreement, the rights and obligations of the parties involved in the project, both models are unclear in the methodologies and approaches to follow regarding the control and allocation of risks. Furthermore, there is no specific analysis of a diverse sample of infrastructure projects to date to understand the most relevant risks, their nature, and a clear suggestion for the allocation criteria when endeavours use the Bouwteam setting for the design phase. Based on what is mentioned in this section, the following problem statement is formulated:

"The recently developed models of contracts for Bouwteams do not present specific insight for the allocation and control of risks amongst the parties involved"

1.2 Gap Identification

The available literature is abundant on the concepts of Early Contractor Involvement in The Netherlands (Lenferink et al., 2012, 2013; van Valkenburg et al., 2008); while other authors focused on the mechanisms for the implementation of two-phased contracting processes (Verhees et al., 2015). However, the most comprehensive analysis of the legal aspects of using the Bouwteam model was the manuscript released by Chao-Duivis (2012), although this document was elaborated based on the VGBouw model from 1992.

Previous academic studies on the use of Bouwteam were focused on its benefits for the construction sector (van Riggelen, 2019) and the factors needed for successful collaboration within the building and the infrastructure sector in The Netherlands (de Hoog, 2020; van de Hoef, 2020); comparative analysis with similar integrated contracts in Finland and the UK was performed (Varanasi, 2021), and the critical factors for a successful price determination process during the procurement and design phase of the Bouwteam were identified (van der Pas, 2021).

At the same time, on subjects relative to Risk Management, other researchers focused on including drivers, project characteristics, and specific KPIs in the risk management process (Christodoulou, 2021). In addition, an alternative analysis on how to capitalize on opportunities, or the positive side of risks in complex projects, was performed (Massaad, 2021). And finally, a joint risk management methodology for the two-phase delivery models was developed (Clemens, 2021).

The present study will focus on analyzing projects executed under the Bouwteam model, thus bridging the subjects of Project Delivery Method and Risk Management. Within the Risk Management process, the attention will be on the distribution of risks between the parties and the measures used to control

these risks. The mentioned gap has not been previously explored in literature and can be shortly summarized in the following statement:

"There are no studies addressing the risks inherent and identified when using Bouwteams as PDM"

1.3 Research Goal

The allocation of risks is essential as it will assign the responsibilities that each party will afford throughout the project. At the same time, the control process links the identified risks assigned to each party. It proposes a follow-up system to analyze if the risks suffered any change in the exposure or if the control actions were effective. If the risks are not correctly distributed, the control measures applied are most likely to fail.

This research aims to incorporate the missing aspects of risk allocation and control when Bouwteams using the integrated set of conditions UAV-GC are used as Project Delivery Method. The present graduation research will use input projects performed using these delivery agreements to identify, list, and categorize the most relevant risks and build a risk allocation and control model. With the findings of these projects, criteria for the distribution can be outlined. Lastly, it can help the parties involved to decide whether it is convenient to include these elements as part of a second phase contract.

This risk model can help identify hot spot areas for the development of the design phase and propose a set of control strategies that effectively help tackle these risks based on a pre-defined reference guide. Therefore, it can clarify the weakly defined areas of the Bouwteam agreements, as was discussed in the introduction. Moreover, this thesis project aims to answer the call made by past studies regarding the need to analyze the practical aspects of the implementation of a risk management process in two-phase contracts (Nieswaag, 2020). Analyzing different projects will help broaden the sample and insights over the Risk Management practice in Dutch infrastrcture projects (Christodoulou, 2021), filling the outlined knowledge gap. Furthermore, It is expected to increase understanding by giving insights into the risks of using Bouwteam as a project delivery method.

1.4 Research Questions

The following main research question was formulated to achieve the research objective:

How can the allocation and control of risks be incorporated when Bouwteams are used as a Project Delivery Method?

And to support the development of the leading research question, the following sub-questions were identified:

1. What are Bouwteams and where they stand as part of the collaborative Project Delivery Methods in the literature?
2. What methodologies or principles are used in literature for the allocation and control of risks in infrastructure projects?
3. What risks can be identified when Bouwteams are used as a Project Delivery Method?
4. What elements should be included in a model for the allocation and control of risks in this Project Delivery Method?
5. How could the implementation of the risk model be of help for teams when using this project delivery method?

1.5 Research Methodology

The methodology used during this research is a *multi-method research* approach (Mik-Meyer, 2020). In this method, a set of techniques is used following the same epistemological perspective -a qualitative approach-. Different data gathering techniques will help tackle the research goal and answer the stated research questions. The present research will be divided into three sections; the first aims to build the conceptual framework, the second is dedicated to the empirical study, and the last is to review the resulting model and derive the necessary conclusions for the study. An outline of the research design can be found in Figure 3, which outlines the design proposed for this research:

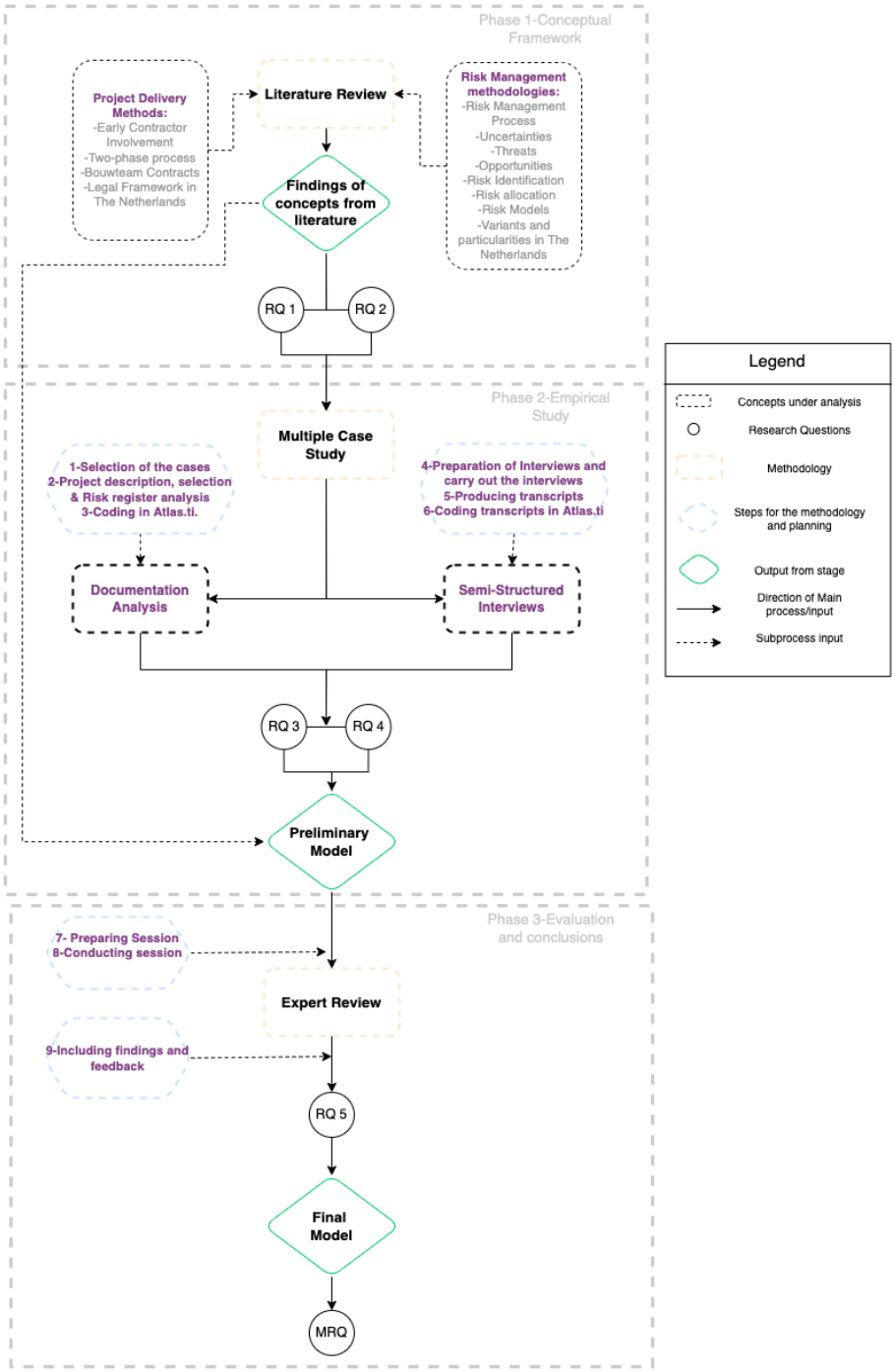

Figure 3-Research process diagram

During the first phase of the study, the construction of the conceptual framework will be performed. This is done by employing a Literature review. There, the concepts relevant to this theme will be explored. Two branches can be distinguished; one related to the concepts of the Risk Management and their related methodologies, including its process. The other is related to project delivery methods and its specifics in The Netherlands. Research questions 1 and 2 are tackled in this first phase.

For the following phase, the methodology used is a multiple-case study. The researcher resorted to two data gathering techniques, a documentation analysis and semi-structured interviews, thus employing the multi-method approach. There are several reasons to choose a case study approach, as it is suitable for situations where there are "what" and "why" types of questions (Tellis, 1997). Still central to the development of this research is that the company where this study was developed counts with a significant portfolio of projects using Bouwteams, as will be elaborated in Chapter 3. Looking across cases will help to understand the differences and similarities between cases (Baxter & Jack, 2015; Yin, 2003). The insights gained through the documentation analysis will be complemented using semi-structured interviews with practitioners in the fields of Project Management. The use of these techniques allows to expand the depth of data gathering and increase the sources of information relative to the topic (Tellis, 1997). In addition, the combination of the two methodologies, the document analysis and the interviews, can help to strengthen the quality of the research by allowing different angles to be visible (Mik-Meyer, 2020). This phase will help answering sub research questions 3 and 4, and will further contribute to outline a preliminary model which will be used in the last phase of this study.

During the last stage of this research, the preliminary model resulting from the empirical study will be evaluated with experts. An expert review consists of asking the opinions, suggestions, feedback, or comments from experts (Angkananon et al., 2013). Using this evaluation technique will help judging if any missing element could be included in the model, assess the practical implementation into projects, and define how this should be included when Bouwteams are used. Assisting on the discussion of the interim findings from this research with the practitioners, this evaluation technique will help unlocking the necessary knowledge to answer sub research question 5 and ultimately lead anwering the main research question of this research.

Literature Review

The present chapter is divided into three sections; the first is dedicated to defining the literature review set-up and the structure followed in this review. The following two sections elaborate on the topics relevant to sub-research questions 1 and 2, namely those aspects related to project delivery methods and, later, the risk management methodologies.

2.1 Literature Review Set up

Search engines were combined to cover the aspects most relevant to this research. First, the terms to be researched were scanned through free-access sites like Semantic Scholar, Microsoft Academic, Google Scholar, and later Scopus and Web of Science were utilized. In the latter, the access is restricted to registered users. However, it was possible to log in to these two using the credentials from TU Delft. It is vital to notice that each engine presents a different technology to index the search and retrieve the results; also, in some instances, they limit their search to specific journals while others can search across the internet, thus the need to be cautious and selective into which is the browser most suitable for the research.

The retrieved results using each engine turned very dispair, and the number of articles related to one term varied significantly. An overview of this spread can be found in Annex A. Google Scholar repeatedly turned out to be the one with the most results due to the limited options to filter and funnel the search, meaning that it will scan all the possible matches. Making results too general and time-consuming to find, as many of the outcomes were relative to other fields of knowledge.

Other engines, such as Scopus and Web of Science, allow the user to filter by field of study, subtopics, publication type, and others, making it simpler to narrow the analysis into sources closer to the research field. Eventually, for this study, it was decided to continue using the first of the two, given not only the power to cut across different platforms, filtering options. It also allowed to download the metadata of the articles, and simulateneously download as many articles as needed.

The parameters to filter the articles included the fields of Engineering, Business Management and Accounting, Economics, Econometrics, and Finance. Only data ranging from 1990 onwards were analyzed, and the types of publications included Scientific Articles, Conference papers, Books, and Book Chapters. In addition, journals and publications in Civil Engineering, Management, and Business were chosen. Once the filters were applied, the results were sorted by relevance and citations. Finally, the abstract of the first 75 results was scanned, and those with a theme closer to the concept under review were selected to be downloaded and thoroughly read.

For the cases of concepts such as “Two-phase contracting” (*Tweefasen contracten*) and “Bouwteam”, the mentioned search engines did not retrieve relevant results or sometimes any results at all. English is the primary language for scientific publications in international journals. In contrast, these terms are mainly addressed in specific Dutch articles or libraries of knowledge for the construction industry. Therefore, sources from related studies in the TU Delft repository were used, together with articles from platforms like CROW, PIANOO, IBR, and Cobouw.

For organization purposes, a spreadsheet was used to follow up on the progress of the different concepts, take notes, and group relevant findings. The articles were also classified according to their relevance in High, Medium, or Low in this sheet. Questions like “*In what ways does this book or article contribute to the problem under study, and in what ways is it useful for practice?”*, *“What are the strengths and limitations of this article?”* or *“How does this book or article relate to the specific question I am developing?”* were used to determine the articles' value and rank them.

2.2 Project Delivery Methods

Companies, clients, or entities in the construction industry acquire services and goods through different approaches or methodologies. Therefore, it is recurrent to find the term Project Delivery Method, from now on PDM, to describe how this procedure will be executed. Although PDMs are used across different industries (automotive, aviation, military, etc.), the focus of the present work is narrowed to those used in the Construction and Infrastructure Industry.

Across the view of different academics, these concepts extend beyond the purely transactional nature of acquiring a new asset or product. For example, J. B. Miller et al. (2000) defines a project delivery method as *"the system for organizing and financing design, construction, operations, and maintenance activities to deliver a good or service".* Touran et al. (2011) extend the view from only the operational aspects to include those liaisons amongst the involved parties. The term is then used to describe the contractual relations, roles, and responsibilities of the entities involved in a project. Associated terminology has also been used to refer to these procedures, such as Contract Strategy, Building Procurement Systems, Project Procurement System, Project Delivery System, and Project Delivery Strategy. Still, as described by Engebø et al. (2020), the general understanding is that *"all these concepts describe how the participants of a project are organized to materialize the owner's goals and objectives."*

A broad range of these organizational systems have been used throughout time, and new ones are emerging. The reasons for this constant evolution are the needs of the industry to cope with new requirements, increased complexity, an accelerated pace of technology development, and a ceaseless flow of information. Although it is common to find the names of the PDMs shortened by their initials in literature, this can confuse the reader as recurrently authors group and divide them using different criteria. For this research, the classification used by Walker & Lloyd-Walker, (2015) will be utilized; however, an important thing to notice is that rather than a discrete categorization, this clustering represents a continuum (Engebø et al., 2020), as it is graphically represented in Figure 4:

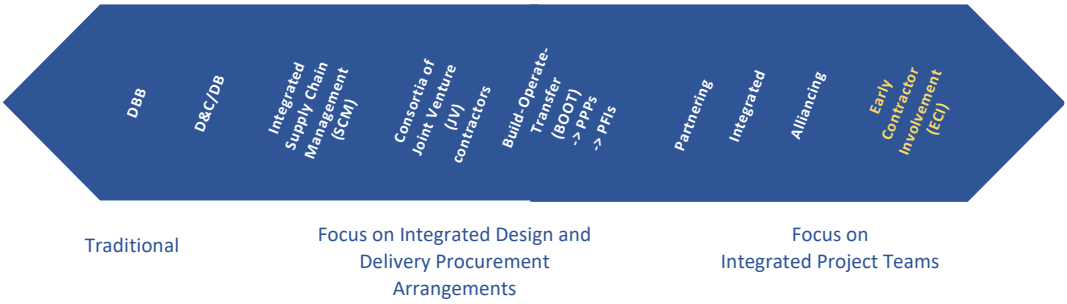

Figure 4-Continuum of PDMs (own illustration)

One aspect in which clarity will be set for the further development of this review is the use of the word 'Traditional' as a Project Delivery Method. As seen in the above picture, it can refer to at least the DBB and Cost-Reimbursement form. Still, from the scanned literature, it is agreed by the authors that the term 'Traditional' is the DBB (Design-Bid-Build) methodology (Creedy et al., 2010; E.D. Love et al., 2014b; Engebø et al., 2020; Jansen, 2021; J. B. Miller et al., 2000; Nibbelink et al., 2017; Paar et al., 2019; Raisbeck et al., 2010; Song et al., 2009; Touran et al., 2011). When using this method, the design works are performed by a consultant in direct relation to the Client. Once the documentation is finished, the Client is in charge of tender such design in the market and awarding the realization task based on the lowest bid or using the MEAT (Most Economically Advantageous Tender). In some cases, the Contractor could be awarded based on other criteria such as quality or technical merit. The tender

winner will take care of materializing the concept and usually the responsibility of operation and maintenance will then be transferred to the Client, who is the total owner of the asset.

2.2.1 Early Contractor Involvement

Collaborative types of contracts have been around the procurement strategies for the construction industry for quite an extended period. The first appearance of relational contracting practices using this definition date back to 1998, with the introduction of the concept of Early Contractor Involvement, firstly implemented by the British Highways Agency (Rahmani et al., 2013). However, implementation of this type of PDMs was being practised already in The Netherlands, as will be explained in subsection 2.2.3.

Different definitions of these PDMs can be found, but particular elements from them are noticed:

- *Timing* for the involvement of the Contractor; in this methodology, the Contractor is involved from an early stage of a project (E.D. Love et al., 2014b; Lahdenperä, 2012; Mosey, 2009; Rahman & Alhassan, 2012; Scheepbouwer & Humphries, 2011; van Valkenburg et al., 2008; Wondimu et al., 2018), in comparison to the traditional delivery strategies.

- *Activities* for which the Contractor is appointed; in this aspect, the authors' views differ on which activities the Contractor will be performing during its early collaboration. However, it is agreed that the activities are related to the planning (Rahman & Alhassan, 2012; van Valkenburg et al., 2008), the design (Rahmani, 2021), and a combination of design and detailed planning (Scheepbouwer & Humphries, 2011).

The main advantages of using these collaborative methodologies are the price certainty after the design phase, the possibility of fostering innovation, improved constructability of the concept, and the risk aspects, such as an enhanced risk management practice and reduced risks in the later project. However, it would not be possible to say this is the solution for all the industry problems as its successful implementation will only flourish in the proper context (Song et al., 2009).

The application of this method is not universally shared. Different legal systems will support the steps and the arrangements between the parties to a different extent; therefore, public entities have adapted these collaboration formats to make them suitable for their legislation framework. Scheepbouwer & Humphries (2011) comparatively reviewed how this PDM was implemented in Australia, New Zealand, the UK, and the USA Army Corps of Engineers. Broadening the scope in a study examining the related literature, Wondimu et al. (2020) found 25 different forms of implementing this partnering form in countries like the USA, Australia, New Zealand, UK, The Netherlands, Germany, and Norway. Each of these forms varies in its delivery arrangement, the selection method of the partners, procurement procedure to follow, and structure of the project. With the above findings, we can extend the perception that ECI is more than just a PDM, but also a working principle or philosophy with the critical characteristic of involving the Contractor's expertise in the phases preceding the realization of the project.

Table 1- Advantages/Barriers to implementing ECI

	Advange/Benefits														Barriers or obstacles for its implementation									
Author	Price Certainty	Reduce disputes	Project Design	Innovation	Decision-Making	Risk management	Level of risks	Risk Mitigation	Constructability	Working Relationship	Project Delivery	Resource Utilization	Contract Administration	Project Duration	Total man hours	Unnequal Commitment	Lack of win-win attitude	Clash contractor/consultant	Disclosing company secrets	Opportunism	Final construction cost	Lack of competition	Budget-Time frame after design development	Contracting Practice	Culture change
Cicmil & Marshall, 2005	X	X																						
Molenaar et al., 2007	X																							
van Valkenburg et al., 2008				X	X				X					X										
Mosey, 2009																				X	X			
Song et al., 2009														X	X								X	X
Scheepbouwer & Humphries, 2011							X																	
Rahman & Alhassan, 2012						X				X	X	X	X			X	X	X	X					
E.D. Love et al., 2014			X	X	X	X																X	X	
Eadie & Graham, 2014								X	X															
Nibbelink et al., 2017			X				X																	
Rahmani, 2021	X			X					X	X														
Nº of authors referring to the concept	3	1	2	3	2	2	2	1	3	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1

As seen from Table 1, several studies have tried to highlight the convenience of the early contractor involvement in the project. However, others have also addressed the obstacles to implementing such a methodology. For example, Mosey (2009) proposes that these obstacles belong to three sources; "*those that are specific for a particular type of project, those that derive from procedural and cultural issues, and those that stem from a lack of awareness of what is possible*". On the other hand, E.D. Love et al., (2014) refers to them as "barriers for its implementation", and Song et al. (2009) approach them as *challenges*. Moreover, Finnie (2020) evaluated the industry perception of the contractual application of ECI to find that the main challenges of implementing the principles of this delivery method were linked to a combination of participants' characteristics. The author mainly recognized trust, open and honest communication, changes in the personnel, the members' low performance, and the documentation quality as main challenges. Finally, in a comparative study, Rahman & Alhassan (2012) look at both benefits and obstacles to conclude that the benefits outweigh the barriers when using this approach.

2.2.2 Two-Phase process

This section will describe the so-called Two-Phase process as part of those Project Delivery Methods using the principles of ECI. This distinction is essential as, during this literature review, it was found that some authors discussed the two-stage tendering procedure under the concept of a two-phase process (Doloi, 2013; Lahdenperä, 2010; Molenaar & Gransberg, 2001; Ramsey et al., 2016). A practice dedicated to qualifying and evaluating the technical or price proposals within the procurement process, an area outside the scope of this review.

Within the many forms of delivery methods using the principle of the Early Contractor Involvement, we can find the so-called "two-phase" process Figure 5. For example, Fijneman (2020) explained that when is being used "Client and Contractor first work on the design phase. Then, if it has been successful, the implementation agreement will be concluded between the parties, and they will move into the realization phase. Otherwise, the contract will end in the first phase".

The pricing for the construction is preceded necessarily by the phase of design or engineering using a two-phase process. As more information becomes available during the first stage, a better perspective of the potential uncertainties allows for an improved risk distribution (van Wijk-van Gilst, 2020).

Finally, the resultant technical solution will have to be expressed in an implementation contract (PIANOO, 2019).

Similar to the argument supporting the use of ECI, Boes & Fijnman (2021) advocate that choosing a two-phased process will provide added value for the project participants. The author suggests this will happen when "risks cannot be adequately estimated during the contracts, there is a need to achieve high degrees of collaboration to reach solutions or when the solution in question requires an innovative approach". Although the two-phase contracts come in different shapes and sizes (CROW, 2020), this delivery models are as of Clemens (2021) perspective "an umbrella term for the wide variance of existing two-phase models in the construction industry".

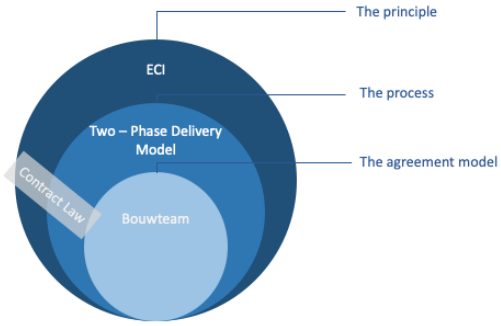

Figure 5-Early Contractor Involvement scaled down (own illustration)

Rijkswaterstaat is the Ministry of Infrastructure and Water Management executive agency in The Netherlands. In 2019 the organization released a report on the prospects of challenges and opportunities for the future construction industry. The report pointed out that the main driving task was introducing the "two-phase" contract process to reduce risks in large and complex projects (McKinsey, 2019). Although the final model for this process has not been released yet, this statement of intention turns out to be of high importance for the sector as the agency is the largest Client for infrastructure works in the country. Consequently, there has been a ramping up trend in utilising these delivery methods across different projects, including Bouwteams, as reported in the datasets from the Dutch government's tendering system, TenderNed.

2.2.3 Bouwteam Models

The Bouwteams, which are encompassed within those using a two-phased approach, are a widely recognized project delivery method in The Netherlands. This model of agreement is usually implemented during the initial phase of a project. With its early origins in The Netherlands in 1992 its implementation goes back to the general conditions for the design team in which a contractor takes part (VGBouw, 1992). This model was developed back then to respond to the housing shortage the country was facing. Bouwteams have gained popularity as a response to the market pressure and as an alternative to tackling some problems often found in the construction industry. The industry's most acknowledged issues relate to time and costs overruns (Flyvbjerg, 2007). Applying a Bouwteam agreement is not suitable for every kind of project. This agreement is appealing to the Client when innovative solutions are to be implemented as a way to solve the problem in question. Also, when little or no pre-existing knowledge on reaching a solution is available, or when the time to incur in separated tender procedures for the works is limited (speed).

Clearing what is called Bouwteam will help further develop this section and the upcoming work elaborated under this research. A comparative chart with the definition given by different authors can be found in Annex B. Nevertheless, they converge over crucial aspects such as *Temporary partnership, Equal footing between parties, Contractor participation in the design and/or preparation phase, Advice*

and contribution with expertise. The goals and objectives of a Bouwteam, as stated by previous authors, are: "Making a design for the project desired by the client" (Koenen, 2017), "Start of the works sooner and more efficiently. Save costs on executing the design as well as the costs of the construction itself" (Chao-Duivis et al., 2018), "Reduce preparation time, control technical and organizational interfaces, and ensure continuity of production in the construction process. Jointly arrive at an optimal integrated design and agreement for the realization phase supported by all parties" (Gido et al., 2021) and "Collaborate in the design phase" (Hertstein, 2021).

The notions exposed in this section can make us theorize that the Bouwteam, as a project Delivery method involving the Contractor and other experts from an early stage, could help manage risks during the design and decrease the uncertainties for the execution phase. Furthermore, including experts from different fields in the process could help foster an environment to develop and work over all types of risks in the project.

Variations in the implementation of the Models

Because of the experience gained over the years and the different developments in the industry, accompanied by changes in legal frameworks, new agreement models and guidelines have emerged to cope with the latest industry requirements. First, the Bouwteam DG 2020 model was released in early 2020 by Duurzaam Gebouwd (DG). Then, in 2021 the Dutch association of construction and infrastructure companies, Koninklijke Bouwend Nederland (KBN), released the contractual model Bouwteamovereenkomst 2021. Compared to the VGBouw 1992 model, the newest versions allow to choose between UAV-2012 or UAV-GC 2005 (v. 2020) (Hertstein, 2021), options that were included by the demanding needs of the construction industry.

Due to the alternative ways the contracting party can opt when deciding to proceed or not to the realization phase, there are variations within the Bouwteams. Therefore, using as a defining factor the type of administrative conditions under use for the second phase (UAV or UAV-GC), we can distinguish two variants of Bouwteams, as is presented in Figure 6.

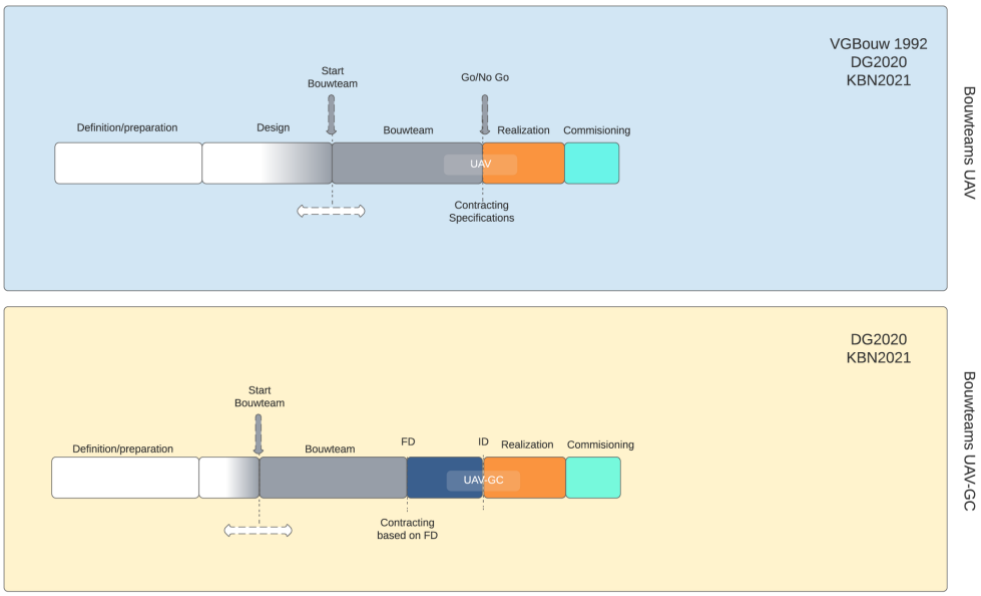

Figure 6-Variants of Bouwteams

When the UAV is used in the execution, the first case in the previous figure, the advisory role of the Contractor will be included in an advanced stage of the design and up to the elaboration of

specifications. After this, the Contractor is given the exclusive option to offer a fixed price for the follow-up works. This alternative implies that the agreement for the second phase is reached based on the final set of specifications. This legal base is also used in the DBB format of the contract. However, if an agreement is not reached here, options are contemplated to exit the relationship. This moment is usually referred to as the Go/No Go point. This procedure can be followed with VGBouw 1992, DG2020 and KBN2021.

The second version applies the integrated conditions (UAV-GC), but on their original structure, only models DG2020 and KBN2021 can be used here. This legal basis is also implemented in Design and Construct or Engineering and Construct format. Here, the Client only elaborates on a list of requirements that may or may not be assisted by a consultant according to its in-house capabilities. The Contractor is thus included in the loop together with the Client and consultant (s), starting on the Preliminary Design up to the point that can go as far as the Final Design, the moment in which a price-determination process starts. Again, the involved Contractor holds the exclusivity to bid a fixed price for the upcoming works. If a final agreement is reached, the next phase will finalise the implementation design, specifications, and construction. In this second option, it is essential to emphasize that the contract for the follow-up works is reached between the parties without finishing the implementation design and the specifications package; therefore, not all the risks have been cleared.

2.2.4 Challenges to the implementation of Bouwteams

In the recently published *Bouwteams Guide* (Gido et al., 2021), several principles are introduced to implement a Bouwteam as a Client or Contract organization; although the authors positively introduce them, they can be seen as the challenges faced between the parties when using this type of contract:

- Not enough organisation experience when working with this delivery method.
- The target budget for the Bouwteam or Realization phase is not realistic.
- Not all the ambitions/drivers can be met.
- The team is dysfunctional.
- Assumptions taken by the parties turn out to be incorrect.
- Unbalanced decision-making power between parties.
- No final agreement on the price for the realization phase.

Similarly, (de Hoog, 2020) identified 38 factors for successful collaboration in Bouwteams, leading to five categories related to the *Capabilities of the team*, *Contractual facts*, *Joint working*, *Relational attitude of the group*, *Team integration* and *team working*. van der Pas (2021) observed the obstacles related to the price determination process of the Bouwteam, and one of the factors was that the allocation of risks is not sufficiently developed when the negotiation for the price starts.

2.3 Risk Management Methodologies

Two important notions can be found throughout the life of any project; the first relates to the temporality of projects, as projects are meant to be started and finished. The second relates to its singularity and uniqueness, meaning that projects by nature are born and developed under an environment of uncertainty. Uncertainties can be defined as the “lack of certainty, involving variability and ambiguity, due to insufficient data, experience or detail” (C. B. Chapman & Ward, 2003). As such, uncertainties have a defined range of possible outcomes, either positives (opportunities) or negative (commonly referred to as threats or risks) (A. Murray et al., 2009). The present study focuses on the later ones, as these are the ones that can potentially jeopardize the outcomes of the project.

Across the literature is easy to find several definitions for risks. In general, they are divided into two groups, those describing risks as a function relating to the probability of occurrence and expected outcomes (Graham & Baert Wiener, 1997; ISO, 2002; Jaafari, 2001), and those describing risks as the effect of uncertainty on objectives (C. Chapman & Ward, 2004; ISO, 2009; R. Miller & Lessard, 2001; Olsson, 2007; PMI, 2017). It is believed that the latter gives a better understanding of what are risks, while the first can serve as a way to represent these events and can be used for the risk management process and the management of projects in general.

2.3.1 Risk for the Bouwteam

To understand what is considered a risk for the Bouwteam, let us first look back on the definition of risks as given initially in this section: *the effect of uncertainty on objectives*. But also, we should consider the goals or objectives of using this PDM, as elaborated in section 2.2.3:

- Make a design for the project
- Start work sooner and more efficiently
- Saving on costs to execute the design and the costs of construction
- Reduce preparation time
- Control the technical and organizational interfaces
- Ensure continuity of production in the construction process
- Jointly arrive at an optimal integrated design and agreement for the realization phase
- Collaborate in the design

We can argue that risks for the Bouwteams are not only related to the production of a design but also to how this outcome is achieved. The last is the distinguishing factor of using a Bouwteam compared to other traditional delivery methods. Required to achieve the intended goals in this PDM is reaching high levels of colaboration. In summary, we can say these are the effects that can compromise the deliverables expected of using a Bouwteam as a Project Delivery Method or how such deliverables are achieved.

2.3.2 Categorization of risks

Existing frameworks studying the factors that influence the activities in an organization have also been transferred into the risk management area, and they can help determine the nature or sources of risks. For example, some authors have divided risks according to their sources into External/Exogenous and Internal/Endogenous (Bing et al., 2005; S. Zhang et al., 2016; Zhi, 1995).

A framework for risk analysis is PESTLE/PESTEL, which stands for the following categories: Political, Economic, Socio-Cultural, Technological, Legal, and Environmental. This well-established framework is adapted to the RISMAN method, which Rijkswaterstaat jointly developed with NS Railinfrabeheer, Rotterdam Municipal Works, TwynstraGudde, and TU Delft and has grown in popularity amongst Dutch infrastructure projects (van Well-Stam et al., 2013). The present study will use these seven risk categories, as it has been demonstrated that, to a large extent, covers the possible options elaborated in other frameworks (Hoseini, 2020):

1. Technical: Risks emerging due to incorrect assessment of technologies, quantities of materials, construction method, modification in design estimates.
2. Organizational: Risks related to lack of project procedures, poor Client requirements and clarity in project scope, an insufficient workforce, and contract preparation.
3. Zoning: Risk arising from the project location, ground and underground conditions, worksite conditions, and environmental-related circumstances.

4. Political: Risks related to the acquisition (in time and form) of work permits locally at the municipality level or up to the general government level.
5. Financial: Risks related to potential financial distress overcome by the parties, abrupt changes in prices, and or access to financing options.
6. Social: Risks emerging from the interaction project-public perspective can be related to communication issues or disturbance and damages to private property.
7. Legal: Risks arising from claims between parties and errors made by contractors/consultants or clients about regulations.

Categorizing can help by providing a systematic structure to define risks and enhance management focus. In addition, it gives the participants of the process a shared understanding of what is being talked about. Moreover, risk classification is the bridging link between risk assessment and evaluation and provides a knowledge base for risk managers to select the most appropriate control strategies (Klinke & Renn, 2002). It can further help indicate situations where common approaches to the risk management process can be established (Bing et al., 2005). Following previous literature findings regarding the project delivery methods and the definition outlined earlier, we could argue that risks in the *Organizational and Financial* categories would be those of highest relevance when a Bouwteam setting is used as Project Delivery Method.

2.3.3 The Risk Management Process

The concencepts and notions of risks have a long history, but as a scientific field of study is relatively new (Aven, 2016). The management of risks is considered as a key technique for handling projects (D. Hillson & Simon, 2020; Nicholas & Steyn, 2017), where implemented effectively can help in achieving project objectives and parties motivation (C. B. Chapman & Ward, 2003; D. Hillson & Simon, 2020). As risks can occur throughout the whole lifecycle of the project; they should be accounted for and analyzed from an early conception phase. Thus, the risk management process assist on handling this aspect since the project is initiated and would only be finished after the assessment of its resulting outcomes.

A holistic perspective of this process is that of a system where interwined elements or activities interact to ultimately assist on the realization of the project goals. Academics have extensively studied the Risk Management Process and several models have been proposed in the literature (Goh et al., 2013). With perspectives raised by different authors, a comparisson analysis of its overalaping points can be found in Annex C. The diagram in Figure 7 gives a schematic representation of this throughout the project's life cycle, and the complete explanation of its steps can be found in Annex C.

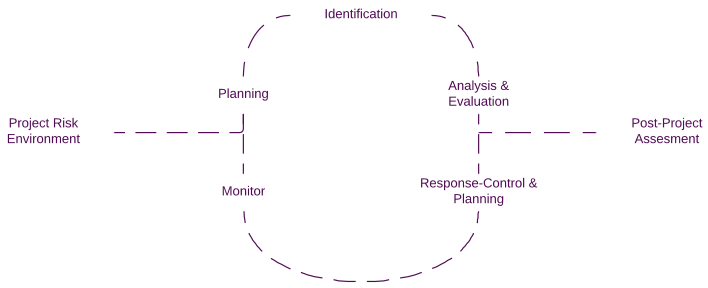

Figure 7- Risk Management Process (own illustration)

Implementation of the Risk Management practices has a considerable impact on the project results and, therefore, should not be considered a mere administrative process but instead adopted within the entire management process of the project. Furthermore, involving Risk Management within the

project's environment can influence the results (Nicholas & Steyn, 2017; Royer, 2000) by improving decision-making, creating a proactive, open environment, and increasing stakeholder satisfaction (Hoseini, 2020).

Elements of the Risk Management practice, such as fair risk allocation, have been described as critical aspects of achieving project success in collaborative contracting methods such as ECI (Wondimu et al., 2018). These elements are also present in the *Joint Risk Management (JRM)* description, defined by Osipova (2015) as a collaborative strategy for addressing inefficient risk allocation and identifying optimal ways of dealing with unforeseen events. In the application of Bouwteam models, a continuously revised risk register, flexible risk management, and the mechanism of a risk pot were found to be essential for the success of projects using these delivery methods (van der Pas, 2021) and as drivers to positively contribute in the notions of JRM for two phase contracts (Clemens, 2021). This highlights the relevance of the appropriate implementation of the Risk Management practices in the performance of these contractual forms.

2.3.4 Allocation and Control of Risks

Within the whole risk management process, the two aspects central to this thesis orbit around the Allocation and Control mechanisms, which turn out to be vital for the development of any project. The allocation will determine the responsibilities each party will hold. Once risks are distributed, the parties have the power to exercise control measures to oversee these risks, as they later can be judged over the effect these have on the project objectives.

Risk Allocation

Risk allocation is the definition and division of responsibilities of possible future losses or gains and the procedure of assigning the risks to the project participants (Lam et al., 2007). Although, the activities of allocating risks have been considered within different steps of the Risk Management process. Zhi (1995) positions this as part of the Response step, C. Chapman (1997) includes this in a step called Ownership, del Caño & de la Cruz (2002) as part of the Identification and Balancing, and Peckiene et al. (2013) consider the allocation to be a self-standing step of this process. Whether it is embedded in one of the phases of the RM process or as a stand-alone step, these mechanisms are essential as it has been demonstrated that risk allocation can lead to direct financial (Hanna et al., 2013; Lam et al., 2007) and performance consequences in the project (Abednego & Ogunlana, 2006).

In a broader analysis, Zhang et al. (2016) acknowledged three main streams in the studies referring to the distribution of risks, these are *principles of allocation*, *models for risk allocation,* and lastly, the *factors leading to improper risk allocation*. But, when it comes to risk allocation, the arising question is how parties distribute the responsibilities and liabilities of risks arising from the projects. For this purpose, Lam et al. (2007) identified seven allocation criteria to act as a basis for this decision:

1. *Whether the party can foresee the risk,*
2. *Whether the party can assess the possible magnitude and consequences of the risk,*
3. *Whether the party can control the risk chance of occurring,*
4. *Whether the party can manage the risk in case of occurring,*
5. *Whether the party can sustain the consequences if the risk occurs,*
6. *Whether the party will benefit from bearing the risk,*
7. *Whether the premium charged by the risk receiving party is considered reasonable and acceptable for the owner.*

Principles 1 to 7 were used in previous research in The Netherlands to identify and measure the risks allocation. These were found on a study of allocation balance when using PPP in the Waterworks

program (Brommet et al., 2016). Moll, (2015) used the seven principles to give insights into the risk allocation process between public and private organizations for large Dutch infrastructure projects. Damen(2019) advocates that principles 3, 4, 5 and 7 are the most important in a study analyzing the allocation of risks in DBFM projects part of the Sluizenprogramma. Hendrikx (2020) used the first listed principles to evaluate the balance of responsibilities using the UAV-GC 2005 terms and conditions. And research by Clemens (2021) on the risk management process for the two-phase contract found those in line with criteria 3 to be the most relevant when facing this decision in two-phase contracts. Criteria 1 and 2 on the listed earlier are considered less relevant, as not necessarily the party who can anticipate or evaluate the risk will be necessarily the most capable of handling them. Furthermore, the benefit of bearing the risk is related to the parties' premium for accepting to take such risk. Still, it is not believed this criterion is necessarily relevant. For example, in a stable and fair market, the parties will prefer to continue doing business as usual instead of taking additional risks regardless of how profitable this could be. Thus, it is believed that the most significant of these conditions relate to 1- The ability of the parties to control or influence the risk probability of occurring, 2-Manage and bearing the consequences if the risk occurs.

An approach being followed also in the Netherlands is called System Oriented Contract Management (SCB). This was firstly implemented by Rijkswaterstaat in 2003 and a formal framework was established in 2011 (Rijkswaterstaat, 2017). Nonetheless, other governmental agencies such as Rijksvastgoedbedrijf -responsible for the management and maintenance of real estate assets, are also implementing this approach (Nauta et al., 2017). This is used by the agencies to guarantee the quality on the development of their contracts. When it comes to the allocation, such a framework outlines that risks should be "*with those who can manage them best*" (Nauta et al., 2017), and a schematic suggestion for deciding upon this division is represented as follows:

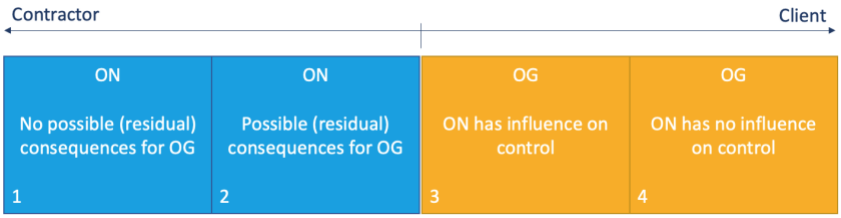

Figure 8-SCB approach for Risk allocation (Nauta et al., 2017)

As seen from the previous figure, this framework tends to have a restricted division from the allocation over the Client and the Contractor exclusively. Previous analysis on Bouwteams would suggest that using a shared risk mechanism would also contribute to the succesful implementation of this PDM (de Hoog, 2020). Attempting to solve the argument over what risks should be considered to be shared, Bing et al. (2005) suggested that risks to be shared are those "*caused by both sectors working in partnership and that could not be managed without the other party's commitment and contribution*". This would allow us to inferr that the risks to be shared would be those affecting the mutual objectives for the Bouwteam phase and that can be jointly managed by the participants.

In order to implement a shared-risks scheme, an approach found was implementing a common risk pot to face the possible consequences when a the risk triggers. This way, certain limits and ratios are settled and contribute to steering the risk, with limitations usually towards the Contractor. Clemens (2021) suggested this scheme could contribute to collaboration; however, this author warns of its implementation's investment cost and administrative burden. De Marco et al. (2016) developed a management model for participants of projects willing to use share reservoirs to deal with future risks. The remaining excess is plunged back as a benefit for these participants. This author suggested that using shared contingencies can contribute to better integration of team and project economic performance. Implementing risk provision budgets with incentives was empyrically found as an

opportunity to stimulate joint risks management in the Bouwteam (van der Pas, 2021). Finally, Adler et al. (2016) reflected that contracts using pooled risk demonstrated a high level of comprehensiveness to mitigate opportunism and engender trust in the partnership.

Risk Control

The previous sub-section described risk control as one of the steps within The Risk Management Process. Controlling risks involve the implementation of measures modifying risk, including processes, practices, or actions to alter them, although eventually, they might not exert the intended effect (ISO, 2009). As part of this process, it entails the development of specific actions with a sufficient definition to allow a practical implementation (Nicholas & Steyn, 2017). The findings in the literature would suggest that the most adopted measures to control risks are:

- *Avoidance:* This measure has the most frequency of appearance in the reviewed literature. Ths mean eliminating the threat or protecting the project from its impact (PMI, 2017). Lukas & Clare (2011) states that this response seeks to eliminate the threat by taking actions for the risk to go away completely. Different approaches were found on this way of responding to risks. For example, executing the project in a different way leading to the same objective or insulating the project from the effect of the risk (D. Hillson, 2002), changing the project management plan (D. Hillson & Simon, 2020), increasing supervision, minimizing system complexity or including redundancies (Nicholas & Steyn, 2017). Also, ISO (2009) mentions the possibility to drop the activity leading to the risk to evade exposure to such a particular threat. However, this last approach is too simplistic, as specific actions will have to be performed to meet the final objectives, and resigning to do them will not contribute to the intended result.
- *Accept*: This response is the second most mentioned by authors and involves the recognition of the risk and its residual effects, but no further action is taken on its influence on the project objectives (D. Hillson & Simon, 2020; Nicholas & Steyn, 2017; PMI, 2017; Y. Zhang & Fan, 2014). This mechanism is expected to be used on those low-priority risks or when it is impossible to apply a cost-effective measure to address them (PMI, 2017).
- *Transfer:* This is understood as shifting the ownership to another party that can better manage it (D. Hillson, 2002; D. Hillson & Simon, 2020). Risk transfer usually involves the payment of a premium (PMI, 2017) or can be as well done by acquiring insurance policies (Y. Zhang & Fan, 2014). However, Nicholas & Steyn (2017) sustain that although risks can be transferred, they cannot be ultimately 'offloaded'.
- *Mitigate:* Actions are taken to reduce the probability of occurrence or their impacts, including adopting fewer complex processes, conducting tests, prototyping, initiating parallel developments, and increasing technical review (D. Hillson, 2002; PMI, 2017; Y. Zhang & Fan, 2014).

An additional control measure is using *contingencies* (ISO, 2009). PMI (2017) defines these as "reserves to account for events that could affect the execution of the project". These are usually applied into two planes, within the budget as a percentage markup based on an estimate (Mak & Picken, 2000) or as a time contingency within the project planning, usually through the use of a buffer added on activities and expressed as a percentage of the project duration (Barraza, 2011).

The fundamental question is what mechanisms or strategies will be chosen to cope with the risks. This subject has been addressed following two streams: those looking over the effectiveness of methodologies for the appropriate selection of risk responses and those investigating the attitude of decision-makers to select such responses (Yan et al., 2021). The latter studies suggest that opting for different measures will depend on the attitude and willingness of the decision-maker(s) towards risks and the preferences of organizations towards risks relative to their ambitions and their available resources (Hoskisson et al., 2017).

Using a semi-quantitative approach, a set of 6 principles to address the effectiveness of risk responses was elaborated. These were later used to analyze the effectiveness of responses to opportunities (D. Hillson, 2001; D. A. Hillson, 1999):

1. *Appropriate:* The level of response should be determined according to the "size" of the risks.
2. *Affordable:* The resources spent on addressing the risk should not exceed the available budget or the degree of risk exposure.
3. *Actionable:* Giving a time frame within which responses need to be implemented.
4. *Achievable:* Responses that are not feasible are far from being realistic.
5. *Assessed:* Assuming effective implementation, will the post-response scenario ensure the conditions to continue with the project.
6. *Agreed:* A consensus and commitment of the stakeholders should be obtained before deciding on the responses.

2.3.5 Risk Model

The model proposed for this research is expected to have the form of a three steps diagram. The chosen form of representation is expected to provide easiness and simplicity of use. To build this model, the risk register of the projects will be collected. With this data, the risks that have been identified will be grouped. This grouping is of central importance as it can determine those more relevant when a Bouwteams is used. The categorization can also help link specific risks to their adopted response measures.

In addition to the documentation analysis, a consultation round employing semi-structured interviews will help shape the preliminary version of this risk model. The essential questions addressed in these sessions can be found in Appendix D. Finally, with the risk model assembled and experts' help, a resultant version including the perspective and insights from this panel will be outlined.

2.4 Conclusions

The present section was oriented to conduct a review of the literature to answer the first two sub-research questions:

SRQ 1- What are Bouwteams and where they stand as part of the collaborative project delivery methods in the literature?

Organizations with different roles in the construction industry acquire services and goods through different approaches or methodologies. The structure for organizing and financing the acquisition of the goods or services required to carry out the design, construction, operations and maintenance activities is defined as a Project Delivery Method (J. B. Miller et al., 2000). A broad range of these organizational systems have been used throughout time, and new ones have emerged to cope with new requirements in the industry, increased complexity, an accelerated pace of technology and constant flow of information. Collaborative project delivery methods are focused on integrating the expertise and knowledge of the different actors in the construction process. Partnering, Integration, Alliances and ECI contracts differ from the traditional way to delivery a project. Of these approaches, the one generally accepted across the literature is using the principles of Early Contractor Involvement. But this is a broad concept and is not supported by the different legal systems of every country in the same way.

A way of involving the contractor from an early phase is through the use of a two-phase process. When using this approach, Client and Contractor work on the design phase and if this is succesfull they will move on to the execution of the project, or the contract will terminate in the first phase (Fijneman, 2020). Within the wide range of delivery methods using a two-phase process, the most widely accepted form in The Netherlands to involve the Contractor's knowledge during the design phase is by making use of the Bouwteam agreement. This model of agreement is usually implemented during the initial phase of a project. With its early origins in The Netherlands in 1992 its implementation goes back to the general conditions for the design team in which a contractor takes part (VGBouw, 1992). This model was developed back then to respond to the housing shortage the country was facing. Its implementation has gained popularity as a response to the market pressure and as an alternative to tackling some problems often found in the construction industry. This delivery method is attractive for both sides, Client and Contractor, as it brings the parties to develop and work over an initial set of alternatives which are narrowed down and further elaborated until an optimal solution is achieved. This agreement requires both parties to interact on an equal basis and contribute with their expertise in different domains. Its implementation is growing in popularity as more and more projects are completed and their objectives accomplished. Several advantages have been reckoned with in its use. Still, the key to its proper implementation is the participants' qualities and attitude to execute their tasks in a collaborative environment.

SRQ 2- What methodologies or principles are used in literature for the allocation and control of risks in infrastructure projects?

Although several frameworks exist in the management literature to implement the Risk Management process (Goh et al., 2013), they agree that this is a continuous practice starting in the early phase of the project but is not entirely done without a post-assessment of the project after its completion. The allocation and establishment of control measures for risks are usually done during the Risk Management process's *Identification* and *Control & Planning* steps, respectively. Risk allocation is the definition and division of responsibilities of possible future losses or gains and the procedure of assigning the risks to the project participants (Lam et al., 2007). The literature explored is conclusive suggesting that the relevant criteria to decide on the allocation of the risk is generally understood to be the capacity of the parties to control either its cause or steer the consequences of the risk. Extending from project to contract management, these principles hold still and are used by official governmental agencies of The Netherlands in practice (Nauta et al., 2017). Once the allocation is defined, the implementation of control measures will serve to either prevent the risk from happening or decrease its effects on the project's objectives. Controlling risks involve the implementation of measures modifying risk, including processes, practices, or actions to alter them, although eventually, they might not exert the intended effect (ISO, 2009). In literature, the commonly accepted way to stand against risks is by using the mechanisms of *Avoidance*, *Acceptance, Transfer, and Mitigation. Contingency* as a proportion of the budget or as a buffer in the planning also complements the general control measures to risks.

Besides helping to tackle the previous research questions, the literature review helped outline a set of theoretical propositions, which will be explored later throughout the empirical study. These can be summarized in the following:

Risks part of the Organizational and Financial categories would be those of highest relevance when this type of Project Delivery Method is used.

The criteria to decide on the allocation of risks will relate to the parties' ability to control or influence the risk probability of occurring and their ability to manage and bear the consequences if the risk occurs.

The Bouwteam as PDM involving the Contractor from an early stage in the process will help decrease the risks of the execution phase during the design.

Case Study set up

This section will first introduce the pre-assessment of cases inside Witteveen+Bos and those explored outside the organization, raising the final selected 4 cases. Later, the protocol followed throughout the investigation is presented, and lastly, an overview of the tool used for the documentation analysis.

3.1 Pre-assessment of cases:

A case study is an act of extensively studying something, in particular, to extend one's understanding of what is said (Wikfeldt, 2016). Case studies have proved to help examine contemporary events and situations when the relevant behaviours cannot be manipulated. This method uses the observations of the events and interviews with those involved in the circumstances (Yin, 2009b). One of the main drivers to expand the sample of cases for the analysis is that W+B counts with most of its projects in the GWW category. Furthermore, this could possible help deriving into a generalization of results and was further fueled by the curiosity on how other organizations do the process in the scope of this research.

Projects inside W+B

Witteveen + Bos, from here on W+B, has been an engineering and consultancy firm with presence in the Dutch construction market for over 75 years. The company possesses experience in projects of water, infrastructure, and construction. However, it does not limit its participation to develop the technical specifications for projects but also assists parties and clients in the market to draft contractual agreements, evaluate proposals of those interested in being part of a project and control the development of these projects.

A wide range of activities in the market makes the projects or areas covered by the company not suitable for this research's scope. In the first place, a round of consultation retrieved 40 projects. Those projects where W+B was not awarded as a designer or consultant were discarded. This decision was taken under the belief these would not represent the company's leading role within the Bouwteam phase. Projects in the tender or preparation phase were also removed from the preliminary analysis, as these would possibly not be developed enough to provide the needed information.

Once this initial filtering was applied, the number of projects was short-listed to 21. Out of these 21, 1 is a Non-Residential Industrial project, and the remaining 20 are part of the GWW category. The categorization of projects follows that of Rijkswaterstaat. These were classified into *Residential Buildings*, *Non-residential Construction*, *Building Maintenance,* and *GWW* (McKinsey, 2019). GWW comprises those disciplines for the construction of dykes, canals, earthworks, dredging, hydraulic engineering, water and waste resources, and road and transport. Figure 9 illustrate how the 20 projects in the GWW are further classified.

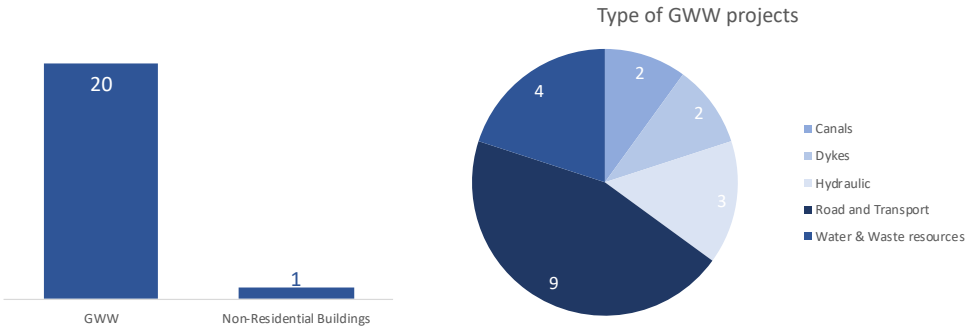

Figure 9-Types of projects by category

Projects outside W+B

Using the website TenderNed, a set of data can be extracted, which turns out to be of significant value. At the moment of this review, all the public announced tenders from 2013 and up to the second quarter of 2021 were ready to be downloaded from this website. Data characterizing the announcements, such as its publication dates, description of the tender, type and purpose of the tender, works or service to be provided, and if this is a European or National procedure, can be found on these files. Another consulted source was Negometrix. A particular focus for this analysis was given to those procedures announced from 2018 onwards.

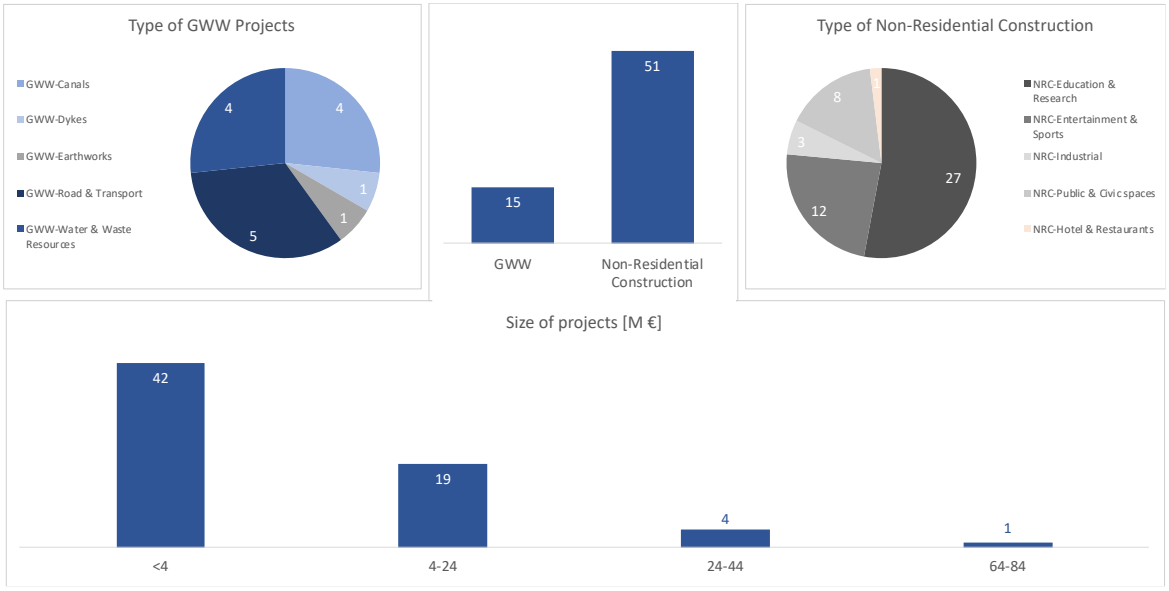

Figure 10-Type and size projects outside W+B

From the resulting 66 projects found, more information was scanned through the web to find the parties involved like the client, contractor (s), consultant (s), project size, and the contacts of their representatives. These projects were classified following the same principles as in the previous section. In Figure 10, the distribution of the type and range of size of these projects is depicted. Of the 42 projects in the < € 4 M range, 35 were assigned with a value of 0 as the data was not found when writing this report. Given that not all the necessary information to develop the risk model (risk registers and logs, a contract between parties, etc.) is available in the TenderNed datasets, these were requested from the representatives of the projects via email or telephone whenever their contact detail was available. Although an answer was not retrieved back in most cases.

3.2 Criteria for the selection of cases:

A set of criteria was established and applied to the pool of projects found in the different databases with the objective of funnelling the number of cases for the analysis and adjusting them to those that comply with the scope of this research. The criteria used were the following:

a. *Bouwteam:* Those projects to be analyzed should use a Bouwteam. Regardless of the agreement model used, they should connect to the realization phase with an integrated contract (UAV-GC) for the reasons explained in Section 2.2.3.

b. *Size of Project-Contract value:* Rijkswaterstaat considers three bandwidths in its report. The first can be regarded as *small* projects and comprehend the range between €5 M-€35 M, *medium* are those varying from €35 M to €250 M, and those above €250 Million are considered *Large infrastructure projects* (McKinsey, 2019). The present research uses the bandwidth between €9 M and 150 million euros to narrow the case selection. It was decided to do it in this way on the belief that for such a range, the necessary data for this study would be available and could further have a straight link with the availability of the participants. Also because quite a big share of the projects within W+B's portfolio are comprehended in this range.

c. *Status of the project:* When choosing the projects to study, there was a preference for those which were more advanced in the design phase. The selection comprehended projects that were close to reaching their realization phase. The reason to do this is that more data could be retrieved from projects in an advanced status.

d. *Diversity of the projects:* An aspect to consider when selecting the cases is to ensure a diverse analysis sample. Therefore, an eye is kept on not solely focusing on one specific type of project, limiting the generalization of the results and findings. Furthermore, an advantage of looking at different types of projects is decreasing the possibility of rival explanations (Yin, 2009b), which could limit the concepts' generalizability. Furthermore, looking into a varied sample will ensure that the topic of interest is well explored and possibly revealing aspects examined through various lenses (Baxter & Jack, 2015).

e. *Availability of data:* The research cannot be carried out without data. The documents to be used should be available for its access. The data to be used will be the risk registers, risk logs, the contract used, and the people involved in the project should be reachable for interviews. At least two interviewees should be available for this process.

Final selection and overview of the cases to be studied

Although a vast sample of projects was consulted internally and outside W+B, not all complied with the established criteria to continue the analysis. An overview of this check of the requirements for the total sample can be found in Appendix F. However, from this sample, three projects inside W+B and one project outside the organization complied with the requirements for the analysis, as seen in Table 2. Following a brief introduction to the cases in done.

Table 2-Criteria check on the pool of cases

				Criteria						
Source	Code	Type of Project_ Cat 1	Type of Project_ Cat 2	Availability of data - Risk Registers *	Availability of data - Participants *	Availability of data - Contract between parties *	Bouwteam	Connection type to realization	Status of project	Size of Project (Contract Value)
W+B	A	GWW	Road and Transport	✓	✓	✓	✓	✓	✓	✓
W+B	B	GWW	Dykes	✓	✓	✓	✓	✓	✓	✓
W+B	C	GWW	Water & Waste resources	✓	✓	✓	✓	✓	✓	✓
Outside W+B	E	Non-Residential Construction	NRC-Public & Civic spaces	✓	✓	✓	✓	✓	✓	✓

Project A: Bridge Construction

This project consists of constructing a new movable bridge and renovating one deck of the existing structure. Given this bridge connects two prominent localities in the north of the country, it is of high importance for the province where it is located, as it provides service for a high volume of road and maritime traffic moving through the region. This aspects plays a significant role in the constructability of the execution phase, as the link must remain open to the public with only a limited disruption in its capacity throughout the whole construction process.

Project B: Dyke Reinforcement

The rising water level requires the infrastructures preventing floding in The Netherlands to be updated. Several of these engineering works must be strengthened to make the existing infrastructures around the country compliant with the latest safety standards and requirements. This project comprises the strengthening of approximately 14 km of a dyke section protecting a locality from the rising water levels.

Project C: Water treatment plant

The Client for this project, a Water Board, intends to renovate the existing sewage and water treatment plant with new implementation techniques modules and a strong focus on sustainability for this project. The plant, which was lastly renovated in 1988, will no longer meet the future requirements of capacity and changes in regulation and legislation for such type of infrastructure and is therefore required to be extensively overhauled.

Project E: Bridge control and support centre building

With a high number of bridges in a Northern province in The Netherlands, the Client requires a centralized station for its control. Therefore, the main building of this project consists of over 2500 m^2 of covered area. Under this, the electronic systems for the bridge monitoring will be allocated, and the working places will support the province's water management activities. Furthermore, creating additional storage for materials within the same building unit was in the scope for this project. Lastly, the surrounding areas had to be adapted and an extended parking lot for automobiles together with a docking area for boats had to be build.

3.3 Case Study Protocol

This section is dedicated to explaining the documentation to be reviewed, the set-up of the interview and the process of contacting the project participants, and a description of the use of the tool to

review such data. This set of guidelines helped the researcher during and after the case study. Furthermore, a case study protocol is helpful as it helps ensure uniformity of the data collected and the analysis (Maimbo & Pervan, 2005; Yin, 2003).

Documentation under analysis

A set of documentation was requested from the participants and reviewed in detail for the research. An overview of the scanned documents per project is listed in Annex G. However, these comprehended the followings:

- Call for tender
- Tender guidelines
- The Bouwteam agreement
- Integrated plan of approach
- Demand of specifications
- Risk register
- Interview transcripts

While some of the documentation was provided by the representatives of the projects, some other documents were publicly available on the project websites or specific platforms such as TenderNed. As for the interview, transcripts were produced and collected in interaction with the project participants; which is further explained in the upcoming section.

A computer-aided qualitative analysis tool was used to create a workflow that facilitated the extensive set of documentation analysed, including the contractual documents, risk registers and the interview transcripts. This type of software provides a methodological framework to process qualitative data (Blismas & Dainty, 2003), aids to handle big data sets, and produces interconnections and links between different documentation and sources. The software ATLAS.ti. was chosen as TU Delft provides licensed access for students. The workflow used within ATLAS.ti. is depicted in Figure 11:

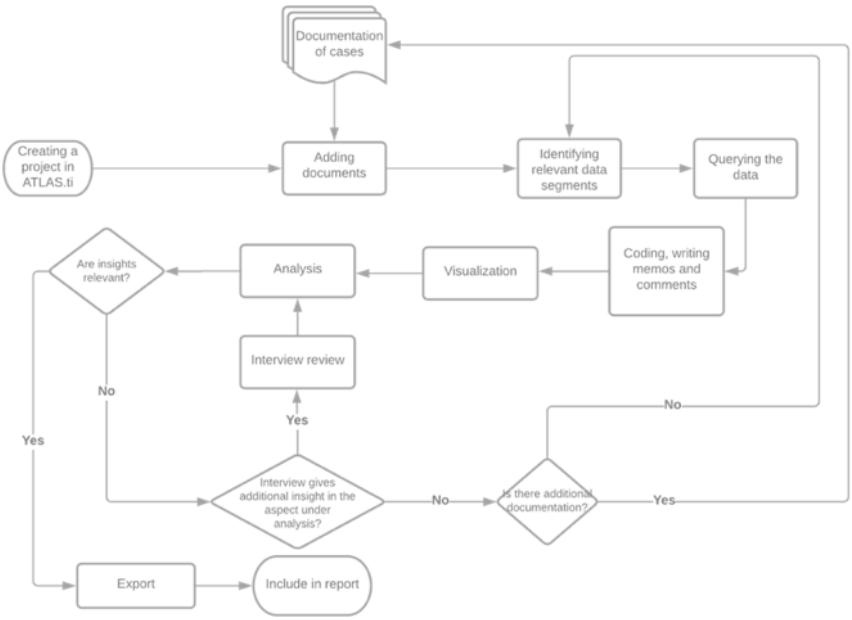

Figure 11-ATLAS.ti workflow

Semi-Structured Interviews

Semi-structured interviews are a helpful methodology to gather data as they provide great versatility and flexibility (Kallio et al., 2016). This technique has helped explore sensible and complex topics (Louise Barriball & While, 1994) and is usually applied in social, economic, and management research. A benefit of using this method is that guidelines are established to follow during the encounter. Still, enough room is left to elaborate on alternative questions that can detach from the central theme and enrich the content while the consult is being held.

Out of all the possible professionals involved throughout the process of the Bouwteam in the representation of the different parties, participants were chosen using a non-probabilistic approach named convenience sampling. Here, a set of individuals conveniently available with specific knowledge (Fink, 2021) on the projects' activities are reached to help answer the query and tackle the research questions proposed for this section. A profiling set of characteristics of the interviewees can be seen in Figure 12. Getting a broader perspective of the possible findings was essential to limit bias and strengthen this research results. For this purpose, the sample of interviewees was compounded by at least one representative of each of the parties involved in the Bouwteam, namely the Client, Contractor or Consultant, and all of them took an active role in the design phase for such project.

Figure 12- Interviewees profiles

Session set-up

The questions to be addressed during the interviews follow a structure comprehended of questions specific to the *central theme,* and *follow-up* questions (Kallio et al., 2016). Although these are further divided into four sections as per the following arrangement. The complete set of questions is presented in Appendix D.

Section 1- General Questions: Aimed to collect general information about the interviewee.

Section 2- Background Information: Collect data about participants' experience using Bouwteams.

Section 3- Case study Project Information: The target is to investigate the particular risks of using this delivery model. As not all the risks might be included in the registers, the discussion aims to understand why this happens and if there are risks that were missing when producing this database. In addition, the relevance or predominance of specific risks for the interviewee's perspective when applying this PDM was explored.

Section 4- Features needed in a risk model for Bouwteams: In this section, the participant will be asked to contribute from his/her experience on what guidelines are missing in using a Bouwteam related to the management of risks. The questions in this section target three aspects, *allocation*, *control,* and another set of general questions for the model development. The goal is to understand what principles

were used to define the allocation of the identified risks in the corresponding parties and why specific response measures were chosen for those risks.

All interviewees were aware of the type of information being produced and granted permission to use the aggregated data that came out from these sessions. For this reason and preliminary to the sessions, a consent form was sent with the invitation to participate, as can be found in Appendix E. In this form, the participant is given an overview of the purpose of this research, the interviewer, the use of the data, when, where, and how the interview will be performed, and if there is any risk associated with taking part in the process.

Following this introduction, the participants are asked to give their consent on three aspects: participation in the research, the use of information from this study, and the future use of the data by other researchers. The form was customized per project and submitted to the participants.

Performing the interviews

Before conducting the interviews with the actual participants of the projects, a pilot test was performed. The pilot test served to check the assertiveness of the query to be used later on and to check whether the questionnaire was formulated correctly, guiding the participant to provide the type of information needed for the study.

Given the measures in place at the moment of this consultation related to the COVID pandemic, face-to-face encounters were advised to remain at a minimum. Nevertheless, this situation was an opportunity exploited as more than one session could be held on the same day. The physical location of the subjects did not represent a limitation or constraint in moving to a specific city or office to host the interviews. However this setting justified the recording of the sessions. The interviewees were encouraged to share their opinions and experiences in a comfortable environment freely. Once the session was held and the transcripts checked, these were forwarded to the interviewee to confirm that the processing was done correctly. This member-checking procedure helped enhancing the trustworthiness of the data collected (Birt et al., 2016).

Case Study results

This chapter looks at the four projects selected for the multiple-case study. The structure of the section is as follows; each case is described on the activities done during the Bouwteam, the Risk management methodology followed, the risk for the Bouwteam in the registers and extracted from the interviews, their allocation and control measures. Lastly, for each case, interim conclusions from the results are drawn.

4.1 Project A: Bridge Construction

The first project in the analysis is the reconstruction of a bridge in a northern province of The Netherlands. The existing bridge, which is a crucial link connecting two prominent localities in the region, counts with two movable decks, out of which one will be demolished and replaced by a completely new structure. At the same time, the other has to remain open to the public. Once the new system is set, the existing one will close to traffic, allowing the old section to be renewed. The phasing needed to be adopted during the execution is part of the most challenging aspects of this project. Furthermore, a set of ambitions and objectives have to be accomplished in circularity.

For this case, three participants in the project were interviewed. Two of the interviewees worked for the Client (A_OG1 & A_OG2), while the remaining is part of the Contractor (A_ON1), all of them playing an active role in the team. All interviewees had previous experience using Bouwteam as a project delivery method.

Table 3-Project A descriptive data

Client	*Contractor*	*Bouwteam model in use*	*Connection realization phase*	*Contract value*	*Status at consultation*
Province	Main Contractor	Consultation version of DG2020	UAV-GC	€20M	-Price and contract formation for the realization

The activities to be done during the Bouwteam phase
During the Bouwteam, the Client and Contractor had to analyze the contract information, detail and develop the requirements, functional, and system structure up to a conceptual level, and create the top-level design of the system during the startup or synchronization phase as was named in the project documentation. This task was followed by the preliminary design. Then, the functional and system structure was prepared according to the level of the subsystem specifications, meaning a more detailed level of the supporting structures taking part in the whole project. Finally, this preliminary design was turned into a final design. Then, the system structure had to be developed up to a physical level of detail, in which the technical interfaces were entirely resolved.

RM methodology used during the Bouwteam phase
By contract, it was established that the methodology to follow would be the RISMAN methodology, as this is the already implemented method used by the Client. The Contractor was adapting this methodology to its organizational environment, a situation that created a treacly startup, given both parties had different quantification scales to measure the risks, as observed by the three interviewees.

While contractually, the task of producing and maintaining the risk file was a joint effort of both parties, in practice, the Contractor took the lead in this respect and was responsible for maintaining, doing the follow-up over the listed risks and updating its status. In addition, this file was handled through the Contractors' software environment.

During the Bouwteam, risk sessions were held on a 4-weekly basis. In these theme-oriented sessions, members of the Contractor team worked together with the Client. During the meetings, designers and engineers from different technical specialities discussed the objects being designed. In addition, safety and environmental experts were involved in some of these sessions to provide input on how these aspects had to be integrated with the design system.

Risk for the Bouwteam **as found in the registers:**

Before the Bouwteam began, the Client drew an initial analysis and identified risks that could be encountered during the design. Once the project was open for tender, different bidders raised concerns or worries later included as risks in the file. Therefore, the existing database was the starting point for the file used over the Bouwteam phase. Still, all the participants reviewed it jointly before entering new data and afterwards was maintained throughout the design phase. As mentioned by A_OG2 and A_ON1, the approach was that of keeping in the database all the risks instead of leaving outside of the register those that could have a low impact or probability; and, when was needed, a set of filters were applied accordingly to the discussions or who was participating of the risk sessions.

Interviewee A_ON1 explained that the procedure was first to brainstorm the possible risks and then include them in the file. Risks were re-assessed throughout each of the design phases. A_OG2 added that at a later stage, there was a specific session to focus on the different building steps and discuss the potential difficulties that could arise from the construction process. The register provided by the interviewees counted with a totality of 107 risks. The entries in such a file were tested against the definition of Risk for the Bouwteam, as elaborated in Section 2.3.1. The complete list of risks complying that verified this condition was extracted from the registers and can be found in Annex G. The following is a summary of these:

Table 4- Risk for the Bouwteam - Project A

A_R_5: "Not good decision making"
A_R_6: "Design is delayed because no definitive choice is made about design"
A_R_8: "Contractor does not achieve its planned progress"
A_R_12: "Interfaces between different parties are insufficiently controlled"
A_R_23: "Project team does not manage planning sufficiently integrally"
A_R_25: "Bouwteam phase takes longer than planned and/or costs more money than estimated (execution agreement)"
A_R_27: "Too little quality of contractor at system and process level"
A_R_28: "Project team is insufficiently risk-driven"
A_R_31: "Other, administrative, interests hinder project planning progress"
A_R_32: "There is no integrated management of the main contractor/combination towards subcontractors/ suppliers/specialists"
A_R_33: "Insufficient cooperation between OG-ON"
A_R_34: "Changes in project team Client, also the Bouwteam"
A_R_35: "Collaboration is not going well"
A_R_4:"Bouwteam budget insufficient
A_R_36: "Target budget not sufficient"
A_R_10:"Ambitions are insufficiently fulfilled

The opinions over what types of risks were identified for this phase diverged between the interviewees. A_OG1 claimed that the discussion was more oriented towards technical and financial risks during the risk challenge sessions. In line with this, A_OG2 mentioned that during the Bouwteam, the focus was on technical types of risks and not on those related to the organizations, political or legal aspects. Contrary to this perspective, A_ON1 mentioned that the process was oriented to *"all different types of risks"*.

Risk for the Bouwteam **as mentioned by the interviewees:**

During the interviews, the participants were requested to give their opinion on the risks for the Bouwteam for this project. The following table summarizes the responses given by the interviewees.

Table 5- Risk for the Bouwteam - Interviews Project A

A_OG1	A_OG2	A_ON1
"I think the Financial aspect of the whole Bouwteam… if the final quotation for the realization of the project is higher than expected" *"It is very difficult to stop the efforts if an agreement is not reached, because there are some further steps or process that have been already initiated by the Contractor"*	*"Not meeting the ambitions… If you have excessive checks on the design is sometimes difficult to achieve certain ambitions, for example, innovation."* *"The financial aspect, as it seems that the construction can be more expensive than originally expected."*	*"Money… The client allocated a budget for this project, and we are now over this figure."* *"The initially expected budget is not realistic or according to the requirements or ambitions for the project."*

At the moment of the consultation with the interviewees, the project was in the phase of contract formation. During this period, the Client and Contractor finalize their estimates to get into a final agreement for the remaining design and execution of the project. Time before this phase of the project, there were unexpected escalations in the price offered for the tasks by the Contractor. Their opinions thus highly reflect the environment surrounding the project at that time. Consequently, the three interviewees reflected on the financial aspects as a relevant risk factor for the Bouwteam.

Allocation of Risks

Project A followed the outlines of the SCB principle to decide on the allocation of risks. Such a method was prescribed in the Integrated Plan of Approach (IPvA) as part of the Quality Control assessment. As a result, we can see in Figure 13 that the risks for the Bouwteam, as extracted from this project register, are divided into either Client, the Client and the Contractor influence, or the Contractor. The allocation decision came in a joint agreement between the parties.

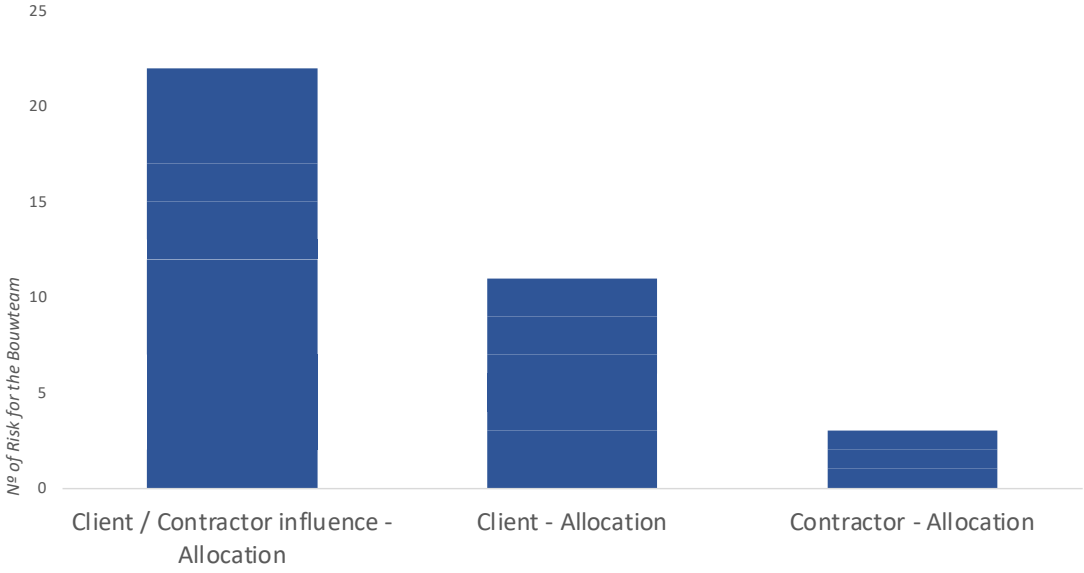

Figure 13- Risk Allocation - Project A

The figure seen before highlights that the Client overcomes a lot of responsibilities over those risks for the design phase. In this respect, the interviewees from the Client and Contractor mentioned that the allocation was the outcome of a common debate, following common sense. The other criteria to consider was the responsibility for the cause of the risk.

Control measures

For this case, the registers listed several control measures per risk. Each action was also assigned to a representative of the IPM structure of the project. Although there was a deadline to be followed for each control measure, these were not linked one-to-one to the causes of the risks. The complete set

of actions applied in the risks for the Bouwteam can be found in Annex I. However, for simplification purposes; in the following table, the responses are shown next are only for those risks in Table 4:

Table 6- Control measures - Project A

A_R_4:"Bouwteam budget insufficient"	*A_R_4_1:894: Determine SSK estimate for each phase* *A_R_4_1:895: Organize the design process efficiently and adjust the product estimate accordingly*
A_R_5: "Not good decision making"	*A_R_5_1:759: Involving stakeholders in decision-making in a timely manner* *A_R_5_1:760: Independent of choice to replace [element] continue with the design process*
A_R_6: "Design is delayed because no definitive choice is made about design"	*A_R_6_1:997: Acceptable*
A_R_8: "Contractor does not achieve its planned progress"	*A_R_8_1:56: Contract [Company] and include in contract as prescribed supplier* *A_R_8_1:57: Stay in touch with diverse stakeholders to incorporate planned events* *A_R_8_1:58: Standard keys on MEAT at SCB* *A_R_8_1:59: Discuss planning frequently* *A_R_8_1:60: Test: In PKP also treat relationship with under-ON* *A_R_8_1:61: Develop a scenario analysis in a phasing plan* *A_R_8_1:62: PMP Critical test*
A_R_12: "Interfaces between different parties are insufficiently controlled"	*A_R_12_1:785: Elaborate list of interfaces. Integrated DO lean planning* *A_R_12_1:786: Recording the principles in the start notes*
A_R_23: "Project team does not manage planning sufficiently integrally"	*A_R_23_1:531: Drawing up outline planning with main work packages and dependencies* *A_R_23_1:532: 6 weeks planning* *A_R_23_1:533: Fine-tuning the processes (agreements) from the Bouwteam phase in line with our planning* *A_R_23_1:534: Integrate planning of Contractor in Client planning* *A_R_23_1:535: Prepare planning conditioning aspects in the relationship between contract and tender.* *A_R_23_1:536: Planning session to discuss key dependencies* *A_R_23_1:537: Mapping the interface between PIP and tendering* *A_R_23_1:538: Discuss current planning within IPM and provide feedback with Bouwteam* *A_R_23_1:539: Applying for an environmental permit by Client* *A_R_23_1:540: Hanging planning in project room*
A_R_25: "Construction team phase takes longer than planned and/or costs more money than estimated (execution agreement)"	*A_R_25_1:258: Thoroughly check Bouwteam agreement in preparation for Bouwteam phase* *A_R_25_1:259: Close monitoring of the budget for the construction team phase (hours based on management)* *A_R_25_1:260: Sharpen the assessment organization* *A_R_25_1:261: Meet design manager* *A_R_25_1:262: Clearly record (joint) design decisions in the construction team phase* *A_R_25_1:263: At the start of the construction team, coordination and explanation about the desired end product* *A_R_25_1:264: Deciding how to implement the actions from the cooperation guidelines and division of tasks* *A_R_25_1:265: Quickly put discussion [design element] on the agenda* *A_R_25_1:266: Appoint 'strong' design manager of IB* *A_R_25_1:267: Discussing process Bouwteam in dialogue phase* *A_R_25_1:268: Much attention to award criteria and Bouwteam agreement* *A_R_25_1:269: Create core team with mandate for decision- making in construction team* *A_R_25_1:270: Make a capacity request to the Contractor for the Bouwteam phase*
A_R_27: "Too little quality of contractor at system and process level"	*A_R_27_1:279: Include sufficient start-up time for contractor in contract.* *A_R_27_1:280: Include clear strategy in the contract management plan* *A_R_27_1:281: Discuss the required available capacity of IPM members* *A_R_27_1:282: Have the Contractor draft PvA on the functioning of the Bouwteam phase*
A_R_28: "Project team is insufficiently risk-driven"	*A_R_28_1:321: Determining which risks should be on the agenda during dialogue* *A_R_28_1:322: Frequently involve the IPM team in the risk file and look ahead* *A_R_28_1:323: More room in IPM consultations (progress) for risks* *A_R_28_1:324: Organize a risk session in which risks are linked to work packages* *A_R_28_1:325: Creating a Visual with Mapping Risks* *A_R_28_1:326: Linking risks to work packages in Relatics* *A_R_28_1:327: Include in project plan how roll holders will manage risks*
A_R_31: "Other, administrative, interests hinder project planning progress"	*A_R_31_1:504: Arrange agreement on exact boundary [project elements] for land transfer* *A_R_31_1:505: Involve stakeholders in planning and consultation.* *A_R_31_1:506: Administrative consultation Client + Municipality*
A_R_32: "There is no integrated management of the main contractor/combination towards subcontractors/ suppliers/specialists"	*A_R_32_1:128: Attention to this risk in tender documents* *A_R_32_1:129: Attention to this risk*
A_R_33: "Insufficient cooperation between OG-ON"	*A_R_33_1:466: Carry out tests together with ON (enhances cooperation)* *A_R_33_1:467: Inclusion of Cooperation Guidelines with the contract documents* *A_R_33_1:468: Mapping the characters of the team members in the PSU also* *A_R_33_1:469: Adjusting liability in contract* *A_R_33_1:470: Give substance to the cooperation guideline during implementation* *A_R_33_1:471: Periodic measurement collaboration*
A_R_34: "Changes in project team Client, also the Bouwteam"	*A_R_34_1:611: Arranging Test Coordinator* *A_R_34_1:612: Administration of the management team*
A_R_35: "Collaboration is not going well"	*A_R_35_1:746: Use En-gager app to measure collaboration* *A_R_35_1:747: Fixed collaboration day* *A_R_35_1:748: Attention to deployment planning* *A_R_35_1:749: Make an inventory of people's needs. Provide additional training if necessary.*
A_R_36: "Target budget not sufficient"	*A_R_36_1:903: Determining [design object] by means of inspection as soon as possible* *A_R_36_1:904: Prepare cost estimate replace [design object]* *A_R_36_1:905: Decision team makes timely decision about [design object]* *A_R_36_1:906: Determine SSK estimate for each phase*

From the above table we can see that many of the responses involve additional steps of revisions and more planning and also aim to increase the efficiency of the processes involved. The interviewees agreed that these responses are selected primarily based on the team's experience regarding the particular aspect. On the Client-side, it was explained that a short estimation loop to evaluate the possible effect of the response is carried out. However, this is based on the expert assessment of the participants rather than doing a qualitative analysis. To this, A_OG2 mentioned that the responses could follow a SMART principle as a suggestion for improvement.

Interim analysis Case A

The current project was consulted in a particular stage, close to the Go/No-Go decision to sign the contract. Discussions were being held about the price offered by the Contractor on its latest cost assessment as this was above the estimation submitted previously. The interviewees' statements reflected such a situation when they were asked about the risks for the Bouwteam. Also is interesting that this was one of the risks listed in the register. Control measures for these risks depended on carrying out cost assessment at every design stage and the decision-making process. For this project, the portion of risks taken by the Client is significantly higher with respect to that taken by the Contractor.

4.2 Project B: Dyke Reinforcement

The first exploration phase for such a project lasted more than three years, followed by two years to prepare the project plans, design, application and acquisition of permits, and elaboration of environmental impact assessment. The Client is the Water Board for the region and engaged in the Bouwteam with a partnership of three contractors and an engineering firm working in combination. These participants were chosen based on the most economically advantageous tender with criteria related to the experience in cooperation, risk management and expertise with such typology of projects. A fifth consultant advised the Client on procedures and permits. Four participants of the Bouwteam were interviewed. Two of them from the Client side, B_OG1 & B_0G2, one from the contractor B_ON1 and one from the consultancy firm B_ON2.

Table 7-Project B descriptive data

Client	*Contractor*	*Bouwteam model in use*	*Connection realization phase*	*Contract value*	*Status at consultation*
Waterboard	Contractor combination	VGBouw1992 with major adjustment	UAV-GC	€150 M	Construction phase

The activities to be done during the Bouwteam phase

The process of design here was divided into two. At first, in collaboration with an engineering firm, the Client elaborated on a preferred alternative (VKA in Dutch), resulting in a selected option to focus on. Overall the possible solutions during this exploration phase, different aspects of technology, environment and spatial quality are analysed. This phase concluded with an initial prototype, which was used as a basis to call for a second tender to elaborate this design further.

The Contractor combination took the initial prototype for the second phase of design and redeveloped the model with new assumptions. This new Preliminary Design was worked out until the status of Final Design. The Contractor further developed the last into an Implementation Design for the most critical sections of the project, or those to be started at an early execution stage. Goals for this project were oriented to the planning, budget, the stakeholders of the surrounding areas, and the collaboration of the whole team.

RM methodology used in the Bouwteam
The general methodology followed for the RM process was the RISMAN method. As explained by the interviewees, this is a standard practice followed by the Client. Although this method was followed in both design stages, the Client was in charge of the RM process in the first design phase.

During the second design stage, the Client was responsible for producing and maintaining the file with those risks related to the Bouwteam phase. Likewise, the Contractor was developing and identifying risks for the Realization phase in parallel. Also, the RISMAN approach was followed by the Contractor in this task. It was explained that proceeding in this way was due to the different scales for risks of Client's and Contractor's organization. Another factor that influenced this decision was that there are different scales for the impacts of risks on the different phases. For example, while a risk for the design phase can have an order of magnitude of several thousand, those of the realization phase can sum up to millions. It was also attributed as a justification of this decision by one of the interviewees that the Client counts with more knowledge on risks that can happen occur the Bouwteam phase but not on those related to the project's construction.

***Risk for the Bouwteam* as found in the registers:**
For this project, it was only possible to access the file developed by the Contractor. The file consisted of 118 risks, and, as explained before, the overall content of the file was related to the tasks to be undertaken during the realization. The extent of this risk file was a downside raised by one of the interviewees, who wondered about the effectiveness of having such an extended list. Out of all the entries, the following can be considered a risk for the Bouwteam following the description given in 2.3.1.

Table 8 – Risk for the Bouwteam Project B

B_R_36: "Coordination with other projects."
B_R_38: "Solution transitions do not meet requirements."
B_R_37: "UO not ready in time."
B_R_39: "Unforeseen requirements from the Stakeholders."
B_R_40: "Team changes"

As it was not possible to access the file for the Bouwteam phase, the interviewees were asked if they could give more insight into their content. The interviewees highlighted that the register for the Bouwteam stage was more focused on organizational, political and financial aspects. It was mentioned that this is normal as it would be the most likely type of risk occurring during this first phase. On the other hand, as the file produced by the Contractor was focused on the realization phase, this had a strong focus on the technical aspects. This agrees with the observation done by the author. Identifying risks for the design phase was a point of improvement, as mentioned by one of the interviewees. It was argued that it would be more accurate to first brainstorm possible risks with core members and later match the outcome to a database elaborated from other sources, such as data from past projects.

As coming from the table above, the risk for the Bouwteam on this project can be associated first with the design and the integration of this design with the surrounding projects and the time available to perform the design. The rest relate to organizational aspects, both exogenous to the team, as could be B_R_39, or internal to the Bouwteam members as is B_R_40.

***Risk for the Bouwteam* as mentioned by the interviewees:**
For this project, a significant amount of time was spent during the interviews to extract as much as possible the knowledge from the interviewees regarding the risk for the Bouwteam. The table underneath summarizes the main points mentioned by the participants.

Table 9- Risk for the Bouwteam - Interviews Project B

B_OG1	B_OG2	B_ON1	B_ON2
"The assumptions for the project were not clear at all, which took us a lot of time, it's always time-related." *"Risks are very often time-related. No image or quality. It's always time-related."* *"Stikstof- Nitrogen <related policies> were a problem."* *"Every time-related issue, and especially the decision-making process of the Water Board"*	*"The quality of the people that are involved in the Bouwteam... So it is all about collaboration, and you need the right competencies to do it smarter, better and faster."* *"There are a lot of people changing the team, so the continuity of the people in the Bouwteam is also a risk."* *"There is a big risk to make the Bouwteam succeed about people not being transparent enough."*	*"The most essential is working together… even on an individual level."* *"Not having the same perception of project success."* *"Even though you have different interests, you must be able to formulate mutual goals."*	*"The available time… You need to plan and assign enough time for the different phases of the design and the different processes related to planning and price calculation."* *"Also was crucial to work together, before COVID… in the same physical environment."* *"To work on an equal basis between the participants."*

This project was caught during the Bouwteam phase amidst an essential change in the legislation regarding the Nitrogen emissions, which derived in significant changes in the plannings steps for the execution. Although the Bouwteam phase was carried out according to schedule, the statements from the interviewees reflect that time represented a significant point of pressure for this project. The complex organizational structure of the Client and the times required to follow the administrative processes are often underestimated, as was explained in the interviews. Another aspect that standsout here is the collaboration factor. Working together individually and physically in the same workplace or on an equal basis between the participants is crucial for using this delivery model.

Allocation of Risks

The risks found in the register were either divided into those for the Client, the Contractor, or for Client + Contractor. However, when looking in more depth, the latter group was screened according to the causes of such risks. Thus, where the cause was born, the responsibility for the risk was assigned, going back to the initial division Client or Contractor. For example, this was the case of the risk *B_R_38;* which could be for the Client if the risk is caused by a *lack of provisions in the contract about surrounding projects* or will be for the Contractor when *there is no coordination on the interfaces according to what is annexed to the agreement*. The following figure represents the distribution of the risks listed in Table 8 according to the register.

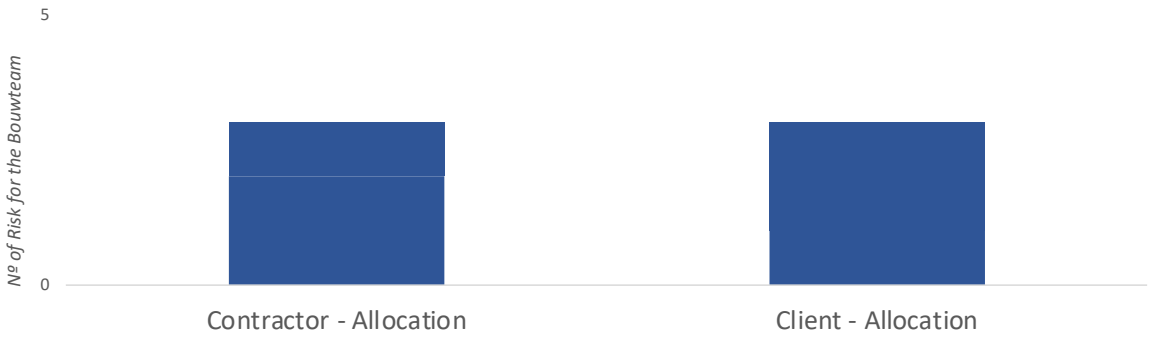

Figure 14- Risk allocation - Project B

When the interviewees were asked to explain the criteria for allocating the risks, they attributed this to *common sense* on the decisions, *who can control or bear the risk best* and *what would be the most reasonable thing to do*. It was explained that most risks went to the Client during the design phase, as the Contractor is being paid for the hours spent on the design tasks. However, it was pointed out that the correctness of such design and its update based on new decisions taken by the team will still rest

on the Contractor over the Bouwteam phase. It was mentioned that the lack of common responsibility roots in the use of the UAV-GC conditions, and as explained by interviewee B_ON2, these follow an approach that *"this is your responsibility, and this is my responsibility"*. The interviewee raised that would be convenient to have shared risks; and mentioned that using such a principle is good, given some risks are not born or caused 100% by the Client or the Contractor, and it is better to influence them between the two parties. B_OG1 saw this as an improvement that can lever the relationship between the two parties, enhance the involvement and create more awareness of the financial consequences this phase can have.

Control measures

When asked about the criteria to choose for the control measures, the interviewees did not refer to an explicit principle or approach that is followed to select for the adopted actions. However, they did agree that once the risk is identified and allocated, it is discussed in the team and based on the expert judgement, it is assigned what would be the best way to mitigate such risk. It was also added that an implicit evaluation is done on how such a measure could affect quantifiable parameters such as quality, time, cost or the environment. The following table shows the responses as recorded in the register for the project:

Table 10- Control measures - Project B

B_R_39: "Unforeseen requirements from the Stakeholders."	*B_R_39_9:12: Do not deviate from the requirements process* *B_R_39_9:13: Discuss expectations clearly with those around them* *B_R_39_9:14: Record agreements in agreements with stakeholders*
B_R_40: "Team changes"	*B_R_39_9:140 When performing additional team meetings, the initiator "pays" hassle-free change* *B_R_39_9:141 Mutual consent of OG and ON in case of key officer changes*

Assessing the effectiveness of the control measures is done during the following risk sessions. Risk owners are asked to check if the risk is latent. However, B_ON2 followed this idea and explained that after every design loop, there was an evaluation of the decisions taken and their effect on price and planning. However, the interviewee explained that *"you can only know when it ends"*, referring to how the effectiveness of the control measures taken for the risks is judged.

Interim analysis Case B

The current project is particular on how the RM practices were implemented between the two organizations, with a parallel process running from the Client and Contractor side. Splitting this process can have practical implications for the team. For example, it could create interfaces and overlaps that require additional effort to sort out. Also might be challenging to map links between risks in the Bouwteam phase and their relation to those for the construction phase.

Although the number of risks for the Bouwteam as extracted from the register was relatively small, the interviews gave a more insightful perspective on this aspect. A recurrent view is related to the time pressure for the design phase. As the Contractor's business model relies on the works of the execution, the sooner they can move on to the realization that would be best for them. The finding on the register about an important risk for the Bouwteam being the changes in the team was also sustained by the interviewees. Another aspect mentioned was the influence of collaboration and team members' attitudes. The payment mechanism for this project had a significant effect on the allocation of the risks, where most of the risks during the Bouwteam phase are pushed to the Client. It could be argued that such strict division could cause a deviation of the original purpose of the Bouwteam, which is enhancing the collaboration, but rather fostering a blame-game situation.

4.3 Project C: Water treatment plant

The primary purpose of project C is to expand the capacity of an existing water treatment plant. The conceptual design was done by the Water Board, the Client, in association with an engineering firm

and the developer of the particular technology to be implemented. The subsequent design phases were performed using a Bouwteam where the Client and a lead Contractor had to develop the concept from preliminary and up to the Final Design. The Contractor was advised on its duties by two sub-contractors and an engineering firm, which contributed with different expertise to this project.

One of the main ambitions for this project is to implement the adopted policies of circularity from the Water Board. This ambition is boosted by using a patented modular technology that uses a plug-and-play principle, making possible the re-location of the tanks and different systems in the future if that is required. However, an added challenge for this project is that the existing plant has to continue functioning while the new modules are built and installed next to the existing structure.

For this project, three participants were interviewed; one of them from the Client (from now on, C_OG1), and the remaining two from the technical contractor group, C_ON1 and C_ON2 from here on. All the interviewees have previous experience with the use of this PDM.

Table 11-Project C descriptive data

Client	*Contractor*	*Bouwteam model in use*	*Connection realization phase*	*Contract value*	*Status at consultation*
Waterboard	Leading Contractor + technical contractor group	DG2020	UAV-GC	€40 M	End of the design phase

The activities to be done during the Bouwteam phase

Using the program of requirements drafted by the Water Board as a basis, the Bouwteam had to develop the initial concept up to a Final Design condition. In the initial design stage, the Contractor had to do a study on the alternatives that could be implemented for this water treatment plant. During this phase, creating the execution plan for the works and jointly producing a risk file were also among the contractual obligations. These duties had to be fulfilled, maximizing the circularity in the design, seeking to commission the construction works as soon as possible and fostering an environment of collaboration between the team members, all of which had to be done within the specified budget for this phase. As a result, the Bouwteam phase for this project lasted slightly more than a year.

RM methodology used in the Bouwteam

There was no prescribed methodology in the contract for this project to be followed for the risk management process. However, the RISMAN methodology was implemented, which is adopted within the Client's organization structure and used in other projects. The contract agreement ruled the process for two aspects; the first one is the content of the file, which should count at least with a unique identification of risks, their description, probability of occurrence and likelihood of its consequences measured in time, money, quality, image, safety and environment, the ownership of each risk, its control measure, residual risk and the control measure for this last.

The second aspect is related to the development and maintenance of the risk file. A jointly established risk file was amongst the objectives of the Bouwteam. However, in the appendix detailing the description of activities and documents to be produced during this phase, the contract stipulated that the Client held the responsibility for making this file during the Startup phase and Design phase. At the same time, the Contractor offered a supportive or advisory role over its development. The task was eventually carried out by a consultant appointed on behalf of the client to coordinate the identification and conducting follow-up sessions for the listed risks.

***Risk for the Bouwteam* as found in the registers:**

The identification of risks was done first amongst the IPM members and later with a different specialist. Once combined, the list was disclosed to the team members for general assessment. The Client provided five versions of the risk files for this analysis. The earliest version corresponded with an initial stage of the Bouwteam phase, and the last version provided was from a date close to the end of the design. As explained by C_OG1, the focus of the initial versions was on risks for the Bouwteam phase, and then the content leaned over those risks relevant to the construction phase. Following the definition given in Section 2.3.1, the following table shows which were the risks for the Bouwteam phase of this project according to the registers:

Table 12- Risk for the Bouwteam - Project C

C_R_41: "The project is not optimally designed, realized and managed in a circular manner."
C_R_42: "Variant choice influences the design process."
C_R_43: "Design does not meet the minimum requirements for landscape integration of the municipality [where the project will be established]."
C_R_44: "Document management of the project is not in order."
C_R_45: "Insufficient available capacity and knowledge of project employees."
C_R_46: "Permits were not issued on time."
C_R_47: "Planning management is insufficient."
C_R_48: "System Engineering is applied incorrectly or inefficiently to this project."
C_R_49: "Modules do not meet [Patented technology] requirements."

This project had particular requirements about using patented technology in the design and others concerning modularity and circularity in the system. These features prompted risks related to integrating these conditions within the structure like C_R_49 and C_R_41. Furthermore, there were expectations on using the system engineering process over the design and the whole project, as was observed in C_R_45 and C_R_48. Conducting the study of different alternatives was among the duties of the Contractor. However, we can see that an associated risk is reflected in C_R_42, which had consequences on the achievement of the final design.

***Risk for the Bouwteam* as mentioned by the interviewees:**

As for the other cases, the participants of the interviews were requested to say what they considered a risk for the Bouwteam. Summarizing their statements, we find the following table.

Table 13 – Risk for the Bouwteam - Interviews Project C

C_OG1	C_ON1	C_ON2
"Working together. That's the biggest challenge. It will never result well if you do not work like a Bouwteam. You have to be open and share things." *"I think the biggest risk of a Bouwteam is that people do not work together with the way it's intended."*	*"The personal characters can be considered critical because you have to cooperate."* *"Indecisiveness"* *"We all have expectations… Unfortunately, the exchange of information can create confusion and misunderstanding."* *"You need to produce less information, but information of excellent quality. So we have to downsize the quantity of information."*	*"The cooperation in the team"* *"Not meeting the ambitions or goals of this project [Circularity/Modularity]."* *"Not being able to do the design within the planned time."* *"The quality of the resulting product of the Bouwteam phase could not be sufficient."*

Technical aspects such as the quality of the final product or meeting the ambitions set for the design were mentioned, and the achievement of the design within the planned time. The remaining statements relate to the team's interaction as collaboration and cooperation.

Allocation of Risks

Project C followed the outlines of the SCB principles for the allocation. Therefore, in the registers, the entries were catalogued as Client, Client /Contractor influence and risks for the Contractor. However, the contractual documentation provided by the participants did not refer to this approach. The risks for the Bouwteam from the register and how they were allocated are shown in the following figure:

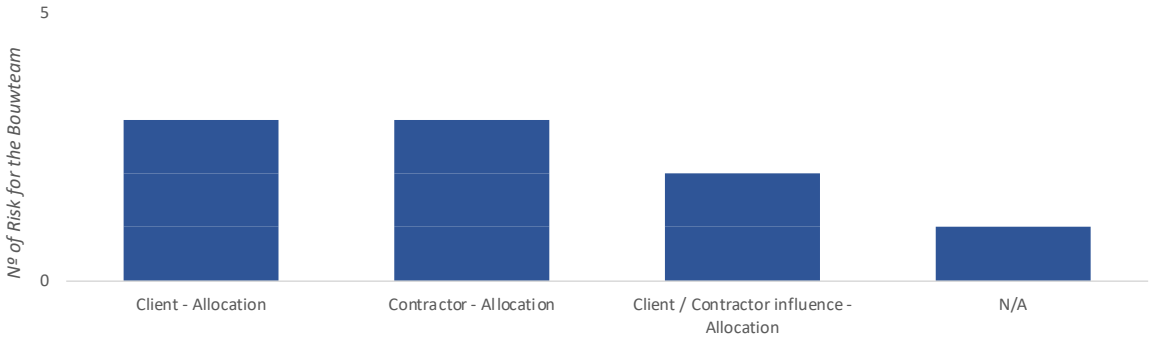

Figure 15- Risk Allocation - Project C

In the figure before, C_R_43 is marked as N/A as it was not assigned following the principle stated before. Risk C_R_46 & C_R_47 were allocated to the Client and where the contract had influence. In C_R_46: *"Permits were not issued on time"*, the Contractor exerts influence as the designs needed to apply for permissions might be delayed, or the documentation quality could be insufficient. For the case of C_R_47: *"Planning management is insufficient"*, the risk derives from the lack of attention to the planning and the uncertainty of the decision of variants being elaborated by the Contractor, affecting the achievement of the milestones of the design.

The different versions of the register allowed us to see the evolution of the allocation of risks throughout the design phase. In the interviews, it was explained that the Contractor bought off some of the risks from the Client during the negotiation phase. C_OG1 suggested there was a significant effort spend on clearly defining the allocation for some risks that could be transferred in the realization phase.

Control measures

The control measures in this project's register were listed and linked to the causes that could lead to the risk. This approach came as a recommendation by one of the interviewees. The following table lists the responses for the risks seen in the previous table:

Table 14- Control measures - Project C

C_R_44: "Document management of the project is not in order."	*C_R_44_4:63: Appoint a document manager who keeps the project file in order and facilitates the role holders.* *C_R_44_4:64: Maintain document registration on a monthly basis.* *C_R_44_4:65: Frequent testing of the file for completeness* *C_R_44_4:67: Drawing up a document management plan (on how to deal with documents in collaboration with Contractor)* *C_R_44_4:68: Periodic checks whether document registration is in order.*
C_R_45: "Insufficient available capacity and knowledge of project employees."	*C_R_45_4:84: Teambuilding, addressing team members on performance, management of expectations, the right person in the right place* *C_R_45_4:85: Outsourcing parts on a product basis* *C_R_45_4:86: Provide insight into required capacity for the project* *C_R_45_4:87: Clarity in roles and required hours (for the entire project organization) to be able to fulfil the role properly and to let people focus on this project* *C_R_45_4:88: Achieving efficiency by doing multiple projects with 1 team* *C_R_45_4:89: Make capacity needs known to Client.* *C_R_45_4:90: Identifying the undercurrent of why colleagues leave make known to the client*
C_R_47: "Planning management is insufficient."	*C_R_46_4:120: Keeping Bila's with the IPM roll holders* *C_R_46_4:121: Frequently discuss critical planning elements during IPM consultations* *C_R_46_4:122: Test planning by [Client team member]*

When looking at the content of the measures, recurrent ways of tackling the risks additional checks on the documentation. An interesting response is that of C_R_45_4:85, which could be considered a way of transferring this risk to an external party. As of C_R_46_4:120, the term *"Bila"* comes from a Bilateral Interview, a conversation held between the manager and team members to get control over the output of the tasks.

The interviewees stated that risks related to the collaboration are usually hard to manage or assign a response given the difficulty of their measurement. Therefore, when an evaluation of the status of such risks during the following review has to be done, the risk manager will have to trust their feeling about the team environment to decide on its effectiveness or if a change is needed.

Interim analysis Case C

The analysis of project C and the different interviews with the participants from the technical contractor group allowed understand how the RM process cascade further from the Leading Contractor. For example, although the prescription in the contract suggested a joint development of the risk file, and although it was built on different participants' contributions, this was maintained and followed by an appointed person from the Client on a more centralized basis. This situation could negatively affect the awareness of all the IPM members on the status and evolution of the RM process.

The interviewees' perspectives on risks for the Bouwteam did follow the findings on the registers, at least on the subject of the Documentation Management (found in the register) and Quantity of Documentation (stated during the interview). Another resemblance point was the accomplishment of the objectives or goals, Planning – Management (Register), and time for the production of design (Interview). As of the analyzed registers, the author observed that most of the risks were assigned to the Client, either directly or when the Contractor could influence its control.

4.4 Project E: Bridge control and support center building

Project E, which is now partially delivered to the Client, is the outcome of a collaboration between The Province and a Contractor. At the same time, the leading Contractor counted on the technical assistance of several subcontractors. The main drivers for the design of this building are the inclusion of circular economy aspects and to ensure that the construction could produce a portion of the energy required to operate the facilities. A fast design was one of the main challenges, as the time to develop and execute the construction was one of the main drivers of the overall project. The latter is because the facility served as the control station of the bridges for all the canals in the region and had to be in operation before the summer season. This is the period with the most intense activities in the canals of this region.

For this project, three participants were interviewed. Two interviewees worked for the client, E_OG1 in direct relation and E_OG2, as an external consultant. The third interviewee was a representant of Contractor, E_ON1. All of them claimed to have vast experience using Bouwetam and integrated contracts.

Table 15- Project E descriptive data

Client	*Contractor*	*Bouwteam model in use*	*Connection realization phase*	*Contract value*	*Status at consultation*
Waterboard	Leading contractor + subcontractors	Consultation version DG2020	UAV-GC	€10 M	Construction phase – Partially delivered

The activities to be done during the Bouwteam phase

During the Bouwteam, the Contractor was in charge of producing the design up to and including the Final Design, after an agreement was set in place under the UAV-GC scheme for the further development of the implementation design and the execution of works. Throughout this phase, the structural design and program of requirements up to the demand of specification levels 1 and 2 had to be outlined together with specifications regarding the project's circularity ambition.

RM methodology used in the Bouwteam

The production of a risk register was not prescribed for this project as part of the participants' primary tasks. However, the Client opted to follow the steps on the RISMAN method, as this is already

embedded within the organization. Before and during big the Bouwteam, the process was followed by a consultancy firm as part of their obligations to the Client.

The responsibility to continue and maintain the risk file switched throughout the Bouwteam and was transferred to the Contractor. The Contractor followed the GOTIK methodology to classify and define the consequences of the risks throughout this phase. Monthly meetings were organized to track the current status of the identified risks.

***Risk for the Bouwteam* as found in the register:**

From the interviewees' perspective, the risk sessions held throughout the Bouwteam phase were oriented toward financial, technical, and political risks. However, it was mentioned that the focus is predominantly on technical and organisational when moving to the realization. In this case, the Client provided the register, although it was the one developed by the Contractor. The interviewees were asked about the limited content of such a file, and it was explained that only project-specific and significant risks were listed. In addition, the interviewee on the Contractor side argued that a balance must be found between spending time identifying risks and working on their implications, resulting from what small risks might not make it to the register. Next, the table shortlisting those risks for the Bouwteam can be found:

Table 16-Risk for the Bouwteam project E

E_R_50: "Elaboration of the design is not structured according to a plan drawn up in advance."
E_R_51: "Little innovation in progress"
E_R_52: "Nitrogen"
E_R_53: "Environmental permit objections"
E_R_54: "Inventorying and integrating user requirements into the design is difficult and delayed."
E_R_55: "The verification shows that the requirements from the various PVEs have not yet been incorporated in the DO design."
E_R_56: "Involvement versus interference."

From the table, it can be mentioned that in E_R_50, the content refers to the lack of follow-up and monitoring of the planning intended for the design phase, with possible effects on the time for the project and increase in prices. E_R_52 and E_R_53 were both related to the necessary permits. While the first one referred to the unexpected changes in the legislation, the second was about the possibility of permits taking longer than planned. The two cases had consequences for schedule and the time of delivery. Finally, the risk E_R_56 refers to the involvement of different stakeholders with different interests in the project.

***Risk for the Bouwteam* as mentioned by the interviewees:**

The table presented next shows the statements given by the interviewees of this project when asked to mention risks for the Bouwteam.

Table 17- Risk for the Bouwteam Interviews - Project E

E_OG1	E_OG2	E_ON1
"Cooperation. It's really about the people working in the Bouwteam; that's the biggest success factor in the Bouwteam. Not the technical risks. They come later in the process."	*"Lack of cost management because there's no competition."* *"There is a risk for the client that when obligations are not met, and you cannot sign the realization agreement, you will have to select a new contractor for the remaining design and implementation."* *"Transparency"*	*"Critical were, of course, that we had, in the beginning, we had quite a little time."* *"And the second one was the secondhand materials."*

Table 18- (Table 17 Continued)

E_OG1	E_OG2	E_ON1
"But also information… that you are transparent."	*"Lack of cooperation"* *"Loss of information between the parties."* *"Clashes between disciplines"* *"Price certainty comes rather late after the final design phase."* *"The threat to success is the transparency between client and contractor."*	*"…there was the risk that we might not make it within the budget. But that was an outcome of the time and the quality".*

It could be argued that three main aspects arise from these statements, those related to the organization, financial and technical aspects of this Bouwteam. The organizational elements highlighted the transparency and possible loss of information among the team members. Cooperation was also mentioned in two opportunities. Finally, the financial aspects mentioned related to the total cost of using the Bouwteam or making it through the design phase within the budget proposed upfront.

Allocation of Risks

The risks for this project were divided between the Client or Contractor. This was reaffirmed during the interviews by the participants. As a principle followed in deciding on this division, the party who can carry the risk best was mentioned, or who has the most considerable influence on the risk during the design. E_OG1 explained that this principle is the basis for the connection contract UAV-GC, thus why it was considered during the Bouwteam phase. Those under this analysis are shown in the following figure:

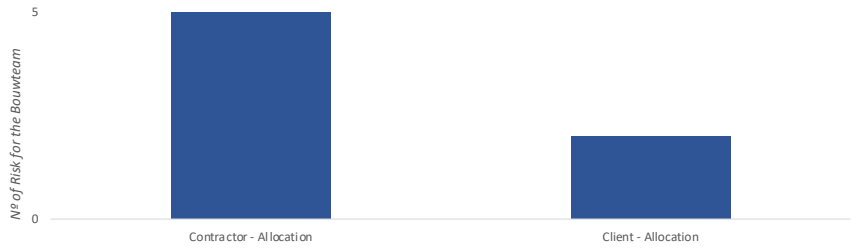

Figure 16- Risk Allocation - Project E

E_OG1 and E_ON1 agreed that there was a strong separation between risks for the client and risks for the Contractor. E_ON1 also explained that whenever a risk was identified that could be born in one of the subcontractors under their supervision, it was taken by the Contractor. For the permits to be obtained, for example, risks E_R_52 and E_R_53 were allocated to the Contractor. The interviews suggested that the task of getting the licenses and permits was under the Contractor's scope in this phase of the process. Furthermore, a specific person deployed on the Contractor was in charge of these tasks.

When asked if there were shared risks between Client and Contractor, E_ON1 mentioned that initially, during the Bouwteam phase, there were some cases like this. Still, as the design progressed, these were later allocated according to the causes that could lead to those risks. According to the interviewees' examples, these were risks that could impact the mutual objectives of the project. For example, the land to build the project might not be available to start the project. The cause could be a delay in the permits to be obtained by the Contractor or due to the acquisition process by the Client. If the risk triggers, the consequences would be faced equally by the Client and Contractor.

Control measures

When it comes to controlling risks, the interviewees mentioned that these measures are taken in a joint agreement between the parties, although it was observed that this entails a subjective approach. Control measures were later followed up during the different reporting periods of the Bouwteam phase, and the status at the moment of its evaluation was checked. The control actions applied were the following:

Table 19 - Control measures - Project E

E_R_50: "Elaboration of the design is not structured according to a plan drawn up in advance."	*E_R_50_8:43: Monitor planning using stand line*
E_R_55: "The verification shows that the requirements from the various PVEs have not yet been incorporated in the DO design."	*E_R_55_8:47: Go through the VS2 concept during DO and expected risks, including control measures, and allocation*
E_R_56: "Involvement versus interference."	*E_R_56_8:23: Formalization of phases, control of involved participants*

These measures relate to applying additional checks over the different processes. For example, in risk E_R_50, this is done in the planning with a standing line which, as explained by E_ON1, refers to the lead and lag times over the tasks to evaluate if it is possible to make it on time. The interviewee referred to this as a countermeasure, although it was also mentioned that more resources could be added as an alternative. For E_R_56, the control measure refers to assessing the decisions in different stage gates by the right people.

Interim analysis Case E

Project E was closely reaching the end of its execution. The initial design stages were challenging for the Contractor, as requirements such as the application of circularity were just becoming a hot topic. However, all the interviewees were optimistic about the design phase results and the progress achieved in the construction. In this project, using the Bouwteam was key to achieving the objectives and moving smoothly to the execution.

Regarding the types of risks observed for the project, the findings from the interviews did not follow those findings on the register. While for the register, the content extracted was related to design aspects and the follow-up and integration of requirements in the design. The interviewees referred to elements of the teamwork, the costs incurred during the design phase and not achieving this process within the available budget, the chance that the project has to be rebooted, and a more technical aspect about accomplishing the ambitions set for the project.

Cross-case analysis

The aim of the present chapter is to establish a comparative perspective on the cases analyzed in the previous section. Extensive data has been presented, and interim conclusions have been drawn for each of the individual projects. This section aims to mobilize such gathered data and the information compiled on the unit level to establish common characteristics, highlight and contrast the findings to help produce new results. The aim of the present is thus to provide an answer for sub research question 3 and sub research question 4, thus helping to establish the framework for the resulting model.

The structure of this section is similar to that seen in the individual cases. First, the risks for the Bouwteams will be discussed, then the allocation of these over the different projects and lastly, the control measures. Before moving toward the elements of this analysis, it is good to begin by indicating the common ground and similarities from the cases under study. For this purpose table Table 20 gives a perspective on the descriptive elements of the individual projects:

Table 20-Cross case analysis overview

Case	Bouwteam model + Connection realization	Project size:	Basis of payment	Bouwteam assembly	Project drivers	Duration of Bouwteam	RM methodology applied
Project A	Consultation version of DG2020 UAV-GC	€20 M – Small*	Cost reimbursable	Client - Leading Contractor + technical contractor group	Collaboration/energy-neutral/circularity	7 months	RISMAN
Project B	VGBouw1992 with major adjustment UAV-GC	€150 M – Medium*	Cost reimbursable	Client - Contractor combination	Results/Collaboration/Quality end product/Stakeholders	24 months	RISMAN
Project C	DG2020 UAV-GC	€40 M – Medium*	Cost reimbursable	Client - Leading Contractor + technical consultant group	Results/Circularity & Modularity/Speed/Collaboration	14 months	RISMAN
Project E	Consultation version of DG2020 UAV-GC	€10 M – Small*	Cost reimbursable	Client - Leading contractor + subcontractors	Circularity/Speed/Cost/Iconic design	11 months	RISMAN & GOTIK

*as per the Mckinsey report scale

5.1 Risks for the Bouwteam and Risk Groups

As a starting remark, it is essential to mention that the risks identified throughout registers lacked proper formulation in nearly all cases. Therefore, rather than reflecting a probability condition, their statement seemed to reflect a factual circumstance. This is not an isolated problem from the cases being reviewed in this research, but has been previously appointed as one of the top mistakes when managing project risks (Lukas & Clare, 2011). To overcome this circumstance the 57 risks collected from the different registers of the 4 cases were merged into a database. Likewise was done for the 42 statements contained from the 13 interviews. This allowed to compare and see overlappings of content between risks of the registers and statements from the interviewees. From here, the Risk Groups containing risk events of similar nature were clustered. This approach has also been followed by academics, who indicated that grouping and classifying project risks can help indicate situations where a common tactic for the risk management process can be established (Bing et al., 2005; Christodoulou, 2021). Once the groups were established, those recurrent in at least two projects or at least mentioned by two interviewees were further analyzed. Making use of these groups aided in reformulating the risks events that were retrieved from the cases. These were restated making use of a grammatical structure named *risk metalanguage* (D. Hillson, 2000), a well established format used in the Risk Management practice and can be found in the Figure 17. Following this, each risk group is described in more detailed. The complete division of the raw data of these risks and the statements divided into the different groups can be found in Annex G.

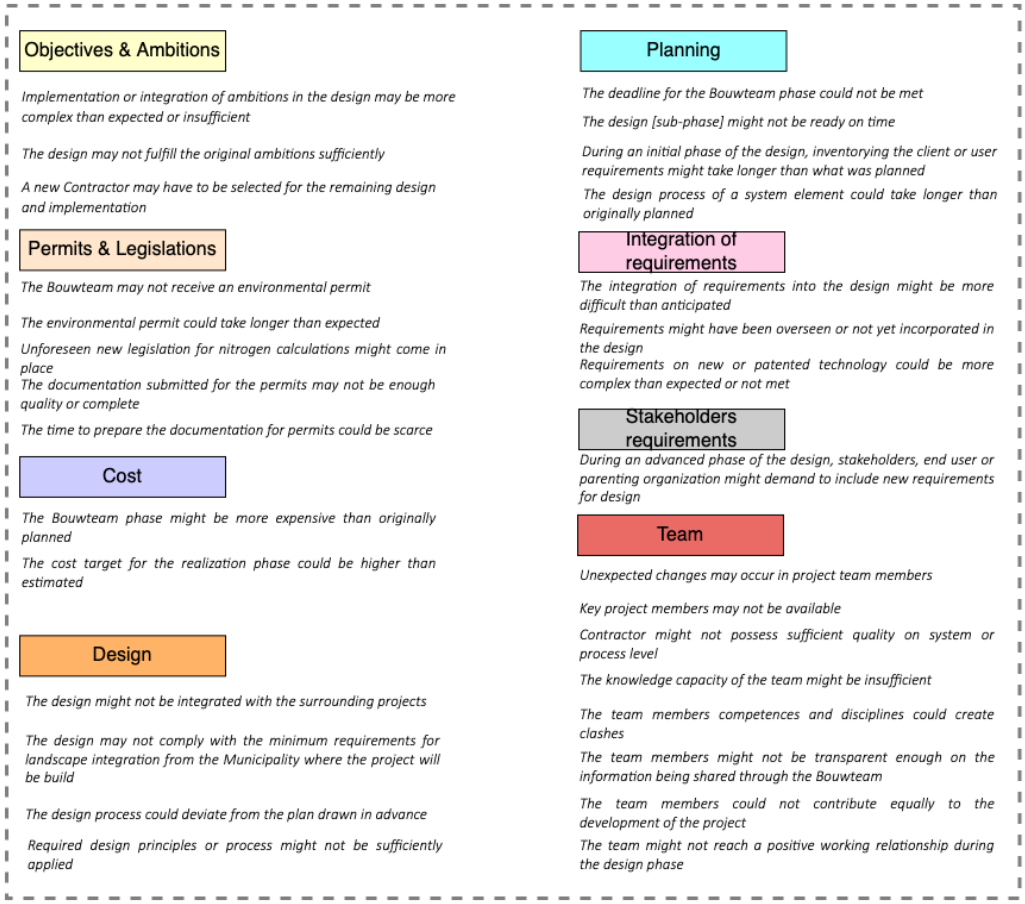

Figure 17- Risk for the Bouwteam & Risk Groups

Risk Group 1- Objectives & Ambitions: Within this group, the related risks referred to the accomplishments of the objectives set for the project and encompassed within its scope. Usually a set of performance indicators would be implemented to measure on the objective, and the failure to meet this could entail the failure of the project. Furthermore, projects could be conceived with particular ambitions in mind (for example, implementation of Circular aspects or achieving an energy-neutral design/project). These entail a strong belief over desired ways to achieve the goals or wishes to be materialized in the process. Within this category, it was also considered that the process has to be rebooted, and a new Contractor might have to be selected for the realization when the contractual obligations are not achieved.

Risk Group 2- Permits & Legislations: As part of the Bouwteam, the participants prepare the documentation and analysis required to request the permits for the execution. Risks linked to this process and the possibility of new legislation emerging amidst the design phase were found in 3 out of 4 projects and also during the interviews.

***Risk Group 3- Cost*:** Risk under this group refers to the costs incurred during the design phase of the project, that could turn to be higher than initially estimated. Also, within this group is contemplated the possibility that the price offer for the execution phase could be above the target settled at the beginning of the project design and Bouwteam phase.

Risk Group 4- Design: Although the degree in the level of outcome for the design differs throughout the analyzed cases, the resulting product was a form of design of a physical structure. The risks in this

group related, for example, to *integrate* the design with the surrounding elements and the *Principles or Processes* used for developing this design.

Risk Group 5- Planning: As part of this group, risks related to meeting the established deadline of the Bouwteam phase, or the team not being able to control sufficiently the plan drawn upfront for the design stage, or the *planning* on specific design elements or sub-phases of the design where found.

Risk Group 6- Integration of requirements: The associated risks in this group refer to the inclusion or the inventory of the requirements or specifications from the user into the design being developed.

Risk Group 7- Stakeholders requirements: This group refers to changes in the originally drafted requirements for the design and the project's objectives, as well as the inclusion of new ones.

Risk Group 8- Team: Within this category, the risks related to the *Changes in the Team members, Knowledge of the team members, Disciplines clashes, Transparency, Equality, Cooperation & Collaboration*.

Organizational aspects found here as risk are significantly related to the capabilities, the relational attitude, integration and team working, as seen in previous literature on Bouwteam (de Hoog, 2020; van Riggelen, 2019). This is reflected on the risk groups *Ambitions & Objectives, Stakeholders requirements, Planning, Team* and *Integration of Requirements*. In addition, those in the *Cost* group have also been discussed previously in the literature, mainly related to the factors that could help achieve a successful price determination process (van der Pas, 2021). In case the target cost for the realization overpass the expected price set by the Client, the parties could not continue in the realization phase. The risks concerning the *Stakeholders requirements* were not foreseen beforehand to influence this agreement strongly. Risks in the *Planning* group are interpreted to have a strong relevance because nearly every consequence impacting the time scale of this phase will jeopardize the targeted execution start. Both the Client and the Contractor are highly determined in achieving this goal. For the Client, it stands as a significant factor due to the potential impact and effect that public opinion could have on the status of the project and the capacity to comply with its promises. Whereas the Contractor's business model heavily relies on the activities to be done during the realization. The earlier they can move into such a phase, the better financial results they will achieve, as was explained by the interviewees.

Out of the thirteen interviewees, 8 were representants of the Client side and the rest were speaking from the Contractor perspective (see Semi-Structured Interviews). The 42 statements retrieved from these sessions made possible to observe that regardless the practitioner’s perspective, they were inclined to reflect on *Organizational* aspects when requested to mention risks for the Bouwteam. And from both perspectives, those pertaining to the *Desgin* Risk Group were the least mentioned. This tendency contradict the observations of the registers, where the entries tend to have a more technical-oriented tint. In the eyes of the researcher, this can be explained by the involvement in the risk identification process of only certain members of the team. If those involved in the sessions are only within the technical team, it could create a sort of tunnel vision over only certain areas that could influence the design phase, leaving some other aspects aside. This phenomenon was confirmed to be frequent by some of the interviewees. Previous studies adressing this situation would highlight that is of prominent importance the involvement of different professional groups when identifying risks (Lindholm & Host, 2009). Factors like the style used for searching the information, the training in risk management as well and awareness of the involved processes in its practice has demonstrated to influence positively the perfomance in the risk identification (Maytorena et al., 2007).

From the analysis, we can also observe there are risks for the Bouwteam which are born from the interaction of the parties involved, as could be those of risk groups *Teams* and *Cost*. These could play a role in affecting the common objectives of the Bouwteam phase. The common goals of the Bouwteam as per the definition from section 2.2.3 and its finding in the project documentation (in parenthesis) are *1. Start the works sooner (C)*, *2. Start works more efficiently*, *3. Continuity to the construction process (B, C, E)*, *4. Jointly arriving at an optimal integrated design (A)*, *5. Jointly arriving at an agreement for the construction,* and *6.Collaboration in the design (A, B, E)*. Determining the joint ambitions has been recommended as a task to be done by the team in its early interaction (Gido et al., 2021).

5.2 Allocation of the Risks for the Bouwteam

The overview of the risk distribution amongst the projects shows that the Client holds the largest share of risks during this design phase, as could be seen in Figure 18. This reasoning was supported in the interviews with the practitioners. One of the arguments given for this is the Contractor being paid on a cost-reimbursable basis. Thus if this phase could take longer, it would not represent a difference for them. Another one is the intellectual property and authority of the design, which remains on the Client's side until a contract is signed for the construction. In this way, any ultimate consequence of this will fall under the Client's responsibility.

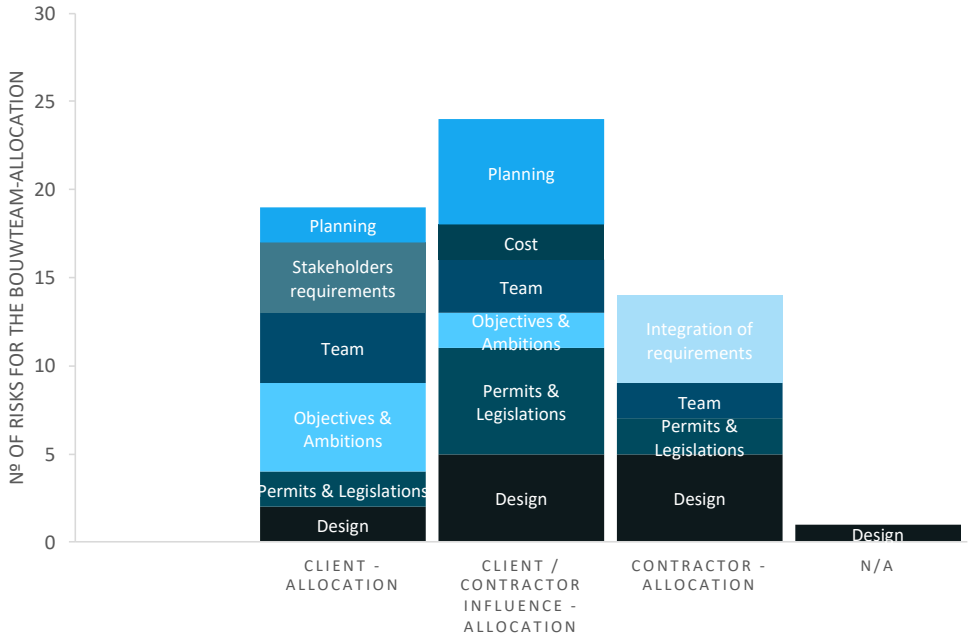

Figure 18- Allocation of risks for the Bouwteam across projects

As can be appreciated from the previous figure, the risk group of *Stakeholders requirement* was the only being present on the Client side. For the group *Objectives & Ambitions*, it was found divided between Client or Client / Contractor influence. The group of *Cost* was found on Client /Contractor influence only. The group of *Permit & Legislation* is found on the three cases of allocation, although that being placed in the Contractor side was particular for Project E, in which case the Contractor had this task as part of their scope. The *Team* group was found in Client and Client/Contractor influence, except for an entry in the register linked to project E. The *Design* group was also found across the three options. However, those allocated in the Contractor referred to the correct application of design principles and the progress achieved in the design process. Lastly, the group only found on the Contractor side belonged to the *Integration of Requirements*. These refer to the inventory of the

requirements or specifications from the user and the inclusion of these into the design being developed.

Although the allocation of the risks was defined in each entry of the registers, the reasoning used behind it was not explicit in this file. In the eyes of the researcher, this resulted in a lack of uniformity in the approach taken throughout the different projects. Out of the contractual documentation under analysis, it was only found such criteria for project A, in which the Plan of Approach explicitly stated the use of the SCB methodology. This situation further highlights the need of unifying the ways of proceeding with respect to the allocation, closely connected to the problem identifying for this research in Section 1.1. To grasp how this decision was taken for the rest of the projects, the interviewees were requested to mention what principle was followed. The insight given by the interviewees provided an answer on *what* was the criteria used and *how* the decision was taken:

> *What principle is used*- The interviewees agreed that the party responsible for the cause of the risk or who has the most significant influence over its cause is a determinant factor. In addition, it was mentioned that they should be allocated to the party who can control or be capable of dealing with the risk when occurring.
>
> *How it was decided*- Interviewees agreed that this was concluded after a joint discussion between team members.

Therefore, the previously mentioned will follow those found in the literature, as seen in section 2.3.4 to be the main criteria for dividing the responsibility for the projects. With the findings of projects A and C following the approach laid on the SCB principles, it would be possible to suggest that a significant factor remains to be the party who can manage or control the risk best and that this approach is suitable for its application over the design phase as well. With this idea settled, the second proposition stated for this research suggested that "*The criteria to decide on the allocation of risk relates to the ability of the parties to control or influence the risk probability of occurring and their ability to manage and bear the consequences if the risk occurs*" is confirmed, and would remain valid and applicable in risks for the Bouwteam.

The polarized division between risks for the Client or the Contractor, with the first one taking over the responsibilities for the most significant share during the design phase, would suggest an unbalanced risk distribution. A balanced allocation has been defined as a distribution of liability that proportionally distributes the prospects of loss or gains in a project (Khazaeni et al., 2012). It has also been appointed as an explanation for the Contractor's uncooperative behaviour (S. Zhang et al., 2016). Interviewees suggested that having a common allocation of risks and that using such a principle is good as there are some of these risks which are not entirely born on the Client or the Contractor. Although this approach has been previously considered in the reviewed literature (see Section 2.3.4), it was not implemented during the design phase in the analysed projects. Furthermore, one of the Client's interviewee mentioned that using a shared risks allocation in the Bouwteam could promote the Contractor's involvement and make them more aware of the financial aspects of the design phase. The potential benefits this approach could have has been acknowledged by the interviewees of the revieweed cases. It would further confirm the need of considering this as part of the elements in the model developed for this research.

Given the dynamic process of the design, in which the product develops and evolves in maturity, the allocation of the risks could also swap accordingly. This notion was particularly found in project C, where the different versions of the registers provided for the case denoted a change in the allocation while moving on throughout the design stages. An explanation for this aspect was that the parties gain

more knowledge on the design and initial uncertainties might be cleared as the desgin develops. With this, the parties are incline to accept responsibilities for the risks.

5.3 Control measures in risks for the Bouwteam

It was possible for the groups of risks extracted from the registers to analyze their control measures. A total of 157 control measures were retrieved from the files, and their content was further reviewed. An important thing to highlight is that the registers of the projects did not labeled the response actions following those of *Avoidance, Acceptance, Transfer* or *Mitigation*, as were found to be the most adopted measures in the Literature review.

Given there is a high number of responses applied to each risk, it would be unreasonable to mention there is a *one-size-fits-all* measure applicable to all types of risk. For this reason, similar responses were grouped in an array of *control strategies*, an approach that researchers have previously followed. For example, Baccarini et al. (2004) proposed a set of strategies for risks, provided these could efficiently and effectively manage an identified group of risks. Also, Carbonara et al. (2015) suggested a set of control measures that would lead to the *most effective mitigation strategy*.

With the risks assigned to each of the groups outlined earlier in this section, it was possible to identify trends on the nature of their control measures. Following, the similar actions were classified in groups according to their content using first key words. For example, in the *Cost* Risk Group, different responses involved making use of 'SSK'. SSK stands for Standard System for Cost Estimates (Standaardsystematiek voor Kostenramingen in Dutch), then initially these similar responses were classified using the word *estimate*. Looking deeper into the description, these were described and explained as an assessment that should be *updated periodically*, *prepared* or *determined* throughout the different phases of the design. Analyzing the specific content and context of the control measures applied to each risk groups gave the possibility to create the *control strategies*. In some cases, more than one strategy could be possibly linked to each risk group. By ranking the strategies on the number of the control measures they contained in each risk group, it was possible to determine which were the most significant. These would be initially considered to be the most suitable to mitigate the risks within the linked group. An overview of the coupling between Risk Group (Horizontal) and Risk Control Strategy (Vertical) is presented in Table 21, following there is an explanation over what each strategy entails. The complete overview of the identified strategies and how these were implemented per Risk Group can be found in Annex H.

Table 21-Control strategy on the groups of risks

Risk Group / Risk control strategy	RG1 Objectives & Ambitions	RG2 Permits & Legislations	RG3 Cost	RG4 Design	RG5 Planning	RG6 Integration of requirements	RG7 Stakeholders requirements	RG8 Team
Consultation/Advisory [External] *This strategy involves the consultantion with an extemal organization, approaching and keeping a close contact with licensors agencies.*	X	X						
Cost assessment *The measures found under this strategy involved the determination of a continuously updated cost assessment for the design.*			X					
Consultation/Advisory *This strategy concems the appointment or involvement of an specialist within the team group. Within this strategy it was also found as a response that a particular part of the scope would be resolved by one of the subcontractors or participant of the technical group.*				X				
Test & Monitor *Measures in this strategy related to the development of test on feasibility, ecological impact, quality assurance, documentation; and also the monitoring of the design process and the budget of the BT phase.*				X				
Reasonable planning and schedule management *Control measures here related to the frequency of review for the planning of the BT phase, the discussion on the current status of the planning and the development of an integrated planning between Client and Contractor.*					X			
Parallel process *Control actions in this group related for example to the initiation of a leading process without having the end product ready.*						X		
Formalization phase/design/decision *Within this strategy measures related to the recording of agreements and demarcation of the scope found.*							X	
Team development *Within this strategy measures provided concemed the training of the team members, the use of tools to measure collaboration, cooperation guidelines and listing the team members*								X

For the risk groups *Objectives & Ambitions* and *Permits & Legislations*, the most relevant control measures belonged to the strategies of *Consultation/Advisory [External]*, when the team conducts a consultation with a specialist source outside the Bouwteam. For the first risk group, this could mean, for example, consulting the energy providers or future providers of second-hand materials. In the second risk group, this measure is linked to the preliminary consultation and close contact with the licensing organisms about the procedures to follow for acquiring permits and the level of detail of the documentation to be submitted.

For the group *Design*, the strategies *Consultation/Advisory* and *Test & Monitor* were equally relevant, outweighing the rest. In contrast with that applied in the first two groups, *Consultation/Advisory,* in this case, concerns recruiting an advisor or consultant to join as a member of the Bouwteam. The second strategy in this risk group relates to conducting quality and feasibility tests over the design and throughout the review stages.

For the risk group of *Planning*, the measures related to the set up of a sound and realistic schedule and the continuous challenge of such forecast against the current progress and the future activities to be done. As for the *Integration of requirements* group, the *Parallel Process* relates to the early start of a process, for example, the elaboration of specific technical solutions in the early design phase, even while these could be of use on a later stage of the design or the project.

The response within the *Team* was named *Team Development.* Control measures belonging to this strategy include the addition of cooperation guidelines in the contract documents, training the team members according to their needs, and tools or apps to measure collaboration. Although only the table shows those measures resulting from the registers, during the interviews, it was also mentioned by the participants to *make everyone feel responsible for the cooperation*; and the use of BIM as a way to resolve clashes between disciplines.

For the group *Cost*, the strategy *Cost Assessment* relates to the continuous update of the cost estimation for the construction phase, which is under development throughout the Bouwteam. Within this risk group, the interviewees' contribution suggested that *at least three loops* of updates of the cost estimate should be made within the whole BT phase. This could be encaptured within a strategy

named *Define process*. For the risk of *arriving at a cost for the realization higher than the target*, it was suggested that the Client always should set a budget ceiling within the contract requirements and expect a design that fits into these limits. It was further indicated that the Client should reserve the rights on a contractual basis to test the market conformity of the offered price.

Based on the literature on risk control, this analysis would suggest, similar to that done by Baccarini et al. (2004), that the project members should be aware of the possible implementation of two or more treatments for each risk. Thus, it would be more appropriate to think of strategies that encompass similar control actions rather than a unique measure for a specific risk. There is an additional motivation to such a suggestion: on each risk of the registers, several control measures are applied. However, it is not possible to factor the influence of each action over the risks. Methods to assess the propagation of the risk responses into the overall response planning of a project have been developed by previous researchers. For example, Fang & Marle (2012) proposed a risk network to support decision-making in the risk management process, including the mitigation actions for risks. Their work addresses the effect of different response measures in the global mitigation planning. In a literature comparison, Ahmadi-Javid et al. (2020) found approaches such as using heuristic algorithms and integer linear programming to optimize the selection of risk responses. Nevertheless, when developing their optimization tool, they argue that considering all details in a mathematical model can make it complex and inapplicable.

Although analysing the effectiveness of the control measures falls out of the scope of this research, the interviewees were asked to provide input on how it was possible to evaluate this. In this regard, they referred this is based on *expert judgement* and a *continuous reassessment with the team* to check if the response worked or not. The literature presented in Section 2.3.4 suggested the use of a 6 A's principle, and in its content could be comparable to the implementation of a well-known framework to establish goals named SMART criteria (Doran, 1981). The interviewees suggested that using such a criteria would be beneficial to define the control measures in a practical way, matching previous analysis on the formulation of action plans for risks (Sheves, 2019). It is of importance that the control actions induce an effect that would reduce the probability of the risks or prevent this from happening. The teams could also be aware, that the syntax in the risk metalanguage (D. Hillson, 2000) for the formulation of these control measures.

All the project participants in this empirical study were requested to describe their experience using this PDM relative to the management of risks before entering the construction phase (Annex I). Even though only projects B and E were already in the execution phase at the moment of the consultation, the participants were all able to give a suggestion based on their experience. In this way, the third proposition stated in Section 2.4, "*The Bouwteams as PDM involving from an early stage contractor in the process will help decrease the risks of the execution phase during the design",* was confirmed. The supporting arguments for this proposition, as given by the interviewees, were the *different points of view involved during the design; the possibility to provide continuous feedback,* which results in a better *quality* of the risk management process and the identified risks. They also emphasized that this setting offers the possibility to *implement strategies to control the risks and analyze their outcome*. However, these advantages are conditioned to the team having the *right mindset*, achieving *trust* and preserving the *equality* between the members. These constraints mentioned by the interviewees link back to the barriers to using the ECI principle in the design, as seen in the Literature review.

5.4 Risk management process in the Bouwteam

It was further seen in projects A, B and C that during the tender phase, the interested market parties were requested to provide insight into the risks they could foresee during the Bouwteam phase and later on for the project. This would entail entail also integrating the knowledge of the potential actors

as part of the risk register, a suggestion earlier proposed in projects using two-phase delivery models (Clemens, 2021). Although for these projects was not a detailed risk assessment, it was used as input by the Client's organization to populate the initial risk register using different Contractors' outsider perspectives. It was further seen that in projects B, C and E, the submission of a risk identification analysis was also used as awarding criteria for the Contractor. This would suggest that the Client, in the Bouwteam setting would act as the initiator of the risk register that would be used as basis for the design phase. However, this is enriched and populated with the input and different insights from different Contractors.

One of the advantages of using a BT setting is that it gives the participants the possibility to engage during the first period to arrange the organizational structure, get to know all the participants, establish the decision-making procedure, and develop the work. It has been previously acknowledge that the early entanglement could contribute on understanding the objectives and boosting the success for the project (de Hoog, 2020). This warming-up stage is suitable to debate over risk tolerances, scales of risks, and a deep immersion in the risk management process. Doing this will prevent arguments over the time when the team has to be focused on the design tasks. The analysis of the cases showed this was done differently in the projects, with alternative consequences. However, it is believed that splitting the risk registers or letting the parties perform their assessment, as was done in project B, would be detrimental to the collaboration. Furthermore, this moves away from the suggestion and advice from previous scholars of keeping a Joint Risk File for this phase (van der Pas, 2021). Some factors are essential to keep in mind for the effective implementation of this Joint Risk file, the first is trust amongst the participants, and the second is linking the consequences of risks to the cost management. Keeping an open accounting and transparency over the expenses incurred by each party would enhance trust and ease the process of commonly registering the risks.

5.5 Answers to research questions

Besides examining the propositions suggested initially for this research, analyzing the documentation and conducting several interviews with the project participants made it possible to establish an answer for sub-research questions 3 and 4.

SRQ 3- ***What risks can be identified when Bouwteams are used as Project Delivery Methods?***

To answer this research question, the risks when using *Bouwteams* as Project Delivery Method, the definition of a risk for the Bouwteam outlined in Section 2.3.1 was used. By doing so, it was possible to screen what were of relevance for the design phase and the interaction between the participants of this agreement, from those relative to the realization of the project. The retrieved list of risks from the registers and the interviews were grouped according to the content of the risk event. As these statements were not consistent with the structure suggested in previous literature, a set of risks within each of the risk groups was formulated. In Figure Figure 19, it is possible to find the *Risks for the Bouwteam* within each of the *Risk Groups*, as results from the analysis done through the projects.

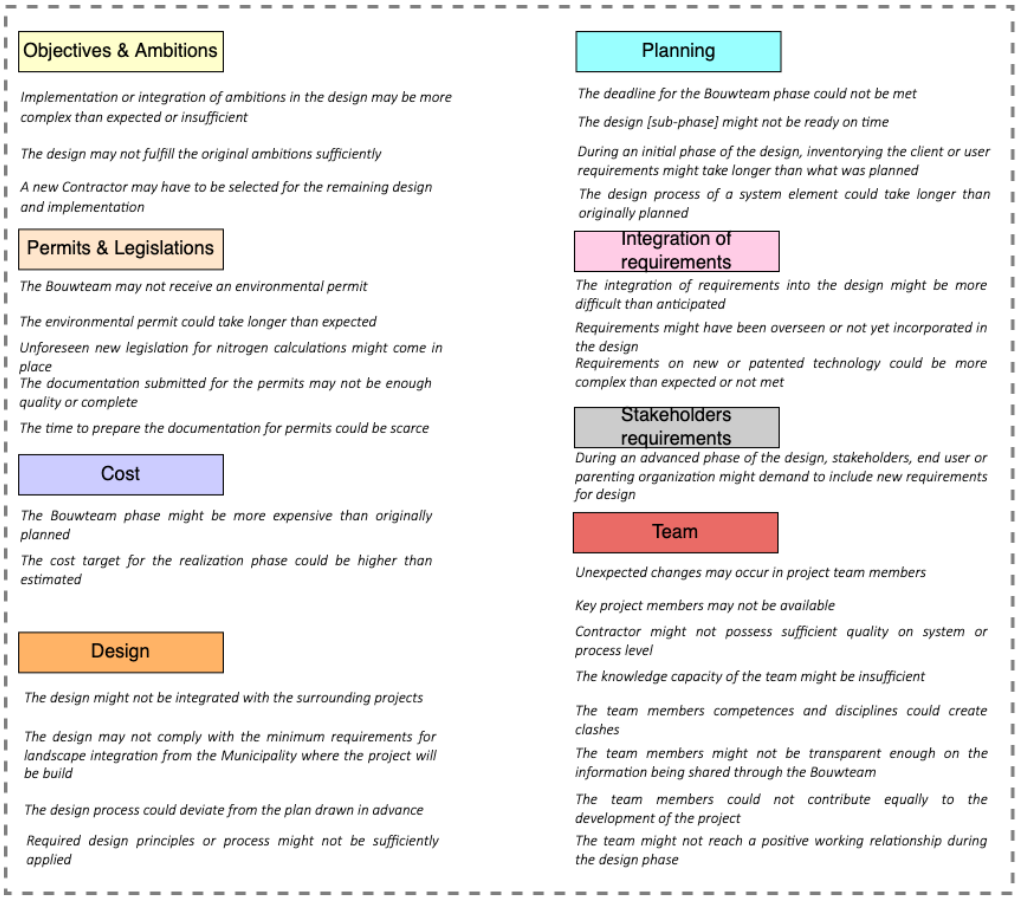

Figure 19- Risk for the Bouwteam & Risk Groups

The gathered data helped reflecting on the proposition originally framed in Section 2.4. This was that "*Risks part of the Organizational and Financial categories would be those of highest relevance when this type of Project Delivery Method is used*". The resulting analysis from the projects would suggest that this proposition is to a great extent correct. However, these two categories, defined earlier during the Literature review, were not the only ones to be of relevance when using this agreement. While the Risk Groups *Stakeholders requirement, Integration of Requirements, Team, Planning, and Objectives & Ambition* would be located under the *Organizational* umbrella, *Cost* would fall into the *Financial* category. Moreover, it is also relevant when using Bouwteams those groups of *Permits & Legislations* and *Design*; which could be linked to the *Political* and *Technical* categories, respectively. Although the data extracted from the registers tend to have a more technical-oriented tint, the interviewees tended to reflect more easily over organizational aspects when using this agreement, regardless what party they represented.

SRQ4- ***What elements should be included in a model for the allocation and control of risks to be used in this Project Delivery Method?***

Based on the empirical study, the model foreseen should count with three main elements, which have further been developed throughout the analysis. These elements are also relevant to the Risk Management Process steps of *Identification* and *Control-Planning*, outlined in Section 2.3. The first element of the *Identification* step is a set of *Risks for the Bouwteam* and *Risk Groups*, and the second element concerns the *Allocation Decision*. Within the *Control-Planning* step, the third element would consist of a set of *Control Strategies* for the risks drafted earlier. The management of risk is integral to project management practices, and its successful implementation has been shown to significantly impact the probability of project success (Nicholas & Steyn, 2017; Royer, 2000). Therefore, including

a chain of logical elements could help practitioners avoid critical steps of the RM Process within Bouwteams, and preventing this is to be merely followed as an administrative process.

The first element, consisting of a group of risks with associated risks for the Bouwteam, could enhance the discussion over critical areas of attention during this design phase. Notably, the register for the design phase tends to focus on the *technical* and even aspects of the execution. Introducing other facets with the inclusion of these risk groups, the discussion over relevant areas for the success of this project delivery method could be enforced. The second element sets off the argument of which party takes responsibility for the different risks for this phase and instead indicates principles to follow to derive the allocation decision. The principles identified for the allocation of risks, which are further implemented in this model, would follow those of the second proposition of this research: *The criteria to decide on the allocation of risk relates to the ability of the parties to control or influence the risk probability of occurring and their ability to manage and bear the consequences if the risk occurs*. Of particular interest is implementing a shared risk scheme that complements the already established and used in practice SCB approach (Nauta et al., 2017). Using a shared mechanism for the allocation of risks has been advocated to improve the collaboration and cooperation between team members (Adler et al., 2016; De Marco et al., 2016). Furthermore, practitioners advocated this could enhance the awareness of all parties over the possible consequences for the design phase. The last element from which this model should be conceived is a set of control strategies outlined to tackle the risks for the Bouwteam stage. The strategies are recommended over a single control measure as these span responses of a similar nature that could be equally applied or in combination to the risk group. Although a preferred option could result from this analysis, the practitioners should be aware of the possible applicability of more than one strategy per risk group.

Integrating the elements of the model

In this chapter, the integration of the model elements is done. A schematic vision of this can be seen in Figure 20. The two first elements of the model refer to the *Identification* step within the cycle of the RM process as presented in 2.3.3. The remaining one concerns the *Response – Control & Planning* step. Throughout the following sections of the chapter, the elements of this model are further explained. It is worth mentioning that to elaborate on these elements, the weighting of the risks nor the impact or consequences of these in scales of *time, quality* or *budget* was considered.

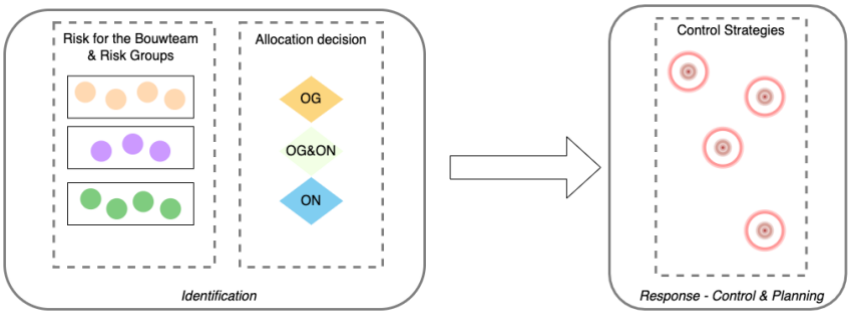

Figure 20- Risk model simplified

6.1 Element 1- Risk for the Bouwteam and risk groups

The risk and groups elaborated in the analysis are the starting points for the integrated model. These can help give the practitioners insight into what *could be found* and *what to expect* when using a Bouwteam in the design phase. The formulated risks and their groups can prompt the participants to discuss the difficulties faced throughout this project phase. Furthermore, these can foster a critical forward-thinking review of the potential sources of conflicts and why these could be triggered. The number of risks formulated is consistent with the recommendation of previous research, where it was advised the team should focus in 20 to 30 risks during the first phase of the project (Clemens, 2021). Next, we can find the *Risk Groups* with the respective *Risk for the Bouwteam*. As was developed during the analysis section, the statements in the *Risk for the Bouwteam* follow the guidelines for describing an event using the *risk metalanguage* (D. Hillson, 2000).

Objectives & Ambitions:
–Implementation or integration of ambitions in the design may be more complex than expected or insufficient
–The design may not fulfil the original ambitions sufficiently
–A new Contractor may have to be selected for the remaining design and implementation

Permits & Legislations:
–The Bouwteam may not receive an environmental permit
–The environmental permit could take longer than expected
–Unforeseen new legislation for nitrogen calculations might come into place
–The documentation submitted for the permits may not be complete or of high enough quality
–The time to prepare the documentation for permits could be scarce

Cost:
–The Bouwteam phase might be more expensive than initially planned
–The cost target for the realization phase could be higher than estimated

Design:

– The design might not be integrated with the surrounding projects
–The design may not comply with the minimum requirements for landscape integration from the Municipality where the project will be built
– The design process could deviate from the plan drawn in advance
– Required design principles or processes might not be sufficiently applied

Planning:
– The deadline for the Bouwteam phase could not be met
– The design [sub-phase] might not be ready on time
– The design process of a system element could take longer than initially planned
– During an initial phase of the design, inventorying the client or user requirements might take longer than what was planned

Requirements integration:
–The integration of requirements into the design might be more difficult than anticipated
–Requirements might have been overseen or not yet incorporated in the design
–Requirements on new or patented technology could be more complex than expected or not met

Stakeholders requirements:
–During an advanced phase of the design, stakeholders, end-users or parenting organizations might demand to include new requirements for design.

Team:
–Unexpected changes may occur in project team members
–Key project members may not be available
–The Contractor might not possess sufficient quality on the system or process level
–The knowledge capacity of the team might be insufficient
–The team members' competencies and disciplines could create clashes
–The team members might not be transparent enough on the information being shared through the Bouwteam
–The team members could not contribute equally to the development of the project
–The team might not reach a positive working relationship during the design phase

As was observed throughout the cases, there is a need for the teams to keep a close eye on what could happen during the design phase. The Risks for the Bouwteam were outlined based on the entries of the four cases under review and the statements resulting from the interview. With the 57 risks collected from the documentation of four projects, and the 42 statements from the interviews these 8 risk groups and 30 events of Risks for the Bouwteam were established. This element could give a north to the teams when they kick off the discussions for the design phase.

6.2 Element 2- The allocation decision

The second element of the model pertains a set of steps intended to guide the teams into the allocation decision for the risk in question. It utilizes as recourse a set of questions to assist deriving such a conclusion. The process is depicted in Figure 21 and aims to solve the argument over *Who will take responsibility for the risks?*. This element is compounded of a starting point which would ultimately lead in assigning the risk as Shared (OG&ON), for the Client (OG) or for the Contractor (ON). When referring to Client or Contractor, it should be emphasized that this refers to the two main parties susbscribing the Bouwteam agreement. This is important to notice, as for example Client or Contractor could be accompanied by different advisors or sub-contractors, as were the cases of Projects A, C and E of this study. The underlying principle is that Client or Contractor are responsible for the behavior

or shortcomings derived from the participants with which they enter into bilateral agreement. This approach was also affirmed by the interviewees during the empirical study.

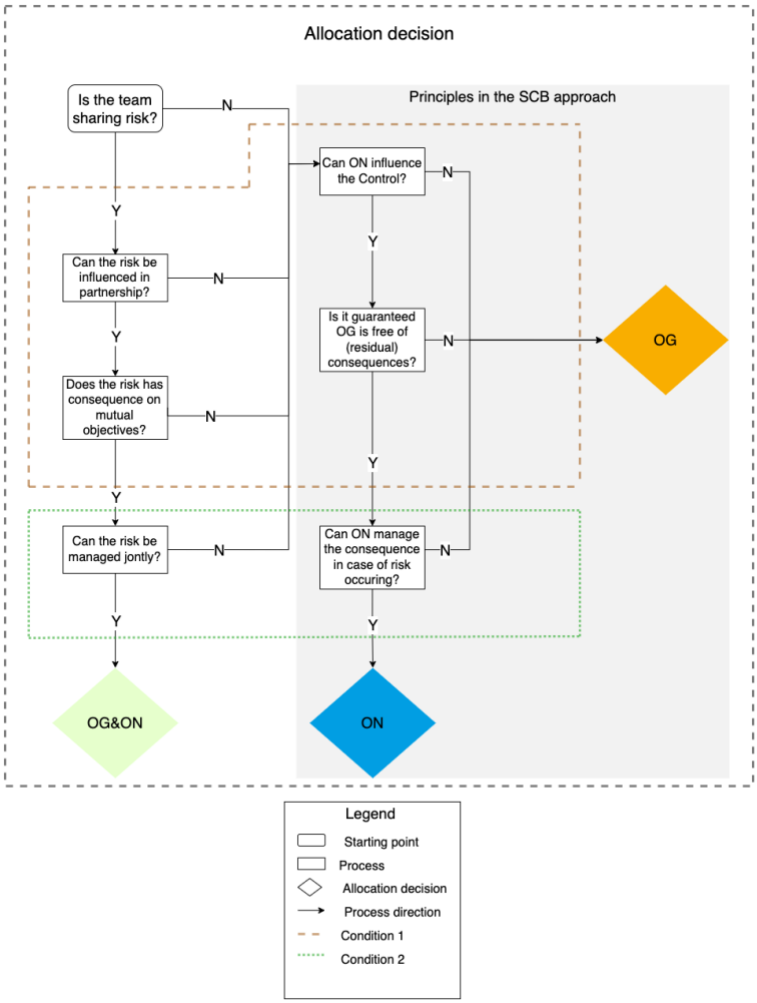

Figure 21- Allocation decision Flow Diagram

As can be seen from the figure above, the starting point of this flow diagram concerns the team's decision to use shared risks scheme during Bouwteam phase. Whenever it has decided to follow such approach, the team could analyse for each risk if these will end up being Shared (OG&ON), for the Client (OG) or for the Contractor (ON). Following the reccomendations on previous literature seen in Section 2.3.4 those risks that could eventually be shared are the ones that could not be managed without the two parties commitment and contribution. Furthermore, those with an effect on the mutual goals and objectives for the team could be considered under this spectrum. Provided there are no pre-established mutual goals for the Bouwteam phase, this can also be assessed based on the mutual objectives described in Section 5.1.

In case a shared-risk scheme is followed, then an evaluation could check whether the team can influence the risk in question and if it will impact the mutual objectives for the Bouwteam. The final testing question is bounded by the possibility to control the risk in partnership for this design phase. If all the conditions resulted positive, the indication would be to share the risk between the Client and Contractor. This left hand branch of the Allocation decision diagram based the decision on three principles: *1-If the risks can be influenced in partnership, 2- If the risk has consequences on mutual objectives for the Bouwteam phase, 3- If the risk can be managed jointly between the parties.*

If any of test gates regarding the use of a shared-risk scheme turns negative, we will move on to the right-hand branch of the diagram, which follows the criteria outlined in the SCB approach. As it was found during the empyrical phase of this research in projects A and C, following such approach turns to be valid also during the design phase of the project as was found under use in two of the projects analyzed. This branch of the diagrams is an adaptation of the SCB, where the conditional gates on each steps reflect the criteria on such approach. As was outlined in Section 2.3.4, there relates to the *influence* the parties can exert over the risk, and the *possible consequences* it could have for the Client. The last conditional step reflects over the capability to manage the consequence of the risk in case of occurring.

Dashed lines in the diagram represent those gates consistent with the condition for the allocation *The ability of the parties to control or influence the risk probability of occurring*. Dotted lines in the diagram represent those gates relative to the condition on the parties' capacity to *Manage and bearing the consequences if the risk occurs*.

6.3 Element 3- The control strategies

The last element of the model relates to the control strategies suggested for the risk groups. These elements relate to the *Response-Control and Planning* step in the RM process. Using these strategies can assist in activating the discussion on *How is the team going to deal with the risks?* And point the practitioners into alternatives to deal with the earlier risk groups. What is under the scope of each strategy is developed next, and each of these is linked to the risk groups in which they could be applied:

Consultation/Advisory [External]: This strategy involves consultation with an external organization, approaching and keeping close contact with licensors agencies. Its application is suggested for the Risk Groups 1- *Objectives & Ambitions,* and 2- *Permits & Legislations*.

***Cost assessment*:** The measures under this strategy involve determining a periodically updated cost assessment for the works during the design. Its application is related to the Risk Group 3- *Cost.*

Consultation/Advisory and Test & Monitor:
The first strategy relates to the appointment or involvement within the team group. The second one comprehends the development of tests and the monitoring of the design process. These two strategies were foreseen to be used in the Risk Group 4- *Design*.

Reasonable planning and schedule management: Control measures in this group relate to the frequency of review for the planning for the BT phase, the discussion on the current status of the planning and the development of integrated planning between Client and Contractor. This strategy is used to tackle the risks under the Risk group 5- *Planning*.

Parallel process: Control actions in this group related to initiating a leading process without having the end product ready, assigned to the Risk Group 6- *Integration of Requirements*.

***Formalization phase/design/decision*:** Measures in this strategy are related to the recording of agreements and demarcation of the scope. The strategy is linked to the group 7- *Stakeholders Requirements*.

Team development: Within this strategy, measures provided concerned the training of the team members, the use of tools to measure collaboration, cooperation guidelines and listing of the team members' needs. The actions under this strategy are used to tackle the Risk Group 8- *Team*.

Following the description developed in Section 2.3.4, would be possible to suggest that the two strategies of *Consultation/Advisory* would fall under the Avoidance type, as they would entail taking actions with the attempt of preventing the risk from happening. Wereas strategies such as *Parallel process, Cost assessment, Team development* and the *Formalization phase/design/decision* would be encompassed on the Mitigation type of response. Given all these strategies required tacking actions on the matter, it was not possible to link any of these to the Acceptance type of response. Although the model of agreements request using insurances, no other ways of Transfering were strictly appointed to the analyzed risks in the registers and thus not encompassed within the formulated strategies.

6.4 Concluding remarks

The present section has outlined a set of three elements that are intertwined and refer back to the Risk Management process. Once merged together, the representation of the preliminary version of this model can be seen in Figure 22. It is believed that using the elements of this model would help the project participants in different ways, first by giving insight into different types and risks relevant for the design phase using this PDM. Moreover, it outlines specific criteria and principles to define who could assume the responsibility for the risks. This approach was chosen instead of assigning certain risk groups to specific parties in the way of rules. It is believed that providing the principles for the allocation would lead to take the most appropriate decision for the team regardless the project specificities. Lastly, this model proposed a set of control strategies to handle the identified risks effectively. This model has been created as a guidance that could help creating uniformity on how the steps of the *Identification* and *Response- Control & Planning* should be done throughout the implementation of a Bouwteam agreement.

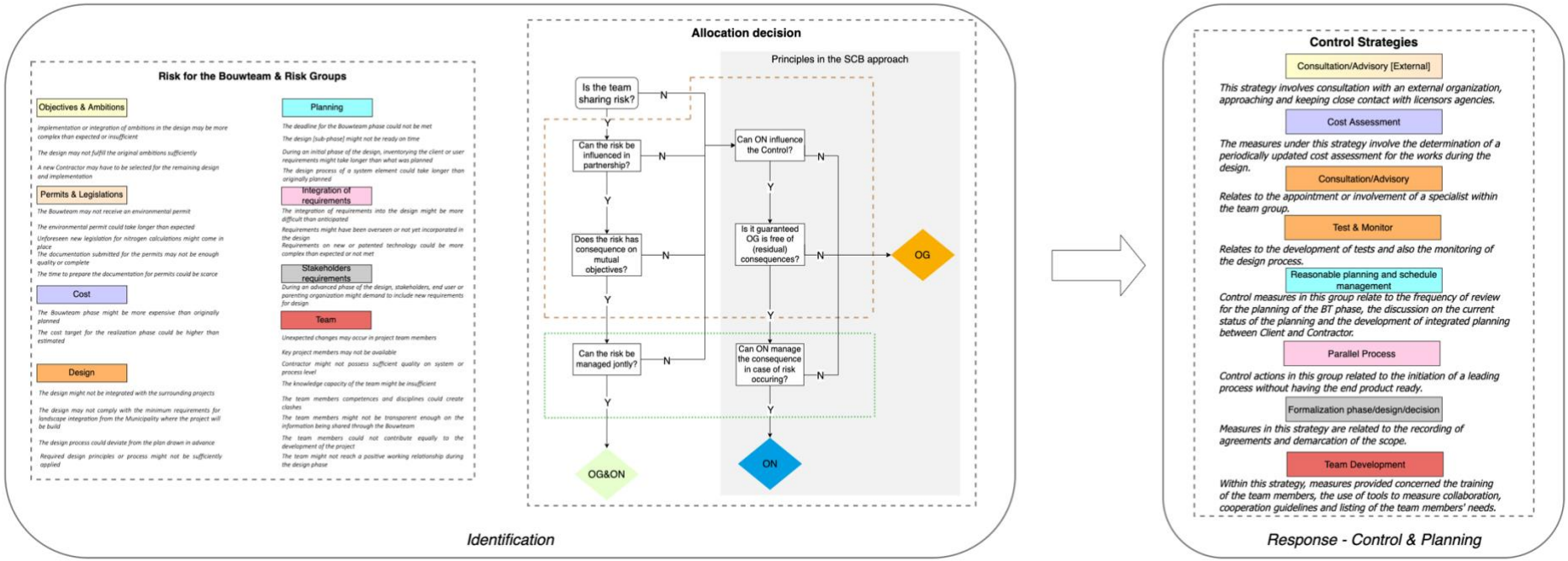

Figure 22- Preliminary version of the Risk Model

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Validation of the model

This chapter will assess the resulting model through an expert review session. An expert review consists of asking the opinions, suggestions, feedback, or comments from experts (Angkananon et al., 2013). The purpose of validating the produced model is twofold. The first is to address and check the individual elements elaborated from the case analysis, and the second is to judge the possible applicability of the model in an actual setting. Furthermore, the feedback retrieved from this session will help giving an answer for sub research question 5. In this section, the setup of the expert session is initially explained, and later on, the results of the validation and lastly the conclusions are presented.

7.1 Set up for the expert session

There are different ways to carry out such validation techniques to the author's best knowledge. *Expert panels* (Galliers & Huang, 2012; Lewthwaite & Nind, 2016), *expert interviews* (Döringer, 2021), *expert workshops* (Thoring et al., 2020) or *expert surveying* (Atkeson & Alvarez, 2018) are some of the available options in the literature. The setup chosen to validate the outcomes of this research will follow that of an interview with expert surveying. When referring to the word *expert*, academics have debated extensively what is entailed under this adjective. According to Bogner et al.(2018), experts "represent or personify a complex interdependence of knowledge and power," and Ericsson et al. (2006) advocated that it "takes approximately ten years of deliberate learning practice and thinking to reach a level of expertise into a specific field of knowledge".

For this study, the *experts* were chosen based on their knowledge in Contract Management, Risk Management, or Project Management. For this purpose, the platform Delve, in W+b virtual environment was consulted to review the profile of different professionals within the firm, examine when they joined the company, their involvement in various projects, and areas of knowledge. As a result, several invitations were submitted to participate in such a session. However, due to the availability of the invites, the session was finally held with 4 participants. The following figure gives an impression of the expert's profile:

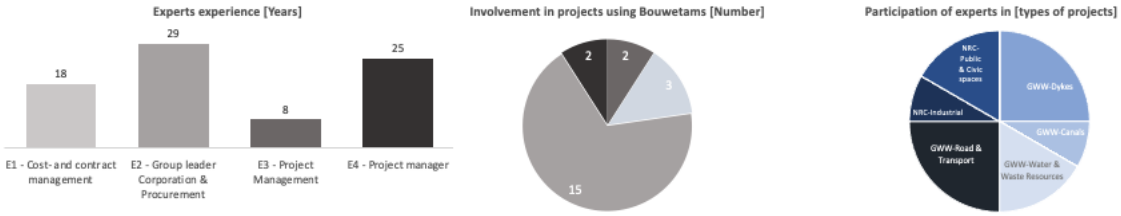

Figure 23-Experts profile

The session was held using MS Teams due to the location of the participants in different offices around the country. The format chosen made the recording of the sessions necessary for its post-analysis. An interactive polling system was used during the session in which the experts were asked to rank and give their opinion on some aspects of the drafted model. This approach was convenient to make the participants engage in the session. It also provided a point of comparison between the experts' opinions, which gave way place for follow-up questions while the main discussion was going through. The complete questionnaire can be found in Annex J. The session was organized as follows:

- Introduction to the research, analysis, and explanation of the resulting model.
- Evaluation of the individual elements in the model.
- Evaluation of the general applicability of the model.
- Session closure & participants experience survey.

7.2 Results on individual elements of the model

Risk for the Bouwteam and Risk Group

The first element reviewed with the expert was that of *Risk for the Bouwteam & Risk Groups*. Here, the practitioners were asked to rank the extent to which they considered the proposed risk groups and their relevancy for the Bouwteam setting. The result from this is seen in Figure 24:

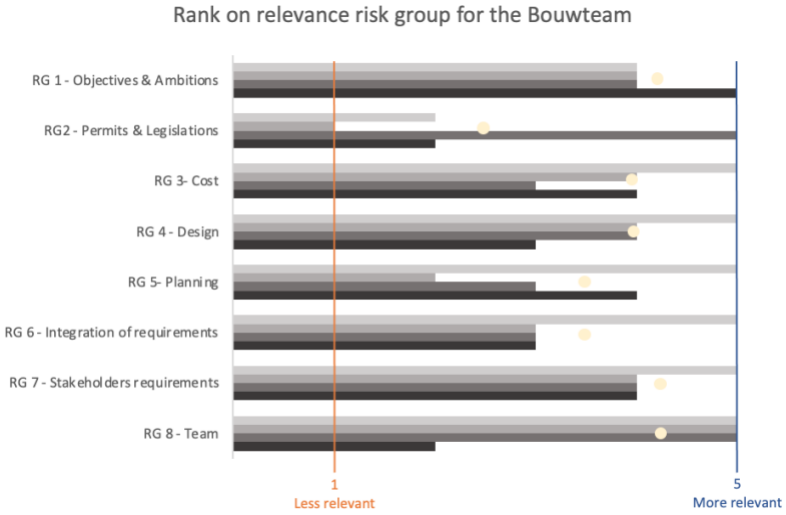

Figure 24- Results of Element 1- Risk for the Bouwteam and Risk Groups

The general opinion amongst the experts was that these risks groups and their containing risks are all important in the Bouwteam. E3 considered that when the team works appropriately together, the presented groups could also be seen as opportunities or areas where the design phase will experience an upgrade. The group scoring lowest was that of the *Permits & Legislations*. To the eyes of E2 and E4, this is relevant for every project and not necessarily for a Bouwteam. Reasons given by the experts is that this is a procedure with parameters and rules to follow, which should not represent much uncertainty for the success of the Bouwteam. The expert acknowledged it is mostly about deciding *who* will take care of this task and doing the different documents.

When consulted on the submitted scores, E1 mentioned that *Objectives & Ambitions* could represent an essential group as failing to achieve these would entail the project's failure. E3 referred to the averages obtained on the *Cost* and *Planning* groups as areas where a learning curve is experienced. The expert mention a tendency where the design phase could result in a higher cost or last longer than expected compared to a traditional approach when using PDM. However, he appointed that this additional effort is paid back during the execution phase.

The experts concluded that these risks groups could also be spotted when using another contractual setting (e.g.:D&B). For example, the risk groups *Cost* and *Planning* could represent factors of importance on any project. However, in the Bouwteam setting these gain relevance because with respect to a D&B contract, the Contractor still has to go through a review process where it will receive the clearance decision to proceed or not. Thus, in case these risks triggers the continuity to the execution phase could be compromised.

All experts agreed that the *Team* group was that gaining the most relevance in the Bouwteam environment and suggested this becomes prominent for this PDM due to the collaboration aspect required on its implementation. This circumstance was also emphasized by E4, who initially scored this risk group the lowest compared to the rest of the participants. When Traditional PDMs are in use, the establishment and distribution of tasks make the *collaboration* between Client and Contractor to

be of less relevance. Using a traditional approach would make the separation of roles more sharpened and defined, and the project parties are less dependent on the reciprocal action of their counterpart. E2 mentioned *Stakeholders' Requirements* group would be present during any agreement for the design due to the large number of parties involved, making changes at a late stage and showing unpredictable behaviour. The expert concluded this would be a general risk and also a risk for the Bouwteam.

Risk allocation decision

One of the experts suggested that the two principles for the decision on the allocation relate to the *ability of the party to influence the risk* and that the risks should be allocated to the party that *can control the risk*. This would thus back up the second proposition of this research and the basis for the allocation decision element of this model. The experts supported using a shared risk mechanism to be implemented during the Bouwteam phase. Contrasting with a Traditional approach, E4 advocated that the Bouwteam setting provides an aspect of work where the parties can *join and help each other mitigate risks*. Furthermore, one of the experts agreed with the observation that the Client usually takes on more responsibilities during the Bouwteam in this design phase. Thus, introducing a shared scheme approach could make participants avoid looking at what is 'only theirs' and gain a *common perspective* on the risks for this phase. For E1, the main criteria for the allocation decision was the possibility of *the risk being influenced jointly between the parties*, part of the conditional gates of this model.

A point of discussion in this element of the model related to implementing the shared risk approach and how this is managed contractually to cover the risk consequences when occurring. E4 explained that splitting the causes of the risk is a technique usually implemented to share risks. Nevertheless, this expert suggested this requires an exact level of detail in the register and the tracking of these risks. E3 discouraged this approach, as this would make the team fall back into the right-handed side branch of the model (SCB approach) or the black/white division between Client and Contractor. This way would make the team lose the inertia gained from the advantages of implementing such a shared scheme, which were suggested earlier. E1 suggested that using a reward arrangement could serve this purpose. It was appointed this could stimulate the Contractor on its duties towards controlling the risk, similarly as was suggested in Section 5.2 of this research. However, E2 was sceptical about using incentives as they might induce the team to pursue only a financial bonus. Therefore, it should be mentioned that using these incentives shall be shaped in mutual agreement between Client and Contractor.

Control strategies

When confronted with the strategies and their explanation, the experts were required to determine the extent to which these could be applicable to mitigate the presented risk groups effectively. The results of the total scorings are seen in Figure 25 next:

Figure 25- Results of Element 3- Control strategies

The discussion suggested that the drafted strategies could be used to tackle the risks of these groups. Scanning each of these strategies gave the experts the possibility to provide remarks on the following strategies:

- Risk Group *Ambitions/Objectives -> Consultation/Advisory [External]*: The experts suggested this is an appropriate strategy and frequently used for different risks in this Bouwteam phase. Nevertheless, it is essential to be aware of the inclusion of many perspectives, which can create more interfaces on the work or aggregate the design expenditure.
- Risk Group *Budget & Cost -> Cost assessment*: All participants recognized this is usually the approach to tackle the risks in the *Budget & Cost* group. They further suggested that as an initial step, a cost assessment is done independently by the two parties using the same starting points and compared to the results obtained. Throughout the development of the Bouwteam phase, this cost assessment should further be *updated on every design loop*. E2 emphasized is not sufficient to just set a periodicity for checking the estimates and suggested a complete cost management strategy must be implemented. In this regard, the team has to check if the entire scope has been considered, including the prices for materials, rates for the effort of the works to be done, margins applied on the calculation, and the possible risks for executing these works. It was further suggested that the Client do an independent assessment on the estimate the Contractor is proposing. For example, E4 emphasized using an external party to the Bouwteam, mutually recognized by Client and Contractor, to carry out this assessment.
- Risk Group *Design -> Consultation/Advisory*: E3 highlighted that using this strategy could only be good if the knowledge within the team is not existent on specific aspects of the design. And in this way, it would help guarantee the fulfilment of the ambitions in the design. E4 suggested this may be applicable, although it shall be tailored to the project's needs.
- Risk Group *Stakeholders requirements -> Formalization phase/design/decision*: The views over this strategy created some debate over the session. E1 could conceive this as a less influent approach, although it was backed by E2, who recognized that using this could help by promoting a fence in which at least part of the scope of the design is guarded to be touched by sudden changes in the requirements. Nevertheless, it was pointed out that while conditions can be recorded as an action within this strategy, they do not necessarily guarantee they will not be changed later on; as E2 recalled, "stakeholders have a very short memory". This could suggest that the strategy is of less influence when dealing with stakeholders distancing significantly from the inner circle of the Bouwteam. Contrarily to this idea, E3 advocated is upon the management of the Bouwteam to decide whether an external requirement will be implemented as part of the contract, supporting the use of this approach. Aligned with this, E2 thought this strategy could back up a history of the discussion held and if agreements have been established.

- Risk Group *Team -> Team Development*: The experts agree this strategy could effectively be used to tackle the risk. In addition, other possible control actions were mentioned by the participants.

7.3 Results on the applicability of the model

During the expert session, the participants were asked a set of open-ended questions to validate the applicability of this model in practice. Coupling the observations provided by the experts with previous findings from the cases made possible outlining a path to follow if the model is implemented before and throughout the Bouwteam phase.

Implementation of the model

It was recommended that the model be used in different stages of the Bouwteam. For example, E3 foresee that during the dialogue phase, the interested Contractors in participating in the Bouwteam could be requested how, using the scheme and structure presented in this model, the participants would allocate the risks for the Bouwteam phase. For this purpose the Client, has to be the initiator, deciding on their intentions to implement a shared-risk scheme, and exploring its applicability with the market parties. Although this approach was not seen in the documentation of the cases under analysis, the contracting authority could lever from this resource having an initial insight on what Contractors are willing to deliver and formulate a better request for the tendering.

The step following the Definition/Preparation phase for the project is the Tendering. Here the Client will use the knowledge gained through the market consultation to define the procurement strategy to be implemented. In the empyrical study it was found that during this stage, bidders for project B were evaluated on the basis of the risks they could identify for the Bouwteam. In addition, the Contractor selected in project C submitted an analysis of risks for the project as part of their bid. Following this reasoning, E3 suggested the Elements of the model could be used during the Tender to compare different approaches between Contractors and check their responses to control the risks for the design phase.

Once a Contractor has been awarded, there is a formal agreement and the obligations between the parties start running. An advantageous resource the Bouwteam provide is using an initial period of the design phase to decide on the ways the team will proceed later on. This is usually referred to as the Project Start-up phase. During this stage of the project the team could define the ways of proceedings for the risk management process, emphasizing the steps outlined through this model. For example, E2 proposed that during this stage, the different risk groups could be used to discuss problematic areas to be faced throughout the design. And E4 highlighted that the Client, as the initiator of the project, should decide upon the use of a model alike since the beginning of the Bouwteam. There is a link on the suggestions given by the expert, with the approach followed in Project A of this study. In this case, the team took two months of work on studying the contractual requirements for the design and the project. Such a period was also used to define managerial aspects for the project, including the risk register and its initial content.

The Risk Management Process only begins when risks have been identified, discussed, allocated, and control actions or strategies have been established. From then on, the process has to be continuously reassessed as was indiciated in Section 2.3.3. For example, E1 suggested that the steps depicted in the model could be run throughout the development of the Bouwteam. The experts agree that there is a dynamic aspect to using this model. While at the start of the Bouwteam, some risks might be allocated, this will evolve with the design as more information becomes available. E3 suggested that every risk for the Bouwteam could initially be shared at first. Then, when moving to the realization, where a

more traditional approach is used, the focus could go back towards a more defined Client – Contractor allocation, applying the one depicted in the SCB approach branch of the model was outlined. Meaning that as the design develops, it could help screen the risks used as part of the contract formation for the execution phase. One of the experts suggested including this as part of the agreement between the Client and Contractor over how the risk management can be done and incorporating the principles outlined in the model for their allocation.

With the observations drawn from the cross-case study and the input of the experts, a *roadmap for the implementation* of the model, thus implementing the necessary resources for the allocation and control of risks in the Bouwteam setting. An schematic overview of this is seen in Figure 26. In this, we can find two main aspects, the *procedural* and those where a *contractual provision* is required to back up these processes. To consider the *contractual provisions* mentioned, some possible modifications to the basic agreements are portrayed in Annex K.

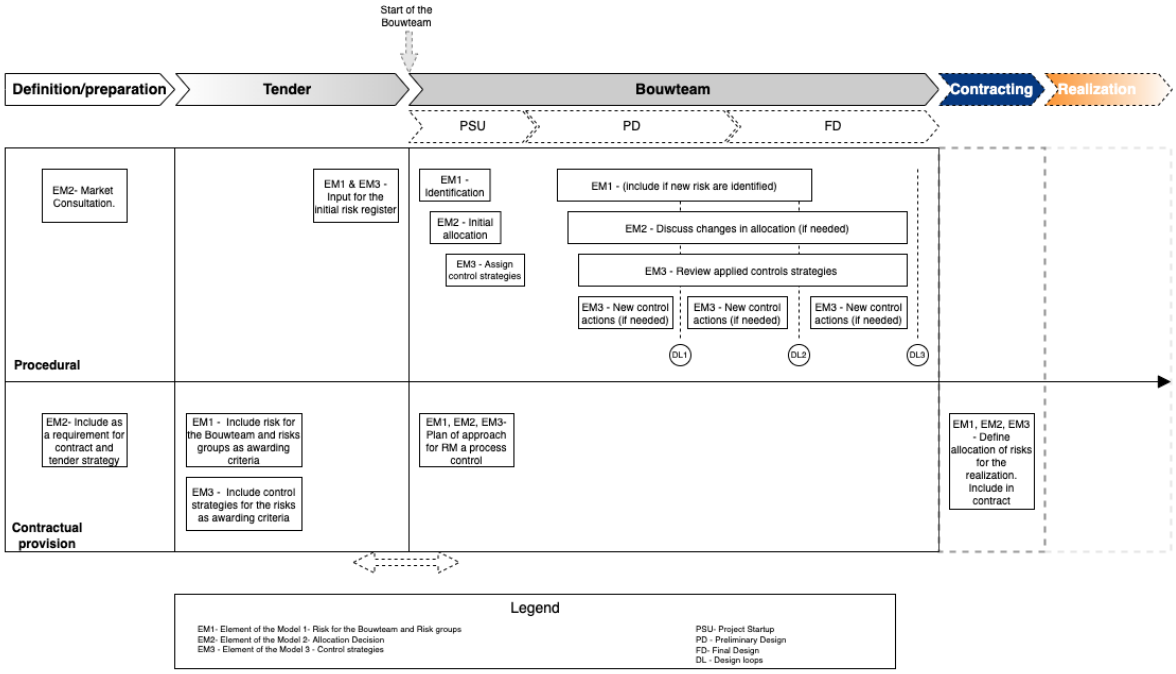

Figure 26- Implementation of the model throughout the Bouwteam

In the figure, the *Procedural* aspect on the upper part of the scheme represents how the elements are used throughout the phases of the Bouwteam and before this is started. On the bottom side of the scheme, the Contractual provision would represent how these elements are portrayed on the legal documents between the parties. For example, Element 2 – Allocation Decision- can be used during the market consultation to evaluate how different participants would approach the use of Shared risks scheme. Elements 1 and 3 of the model (Risk Groups and Control Strategies) could be used during the Tender phase as excluding and awarding criteria for the Contractor bidding for the design and later execution. The different interested Contractors could be requested to submit several risks within the proposed risk groups and suggest how would they implement the strategies in the model or additional ones. On the Procedural aspect, the Client can use this as input for the initial risk register used for the design phase. Once the Bouwteam begins, the three elements of the model can be included in the Plan of Approach, defining how the Risk Management process will be carried out, what risks should at least be evaluated, the allocation criteria to be followed, and the control strategies to be used for these. The three elements of the models are implemented and re-evaluated along with different Design Loops (DL) of the Bouwteam. Lastly, the model elements can be used as the basis for the contractual allocation of the risks during the realization phase.

7.4 Answer to research question and concluding remarks

One of the purposes of conducting this evaluation section was to help answer the last sub research question:

SRQ5- ***How could the implementation of the risk model be of help for teams when using this project delivery method?***

The application of the outlined model of this research, could be advantageous for the team for the following reasons:

- *Working on an integrated basis towards risk reduction*: As identified during the review session, the model in this research could help the team work together on an integrated basis by making the participants establish a commond ground for the risk management process.

- *Giving more insights into the risks when using Bouwteams as Project Delivery Method:* In the risk management practice, and particularly related to the use of the established RISMAN method, there is a phenomen called 'RISMAN glasses'. In here, there is a tendency to see only through the categories presented in that approach. The opinion retrieved in the review session is that the model could help introducing *more glasses*, thus giving better insights into the risks when using this PDM.

- *Induce discussion of problematic areas over the design phase:* It was found throughout the empirical study and also adressed in the review session the rapid tendency of the risk discussion to be oriented into technical aspects mostly. It was also discussed that during this phase, the teams often fall into the discussion over procurement aspects for the execution when the design process has not reached a sufficient maturity status. For this reason was appointed that using the model could help the team focus on what could happen during the design phase. Limiting the view over the short-listed 30 risks in the Risk Groups could give a better structure of the main risks for this phase.

- *Enhance the transparency over the Risk Management process for all the parties involved:* The different elements of this model have been linked to the steps of the Risk Management Process. As was elaborated in the Literature review, this is an important interdependent set of activitis assistin on the realization of the project goals. The counsulted practitioners emphasized this could put under the spotlight *how* the process could be done through the Bouwteam, and *how* to judge over the allocation of risks, giving clarity to the decisions taken throughout this phase.

On the other hand, the participants could spot two obstacles to implementing this model. The first of them is a *Management Aspect* and refers to the implementation of the shared-risk scheme and how the financial implications of shared risks could be adressed by the team during the design phase. In this sense, it can be argued that the third conditional gate of this model -*if parties can jointly manage the risk*- holds of prominent relevance when deciding to implement this scheme. The literature offered possible ways to deal with this that were acknowledged by the experts reviewing the model. Implementing this approach can first be discussed with the market parties during a consultation phase and further shaped between Client and Contractor during the Project Startup. The *Resistance to changes* would be the second obstacle for the implementation of this model. There is often a reluctancy towards new concepts or processes in the practice, which is driven by the lack of awareness in the added value these could bring. This is further enhanced by a limited willingness to spend effort

on applying these concepts, as practitioners are used to working with their methodologies, limiting their motivation to adopt new processes.

This chapter was dedicated to discussing the different elements of the elaborated model with experienced practitioners knowledgeable in the fields of Contract, Risk and Project Management. This was done through an interactive polling system. Questions turned around the applicability of the different elements of the model and the possible implementation of its components in practice. The feedback given by the experts helped improving the preliminary version of this models. Changes were done in the following aspects:

Element 1- Risk for the Bouwteam & Risk Groups: The different risks groups elaborated as part of this model were linked back to the categories outlined in the RISMAN method. These were associated using the descriptions from Section 2.3.2. In this way, the Risk Groups *Objectives & Ambitions*, *Planning*, *Integration of requirements*, *Stakeholders requirements* and *Team* were related to the *Organizational* category. Risk Group *Permits & Legislation* is part of the *Political, Cost* is assigned to the *Financial* category and *Design* is linked to the *Technical* set. Relating the groups outlined as part of this model with the mentioned categories arise as a way to provide easiness for those practitioners who could make use of this model and who are acquainted to working with the descriptions drawn in that method.

Element 3- Control Strategies: Within this element of the model, there were two changes introduced after the review session. The first is providing a visual link to the Risk Groups in the first element of the model were these could be applied was included. In second place, there were two other strategies included to help tackle the risks in the *Team* group. These strategies are *Working together*, which relates to the establishing a fixed day of working with the members of the Bouwteam in a physical location (when possible). *Inventory staff capacity and needs* was the other strategy included. This last one considers the analysis on the personalities of the members of the team to match them with their right counter-part, and understanding the mobilisation of profiles needed to carry out the design tasks.

As part of this section, a roadmap for implementing the model was outlined with the inputs from the experts. Validating the elements of this model and its applicability would also confirm the assumptions under which the model was made, including propositions 1 and 2 signalled during the first stage of this research. The expert's opinion would suggest that this model could enhance the team's awareness of common responsibilities, making them strive for the same goals. It seems this would be of general applicability when Bouwteams are used as Project Delivery Method under the conditions it has been developed.

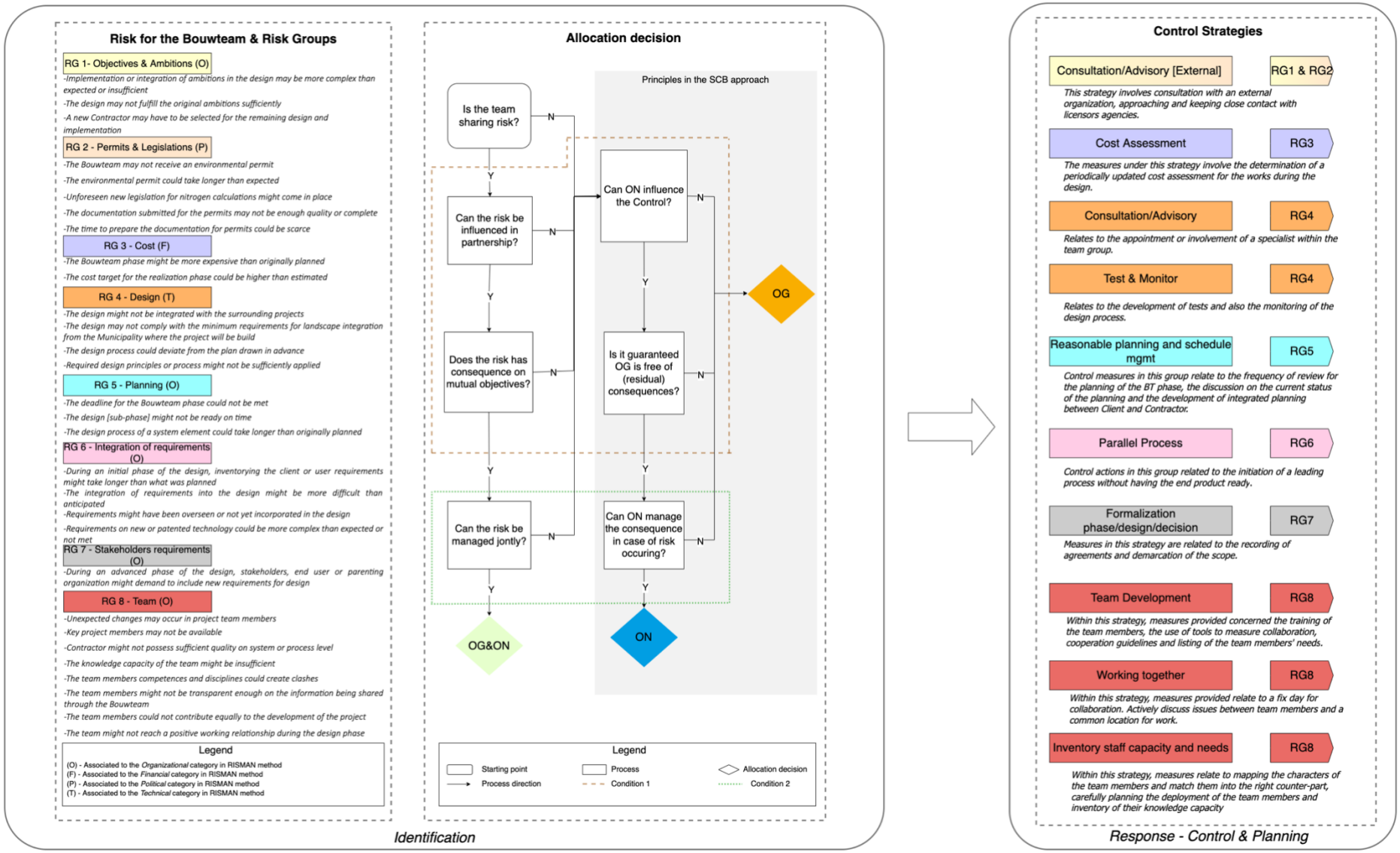

Figure 27- Risk model for Bouwteams after validation

Discussion

This chapter of discussion is divided into four sections. First, a discussion is done over the results, then the construct of the research, followed by the limitations of the study. Next, the practical and scientific contributions are exposed, and finally, additional findings taken from this research are debated. This chapter aims to put in context the results and what they entail in the current practice for Bouwteams.

8.1 Discussion of research validity

A big part of this research has been based on exploring the modes in which allocation and control of risks are done in the practice when a collaborative agreement is used in the design phase of a project. The driver objective for this thesis was to *'Incorporate aspects of risk allocation and control when Bouwteam is used as Project Delivery Method, by developing a model that can help identify hot spot areas of risks for the design phase, and propose a set of control measures that effectively help tackle these'*.

As the formulated problem of this research entailed different aspects, the focus turned around two main areas. These were Project Delivery Methods and their application in the Netherlands, emphasising the Bouwteam agreement and those of the Risk Management, with its methodologies and application. These two concepts were repeatedly seen throughout the research development; the two separate subjects were addressed on an equal basis and systematically reviewed across different sources in the Literature review. The review and analysis during the empirical study follow a similar approach. The documentation relevant to the agreement was reviewed, and the risk registers of the project. Thus, the units of analysis have been consistent throughout this research. In the use of case studies, it has been advocated by Yin (2009) that judging the quality of a research design can be made by testing its *Construct validity, External validity and Reliability.* These are discussed as follows:

Construct Validity
Construct validity has been done through the research on the data collection and the composition of this report in different ways. The tactics implemented to check upon this test were two: using *multiple sources of evidence* and *Establishing a Chain of Evidence* (Yin, 2009, pp 183-195). The first tactic was applied initially in this study during the Literature review. As explained in 2.1, different search engines for this research were consulted. The chosen one was further used to scan various scientific journals and publications. Throughout the Empirical study, data was collected by two means, first documentation on the cases under review and second using interviews with practitioners, detailed in Section Case Study Protocol. The second tactic was implemented through the recordings of the sessions held with the practitioners during the empirical study. These were lengthy documents that were not included in the main report. However, their transcript was submitted to the panel of reviewers of this research. Statements from these sessions are embodied in the main text of this report. Given that the projects reviewed in the empirical study were still active at the moment of producing this research, the documentation was not annexed to the research for confidentiality reasons. However, the aggregated data, as the identified risks for the Bouwteam of the different projects and their control measures, was included in Section 4.

External validity
To check this quality element in the research design when using multiple case studies, the tactic under implementation is that of *Replication Logic* (Yin, 2009, pp. 94-102). This technique was implemented on three levels; first, by selecting the cases to be reviewed in the empirical study, which were compliant with criteria established upfront regarding *PDM, Size, Status of project, Diversity of the Projects,* and *Availability of Data.* As described in Section 5, there are common elements across the

reviewed projects, and these are: all projects were making use of a Bouwteam and connected to the realization phase with an integrated set of conditions UAV-GC. In addition, all of these used a cost reimbursable scheme as a payment mechanism for the Contractor, and in all these, the Client was a public institution. Further, these were all Small to Medium size projects. The second level on which this tactic was implemented was on the questionnaire used during the interviews, as all these were set off from the same basis (Annex D). However, due to peculiarities observed in the documentation, this guideline was later customized when conducting the interviews for each project. Furthermore, as semi-structured interviews were chosen as methodology, new questions could arise throughout the development of these sessions depending on the interviewee and the synergy built during the meetings. The last level in which this technique was applied is the documentation review. For the analys of the risk registers, and the extraction of only the data relevant to this analysis a definition was outlined and used as excluding parameter to review the different projects.

Reliability

To enhance the reliability of this research, the operationalization of the data to be collected was defined beforehand using a case study protocol outlined in Section 3.3. For the interviews performed, all the participants were informed in advance of the purpose of the study, the way the sessions were going to be held and the use of the data coming from these. Recurring to the use of ATLAS.ti. resulted helpful to create a workflow that assisted in systematically reviewing the significant amount of data extracted from the documentation. This software was further used as a database to centralize the documentation of all the projects.

Bias

Although the mentioned steps and tactics implemented were used to enhance the quality of the research design, there are some unavoidable sources of bias introduced when conducting a study of this kind. One of these is the data collection technique, particularly inherent when using interviews as a source of information. To reduce this inclination, the researcher submitted the transcripts from the session to all the interviewees, a resourceful tool of member checking to enhance the trustworthiness of the results (Birt et al., 2016). However, out of the thirteen interviewees, only four participants returned an answer confirming the processed data. Another source is the measurement bias, and this research started by considering the data from different sources to be equally important. Overcoming this source of bias could have been done upfront by quantitatively evaluating and judging whether the data coming from one source or another should gain more relevance for the study. Although this was not implemented for this research, it could be an essential consideration in other analysises using a multimethod research approach as was done in this study.

8.2 Research Limitations

It would be unreasonable to suggest a study is free of limitations. Several strategies were implemented, striving to minimize these effects over the resulting outcome of this research, as was explained before. However, to the best knowledge of the author, the following are the most meaningful:

When analyzing the literature pertinent to the project delivery methods, the concept of Bouwteam is one only available in specialized sources from The Netherlands. This situation prevented using the scientific search engines used for the rest of the concepts analyzed in this thesis. Access to some specialized knowledge sources for the subject of Bouwteams was only possible thanks to the license provided by Witteveen+Bos. Nevertheless, the articles on this topic required additional translation. In this process, and due to time constraints, it is believed that it could not have been realistically achievable to scan all the possible sources available online. This implies that sub research question 1 could be potentially bunded to this constraint.

Although the objective was to analyze a more vast number of cases, the final selection consisted only of four cases due to different aspects. The availability of the documentation for the projects was the main contributor factor to this limitation. As the use of Bouwteams is trending in the construction industry in The Netherlands, many of these projects are just in their initial stages or recently completed. For those in the second situation, there might still be unsettled disputes that impede the disclosure of information, making the documentation inaccessible. Another contributing factor to this limitation was the availability of participants to be interviewed. Even while representatives of both sides of the projects were interviewed, it was only possible to dialogue with only one Project Manager in one of the projects. Due to the limited availability of time, it was impossible to reach other participants with this profile.

During the cross-case analysis and to answer the subresearch question 3, the author outlined a set of *Risk Groups* that were also linked to the categories in the RISMAN method. The groups elaborated cover four out of the seven categories outlined in such a method. Not having found risks within the remaining categories in the cases under analysis would not mean in other projects these should be discarded. This would represent a potential constraint to the third sub research question. In this sense, is important that when deciding to implement this model in practice, the users should be aware on the numbers and types of projects used for its development and strive for expanding its content when possible. This could only make its final application more precise and suited for the purpose is intended.

This research has unlocked the possibility of drawing several conclusions through its different stages. However, it is essential to mention that these are bounded to the characteristics of the cases analyzed, which are formulated under context-specific parameters. Experienced practitioners tested the resulting model in this research to extend the findings and validate its general applicability. The results of the sessions are considered to be on the positive side, thus suggesting the relevance of the model and its elements. This review session was limited to experts from the engineering and consultancy firm Witteveen+Bos, where this thesis was carried out. None of these experts was interviewed before or in direct contact with the research content. In this way, it could be implied the bias would be controlled or limited. Nevertheless, their expertise is closer to the Client role, and they are not that much acquainted with advising the Contractor side. This constitutes a limitation to the generalization of the findings obtained and perhaps on the applicability of the resulting model.

8.3 Research Contribution

Although the existing literature addresses similar problematics in other collaborative contracts, due to the specificity of the mentioned agreement in the Dutch infrastructure sector, no previous records were found to be oriented with this approach on Bouwteam agreements. It is believed that this study has broadened the knowledge regarding the risks that could be identified when Bouwteams are used as Project Delivery Methods, thus contributing to shortening the gap identified initially in Section 1.2. Moreover, the present research has deepened on two other subjects of the Risk Management process applied to these agreements, namely those of the allocation and control of risks. The author recognizes the following as main contributions to the present body of knowledge:

- A particular area of focus for this research was determining the risks identified for the Bouwteam phase. Throughout sections 4 and 5 the author found relevant those aspects relative to the organization and of particular significance those born of the synergy between the participants of the design. Because of the importance of risks related to this group during this initial stage of the project, the research findings also contribute to the practice by inducing the talk over this area of importance.
- It was further reinforced and demonstrated the principles that should drive the decisions over the allocation of risks. Additionally, this research supported the concepts of flexible allocation

of risks found in previous literature. The potential benefits that a shared distribution of risks could have for this project phase were addressed during the empirical study and the expert session, thus answering the call made by earlier scholars on the matter.

- Another contribution of this research comes from the third analysis proposition, which was reviewed qualitatively through the interviews with the project participants. Therefore it would be possible to include such an aspect within the definition or the advantages of using this agreement in the construction industry.
- The use of Bouwteam has gained momentum over the last years, partly by demand of the Contracting Authorities and by showing that its use will provide benefits for the execution phase. These are for both, Client and Contractor as the two parties enter into a more consolidated phase with significantly reduced uncertainties. The findings from the present can help give clarity to the participants interested in using this agreement. Also, its conclusions and suggestions can be used while the design phase is going and hopefully trigger fruitful discussions that enrich the teams' collaboration and work towards a common goal.

8.4 Additional findings

Some other findings have emerged through the study of the documentation and the different interviews done through the process. However, these do not directly support the answer to the research questions. The following summarizes these points:

- Practitioners consulted during the empyrical study of this research were convinced on the use of Bouwteam as a way of improving the final outcome of the project. However, a notion that repeatidely came to light through the interviews was the overall economical result of using this project delivery method with respect to traditional approaches. This was also adressed by one of the experts during the review session.

- Certainty over the price forecasted upfront for the execution still remains a hot topic as was discussed in the interviews. Particularly for the teams proceeding to the execution is of importance to keep the inertia, attitude and will of the participants achieved throughout the design phase. The Bouwteam setting allocates a period of the design phase on what is called the price determination phase. However, it was pointed by the experts in the review session that collaboration always seems to experience some tensions whenever the participants of the project are discussing cost-related aspects over this last stage of the process.

- The steps of the risk management process were followed differently in terms of who will carry out these tasks throughout the projects. In cases A, B and E this was done by the in-house personnel of the organizations. Wereas in project C this was performed by a consultant specially appointed to this task by the Client. The efficiency on the approaches was not measured as part of this research. However, is important to recon there could be differences in the performance of the process when implementing Risk Management as a service provided by an external party to the main organization of the agreement.

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Conclusions and recommendations

The present chapter concludes the findings and contribution of this research. It will first recap the answer to the sub research questions that will lead to the resolution of the leading research question established for this research. The section further includes a set of recommendations for the practice and opens the floor for future research paths.

9.1 Answer to the research questions

SRQ 1- What collaborative project delivery methods are found in the literature and in The Netherlands?

Organizations with different roles in the construction industry acquire services and goods through different approaches or methodologies. The structure for organizing and financing the acquisition of the goods or services required to carry out the design, construction, operations and maintenance activities is defined as a Project Delivery Method (J. B. Miller et al., 2000). A broad range of these organizational systems have been used throughout time, and new ones have emerged to cope with new requirements in the industry, increased complexity, an accelerated pace of technology and constant flow of information. Collaborative project delivery methods are focused on integrating the expertise and knowledge of the different actors in the construction process. Partnering, Integration, Alliances and ECI contracts differ from the traditional way to delivery a project. Of these approaches, the one generally accepted across the literature is using the principles of Early Contractor Involvement. But this is a broad concept and is not supported by the different legal systems of every country in the same way.

A way of involving the contractor from an early phase is through the use of a two-phase process. When using this approach, Client and Contractor work on the design phase and if this is succesfull they will move on to the execution of the project, or the contract will terminate in the first phase (Fijneman, 2020). Within the wide range of delivery methods using a two-phase process, the most widely accepted form in The Netherlands to involve the Contractor's knowledge during the design phase is by making use of the Bouwteam agreement. This model of agreement is usually implemented during the initial phase of a project. With its early origins in The Netherlands in 1992 its implementation goes back to the general conditions for the design team in which a contractor takes part (VGBouw, 1992). This model was developed back then to respond to the housing shortage the country was facing. Its implementation has gained popularity as a response to the market pressure and as an alternative to tackling some problems often found in the construction industry. This delivery method is attractive for both sides, Client and Contractor, as it brings the parties to develop and work over an initial set of alternatives which are narrowed down and further elaborated until an optimal solution is achieved. This agreement requires both parties to interact on an equal basis and contribute with their expertise in different domains. Its implementation is growing in popularity as more and more projects are completed and their objectives accomplished. Several advantages have been reckoned with in its use. Still, the key to its proper implementation is the participants' qualities and attitude to execute their tasks in a collaborative environment.

SRQ 2- What methodologies or principles are used in literature for the allocation and control of risks in infrastructure projects?

Although several frameworks exist in the management literature to implement the Risk Management process (Goh et al., 2013), they agree that this is a continuous practice starting in the early phase of the project but is not entirely done without a post-assessment of the project after its completion. The allocation and establishment of control measures for risks are usually done during the Risk

Management process's *Identification* and *Control & Planning* steps, respectively. Risk allocation is the definition and division of responsibilities of possible future losses or gains and the procedure of assigning the risks to the project participants (Lam et al., 2007). The literature explored is conclusive suggesting that the relevant criteria to decide on the allocation of the risk is generally understood to be the capacity of the parties to control either its cause or steer the consequences of the risk. Extending from project to contract management, these principles hold still and are used by official governmental agencies of The Netherlands in practice (Nauta et al., 2017). Once the allocation is defined, the implementation of control measures will serve to either prevent the risk from happening or decrease its effects on the project's objectives. Controlling risks involve the implementation of measures modifying risk, including processes, practices, or actions to alter them, although eventually, they might not exert the intended effect (ISO, 2009). In literature, the commonly accepted way to stand against risks is by using the mechanisms of *Avoidance*, *Acceptance, Transfer, and Mitigation. Contingency* as a proportion of the budget or as a buffer in the planning also complements the general control measures to risks.

SRQ 3- What risks can be identified when Bouwteams are used as project delivery method?

To answer this research question, the risks when using *Bouwteams* as Project Delivery Method, the definition of a risk for the Bouwteam outlined in Section 2.3.1 was used. By doing so, it was possible to screen what were of relevance for the design phase and the interaction between the participants of this agreement, from those relative to the realization of the project. The retrieved list of risks from the registers and the interviews were grouped according to the content of the risk event. As these statements were not consistent with the structure suggested in previous literature, a set of risks within each of the risk groups was formulated. In Figure 28, it is possible to find the *Risks for the Bouwteam* within each of the *Risk Groups*, as results from the analysis done through the projects.

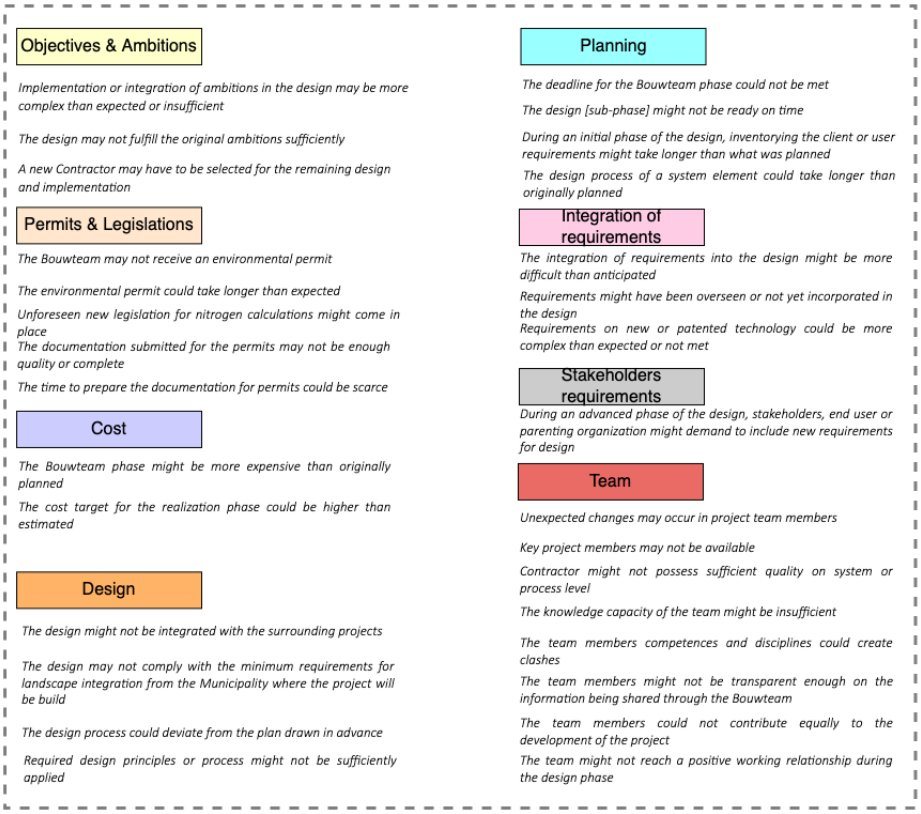

Figure 28- Risk for the Bouwteam & Risk Groups

The gathered data helped reflecting on the proposition originally framed in Section 2.4. This was that "*Risks part of the Organizational and Financial categories would be those of highest relevance when this type of Project Delivery Method is used".* The resulting analysis from the projects would suggest that this proposition is to a great extent correct. However, these two categories, defined earlier during the Literature review, were not the only ones to be of relevance when using this agreement. While the Risk Groups *Stakeholders requirement, Integration of Requirements, Team, Planning, and Objectives & Ambition* would be located under the *Organizational* umbrella, *Cost* would fall into the *Financial* category. Moreover, it is also relevant when using Bouwteams those groups of *Permits & Legislations* and *Design*; which could be linked to the *Political* and *Technical* categories, respectively. Although the data extracted from the registers tend to have a more technical-oriented tint, the interviewees tended to reflect more easily over organizational aspects when using this agreement, regardless what party they represented.

SRQ 4- What elements should be included in a model for the allocation and control of risks to be used in this project delivery method?

Based on the empirical study, the model foreseen should count with three main elements, which have further been developed throughout the analysis. These elements are also relevant to the Risk Management Process steps of *Identification* and *Control-Planning*, outlined in Section 2.3. The first element of the *Identification* step is a set of *Risks for the Bouwteam* and *Risk Groups*, and the second element concerns the *Allocation Decision*. Within the *Control-Planning* step, the third element would consist of a set of *Control Strategies* for the risks drafted earlier. The management of risk is integral to project management practices, and its successful implementation has been shown to significantly impact the probability of project success (Nicholas & Steyn, 2017; Royer, 2000). Therefore, including a chain of logical elements could help practitioners avoid critical steps of the RM Process within Bouwteams, and preventing this is to be merely followed as an administrative process.

The first element, consisting of a group of risks with associated risks for the Bouwteam, could enhance the discussion over critical areas of attention during this design phase. Notably, the register for the design phase tends to focus on the *technical* and even aspects of the execution. Introducing other facets with the inclusion of these risk groups, the discussion over relevant areas for the success of this project delivery method could be enforced. The second element sets off the argument of which party takes responsibility for the different risks for this phase and instead indicates principles to follow to derive the allocation decision. The principles identified for the allocation of risks, which are further implemented in this model, would follow those of the second proposition of this research: *The criteria to decide on the allocation of risk relates to the ability of the parties to control or influence the risk probability of occurring and their ability to manage and bear the consequences if the risk occurs*. Of particular interest is implementing a shared risk scheme that complements the already established and used in practice SCB approach (Nauta et al., 2017). Using a shared mechanism for the allocation of risks has been advocated to improve the collaboration and cooperation between team members (Adler et al., 2016; De Marco et al., 2016). Furthermore, practitioners advocated this could enhance the awareness of all parties over the possible consequences for the design phase. The last element from which this model should be conceived is a set of control strategies outlined to tackle the risks for the Bouwteam stage. The strategies are recommended over a single control measure as these span responses of a similar nature that could be equally applied or in combination to the risk group. Although a preferred option could result from this analysis, the practitioners should be aware of the possible applicability of more than one strategy per risk group.

SRQ5- ***How the implementation of a risk model could be of help for teams when using this project delivery method?***

The application of the outlined model of this research, could be advantageous for the team for the following reasons:

- *Working on an integrated basis towards risk reduction*: As identified during the review session, the model in this research could help the team work together on an integrated basis by making the participants establish a commond ground for the risk management process.

- *Giving more insights into the risks when using Bouwteams as Project Delivery Method:* In the risk management practice, and particularly related to the use of the established RISMAN method, there is a phenomen called 'RISMAN glasses'. In here, there is a tendency to see only through the categories presented in that approach. The opinion retrieved in the review session is that the model could help introducing *more glasses*, thus giving better insights into the risks when using this PDM.

- *Induce discussion of problematic areas over the design phase:* It was found throughout the empirical study and also adressed in the review session the rapid tendency of the risk discussion to be oriented into technical aspects mostly. It was also discussed that during this phase, the teams often fall into the discussion over procurement aspects for the execution when the design process has not reached a sufficient maturity status. For this reason was appointed that using the model could help the team focus on what could happen during the design phase. Limiting the view over the short-listed 30 risks in the Risk Groups could give a better structure of the main risks for this phase.

- *Enhance the transparency over the Risk Management process for all the parties involved:* The different elements of this model have been linked to the steps of the Risk Management Process. As was elaborated in the Literature review, this is an important interdependent set of activitis assistin on the realization of the project goals. The counsulted practitioners emphasized this could put under the spotlight *how* the process could be done through the Bouwteam, and *how* to judge over the allocation of risks, giving clarity to the decisions taken throughout this phase.

On the other hand, the participants could spot two obstacles to implementing this model. The first of them is a *Management Aspect* and refers to the implementation of the shared-risk scheme and how the financial implications of shared risks could be adressed by the team during the design phase. In this sense, it can be argued that the third conditional gate of this model -*if parties can jointly manage the risk*- holds of prominent relevance when deciding to implement this scheme. The literature offered possible ways to deal with this that were acknowledge by the experts reviewing the model. These mechanisms can first be discussed with the market parties during a consultation phase and further shaped between Client and Contractor during the Project Startup. The *Resistance to changes* would be the second obstacle for the implementation of this model. There is often a reluctancy towards new concepts or processes in the practice and driven by the lack of awareness in the added value these could bring. This is further enhanced by a limited willingness to spend effort on applying these concepts, as practitioners are used to working with their methodologies, limiting their motivation to adopt new things.

9.2 Main research question

How can the allocation and control of risks be incorporated when Bouwteams are used as a Project Delivery Method?

This research has explored the risks for Bouwteams. Besides identifying potential threats for the implementation of this agreement, the purpose was to develop a model that can help practitioners highlight relevant areas when these project delivery methods are used. As a result of the analysis, the model, that can be found in Figure 29, counts on three main aspects, which link back to the continuous cycle of the Risk Management process. Throughout the empirical study and confirmed by experts in the field, it was found that this could significantly enhance the work towards a common goal. Given the collaborative nature of the Bouwteams, this could positively influence the achievement of the objectives settled for this phase. The general agreement over its implementation is that the benefits could offset the effort of its implementation. As the model proposes a set of principles for the allocation, rather than a fixated allocation per risk group, it could allow the project participants to evaluate the appropriate division for the risks under the particular conditions of the project. Furthermore, the model provides an integrated set of options for the allocation by embedding notions of the SCB approach. Once the party responsible for the risk is decided, control measures should be implemented to decrease the chance of the risks. In this sense, the model outlined provides a set of strategies that have been reviewed to be effective in managing the risk groups. However, the team members must be aware that more than one strategy could be implemented, and these should also be adjusted to the project characteristics.

To practically transfer the allocation and control of risks, this research outlined a *roadmap for implementing* the elements in the model, visible in Figure 30. The presented gives two angles, one on the processes to follow, including how each element on the *Risk Model* could be implemented before and while the design phase takes place. The second relates to the contractual facet and how this model should be considered within the documentation and agreements beween the participants. Implementing the different elements on this model on the preliminary phase of the Bouwteam phase is of importance to guarantee the Risk Management process runs smoothly throughout the design stage. As a key aspect for the management of projects, the implementation of this process should be initiated from an early conception of the project. Striving to collect the preliminary data for its propper application is a task that would be born in the Client, as the project developer. Nevertheless, all the participants involved would lever the results from these efforts once the process of design is started.

Of leading importance is to mention the steps of identification and control of risks are not a static, and these should be continuously re-evaluated throughout the Bouwteam phase. As more information becomes available, some risks will be cleared and others could be identified. These should be assesed by the team and included in the registers. Furthermore, the parties should be aware on possible changes on the allocation as the design evolves. While the team could have chosen an initial set of control action for the risks in the early start of the design, these should be checked and if needed new ones could be implemented. The participants in this agreement should be willing to engage in the design task using the proper mindset and an open attitude towards new processes to incorporate the aspects of the allocation and control of risks. As a closing remark, is important to notice that when using Bouwteams and collaborative delivery methods, that the management of risks and the presented elements in this model would only boost its benefits when implemented jointly as a team.

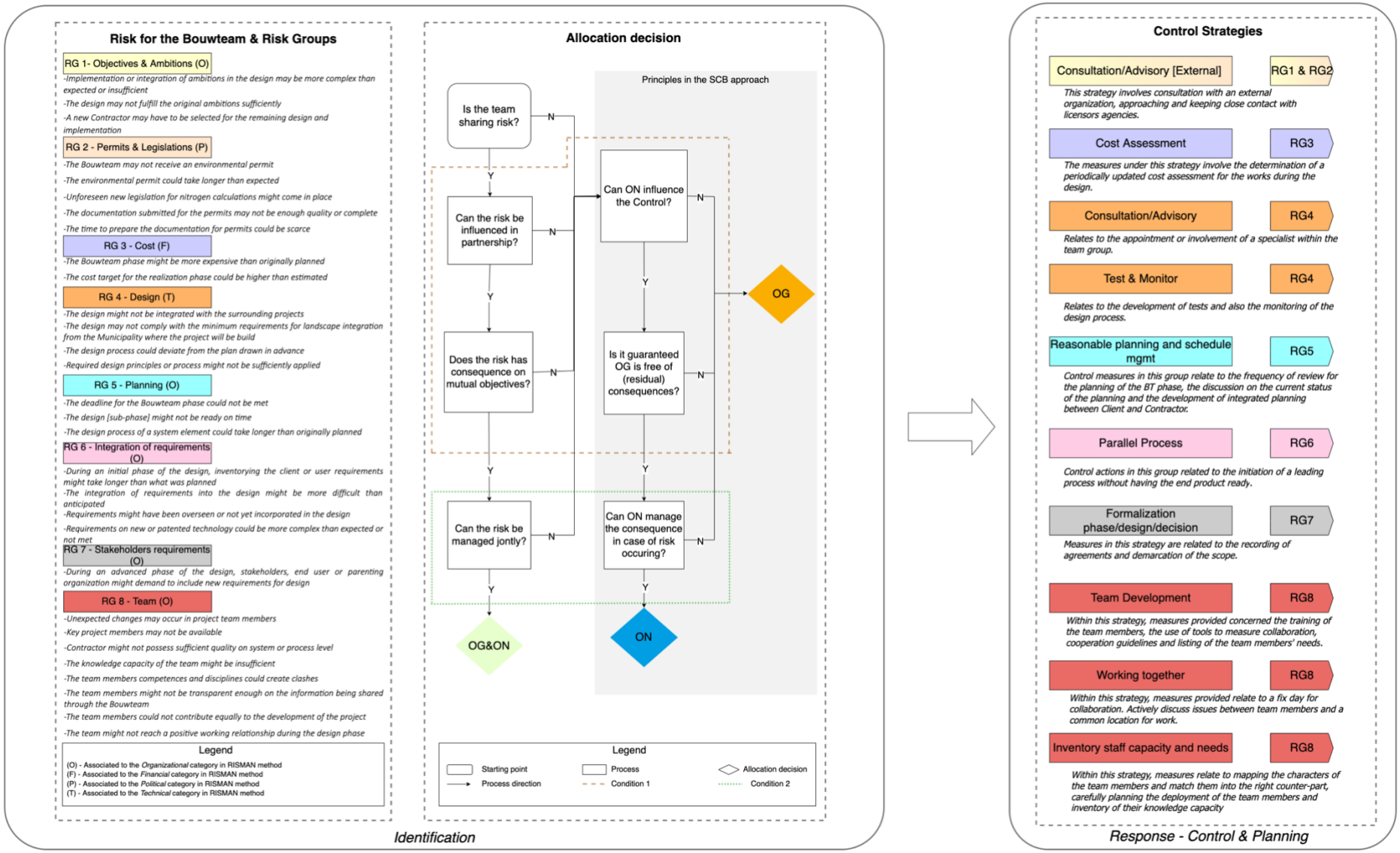

Figure 29- Risk model for Bouwteams

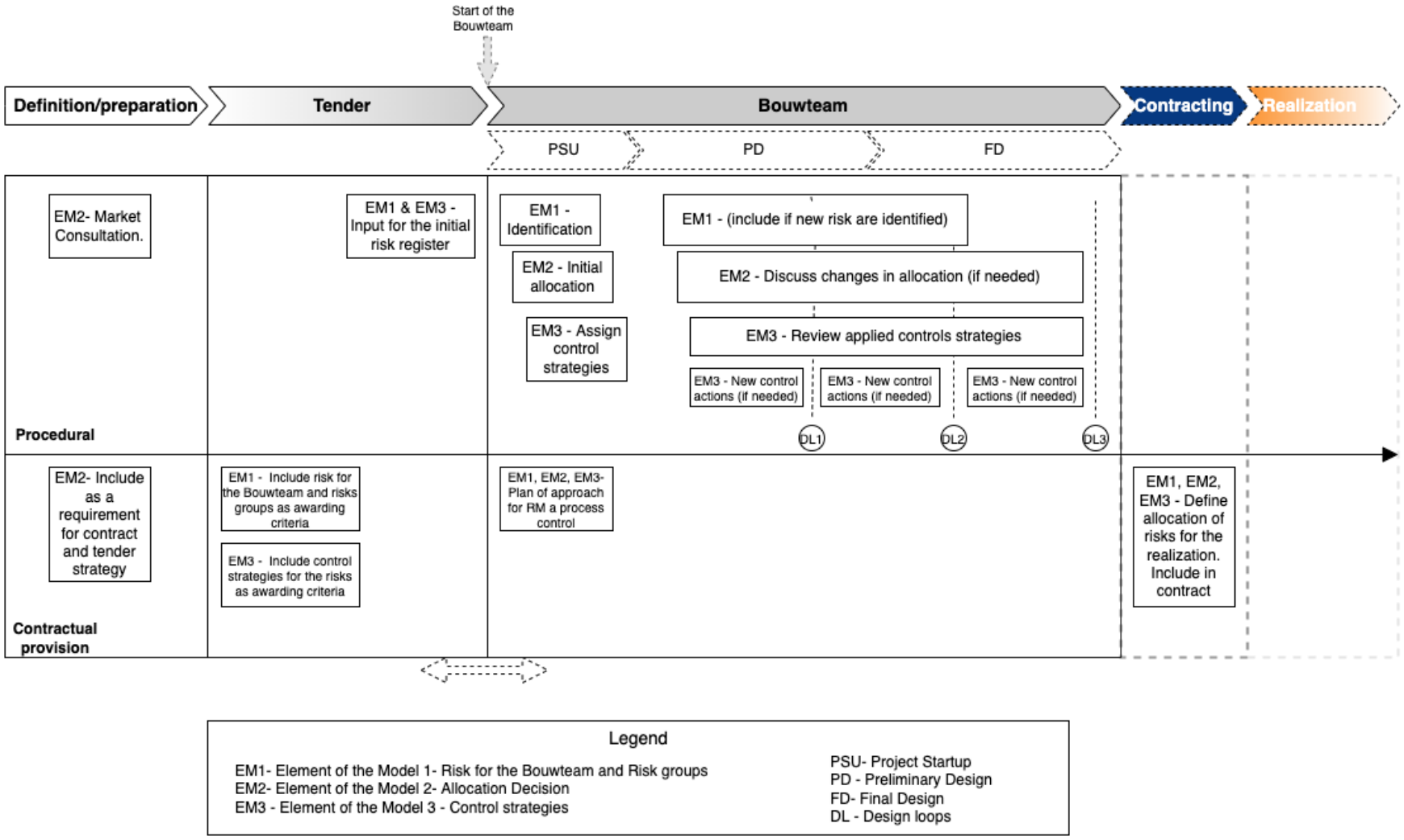

Figure 30- Roadmap for implementing the Risk model for Bouwteams

9.3 Recommendations

Recommendations for practice

Bouwteams offer an excellent opportunity for both the Client and Contractor to engage proactively and develop a more efficient design process. However, great effort, commitment and the correct mindset are needed to use this Project Delivery Method. As it becomes more popular and gains acceptance, parties interested in participating in a project with this setting should be willing to train their practitioners on best practices for its implementation. Furthermore, in this research, it has been repeatedly mentioned the use of the Project Start-up phase for different purposes throughout this research. It is highly encouraged for both the Client, Contractor and the rest of the participants to use this phase to smooth things, define expectations and establish a way of proceeding as a team. Also is essential for all participants to be aware of the implications, reach, and benefits that the RM practices can have on achieving and steering the course of the project. Then would be optimal to use this phase to create awareness amongst the project participants on the difficulties that could arise from the project. It is also seen from the analysis of the documentation a lack of consistency in the risk statements. Therefore, it would be advisable that those involved in the identification sessions for the project are first induced into the proper formulation of risks.

It is essential to be aware of how advantageous the use of Bouwteams could be and equally important to learn from the mistakes committed by the industry in its implementation. It is often seen in literature or reachable for study only those 'successful' cases. However, in projects where problems have arisen, the documentation or the participants are not reachable due to ongoing legal disputes or missing registers of its events. This could be an example of a phenomenon called *survivorship bias* or a form of *selection bias.* Gaining access to a catalogue of projects where things went wrong could also help the practice understand what should be improved. It could especially be necessary, for example, to expand the entries of the risk groups proposed in this model. In addition, it could help tailor a more defined representation of the Risk Management process applied for this type of project delivery method.

The model outlined in this research established a tool for implementing a set of steps of the RM process within the Bouwteam agreements. Although it was foreseen to be applicable by an expert validation session, it has not been implemented on a project due to the time constraints of a research of this kind. It could be recommended that this be tested and adjusted if needed by retrieving the insights from this experience. The limited knowledge of the effort required for its implementation, on time or the budget for the teams could represent a possible limitation. Nevertheless, this entails an opportunity for Witteveen+Bos to pilot-test its performance, see its results and close the dilemma. During the initial stage of this research, it was found that the company is involved in several projects still in the initial phase. Following the recommendations of the company's experts, those in an early conception stage would be interesting cases where the applicability of this model could be tested. It could also allow checking its result along the whole design process up to the realization stage.

Recommendation for further research

- The present research was focused on four different project types, trying to cover a wide span of classes where this project delivery method is in use. However, the focus was on *small* and *medium-size* projects. Therefore, it would be advisable to replicate a similar study for *large* projects using Bouwteam. This will allow us to check if the propositions and conclusions derived from this study remain valid regardless of the project size variable.
- Due to time constraints and availability of the experts, this model was only validated by experts relative to the Client position. Therefore, a further research study could explore the advantages and barriers of implementing this model by including the Contractor perspective.

- During the empirical phase of this study a significant amount of data was retrieved from the documentation and the interviews with the project participants. However, not all the content was used to give answer to the research questions. The data that has been created could be made available for future research focusing on different nuances of using Bouwteams or in case future analysis wants to be done on Collaborative PDMs. A qualitative analysis could be done on the acceptable level of the risk profile to move on in the realization phase of the project. The Bouwteam phase focus on developing the design upto a certain point agreed most of times upfront. However, is important to challenge if this state of maturity of the project is reasonably acceptable for the parties to enter the execution. Some questions to trigger a potential research could be: "*When is a concept or design optimally ready to be executed in terms of the risks for the execution phase?"*, *"How could the maturity in the design be linked to the risk profile of a project?", or* "*What metrics could be used to know when projects are ready to start the execution phase".*
- During the expert session, proposition 3 was confirmed throughout the empirical study and through the experience of an expert. However, it came out from the discussion that there is still a road to explore on proving this suggestion quantitatively, thus clearing some scepticism around the implementation of Bouwteams as PDM. This could be an interesting and challenging area to be explored in a thesis research.
- An area for future research linked to that mentioned before relates to how 'economically efficient' the implementation of Bouwteam as PDM is compared to the *traditional approach*. This subject repeatedly came up during the interviews of the empirical study. It could still take time until a study like this can be carried out, as many current Bouwteams are under development. However, this could be done by looking into a Program of projects, for example, the Dutch dyke reinforcement program-*HWBP*, in which also some tasks are carried out using a Bouwteam agreement. An essential aspect of a study like this would be to establish equivalent comparison units. Therefore, a program like the one mentioned, in which the objects to be built are pretty repetitive, could be thus ideal for setting a comparison. This could have two implications, finally breaking the dilemma of whether the complete business case of using a Bouwteam is beneficial for those with a traditional approach. And as an extension, it could help expand the literature on the use of these Project Delivery Methods and the prospects of early involving the contractor in the design. Unfortunately, studies addressing the Dutch implementation of this principle were not found to be duly discussed in international research journals. Partly this is due to geographical limitations on the use of this agreement in the country and the restrictions on the language of its related publications.
- Although it could be a subject of profound relevance for Risk Management, it was challenging to find academic studies addressing the effects of individual control measures over the total risk or its further propagation to decrease the overall risk profile. While insights were drawn from literature, studying this could have significant implications on how evaluate the effectiveness of the chosen control measures, possibly leading to better a control of projects.
- Finally, it would be significant to carry out further research on the conditions that enable a shared risk scheme and which could eventually be the best way to implement these in relational-based project delivery methods. Construction Theory developed by Sheng (2018) would be an interesting perspective to address this subject. It could give an integral line of reasoning on how to do or solve specific challenges for the construction management practice.

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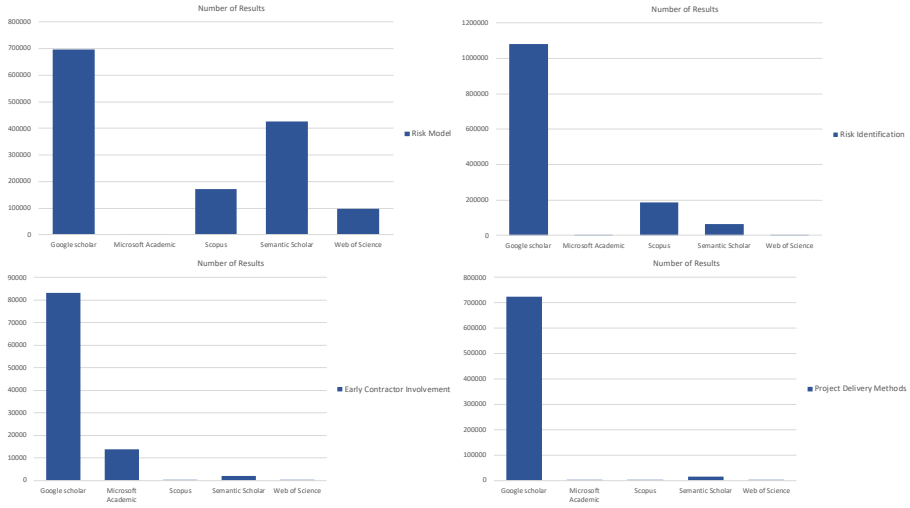
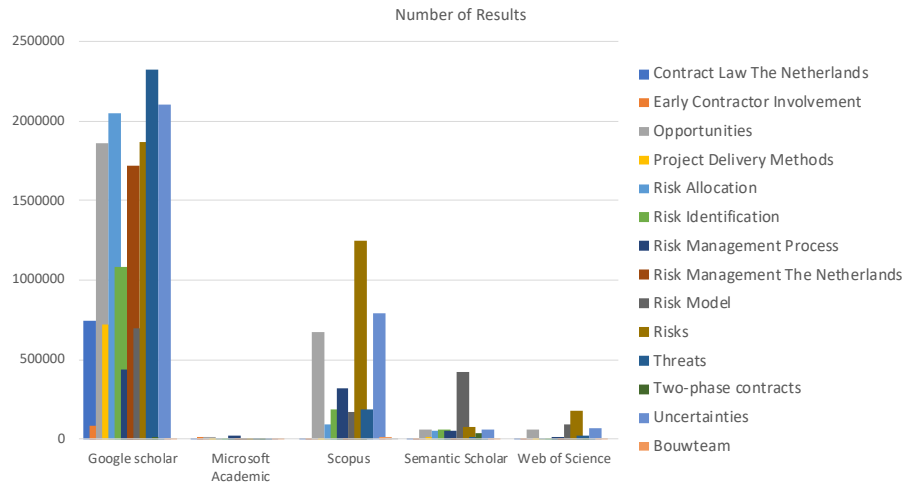
Appendixes

A. Overview of Search engine results





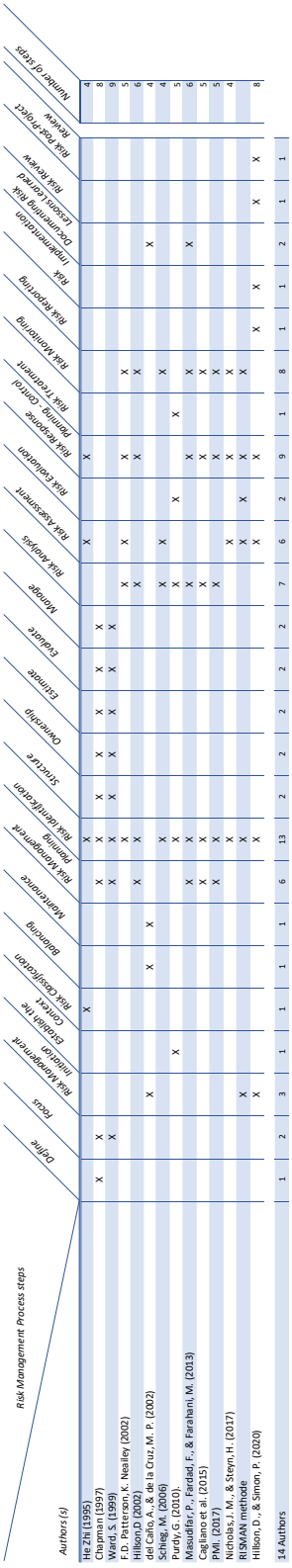
B. Overview Definition Bouwteam

Table 22-Definition and goal of a Bouwteam acc. to different authors

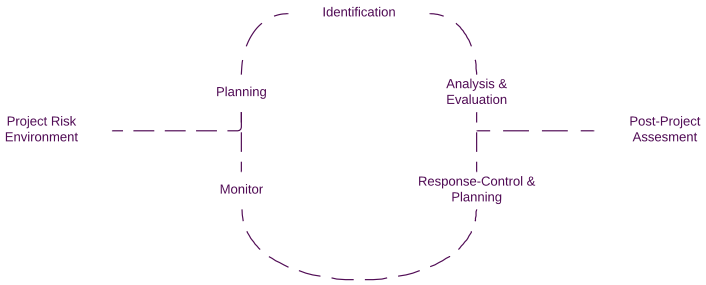
Author	Definition Bouwteam	Goal
(Asser/Van den Berg, 2016)	'A temporary partnership on an equal footing between representatives of the roles in the building process of initiation, design and execution, where the participants in a coordinated manner perform the tasks arising from their particular roles and on top of this, where possible, assist their fellow participants to perform their tasks by giving advice'	
(Koenen, 2017)	'The construction team involves collaboration between the client, his adviser(s) and a representative of the implementing discipline (i.e. a construction company).'	The aim of the collaboration is to make a design for the project desired by the client.'
(Chao-Duivis et al., 2018)	'The main characteristic of a Bouwteam is that a design is arrived at in partnership, with input from the contractor. It is in this input that the added value of this contract model for the client lies: the contractor contributes practical know-how to the design, which is therefore produced more efficiently with execution in mind.	As the contractor is already involved in the design, building work can be started sooner and more efficiently. The contractor is also likely to contribute his cost expertise to the design, thus making it possible saving on cost on executing the design as well as the costs of the construction itself.'
(Chao, 2018)	'A Bouwteam agreement is characterized by cooperation between the client and the contractor in the preparation of the construction process. The parties involved are equal to each other, at least as far as the professional/technical input is concerned. This collaboration is temporary and ends after completion of the design process. The latter does not alter the fact that the aspects that make the construction team a success cannot also be applied during the implementation phase.	
(van Riggelen, 2019)	'The Bouwteam is a collaboration agreement in which the participants - while retaining their independence and responsibility - work together on the preparation of the project. For that purpose, each of the participants is obliged to make the best possible use of their specific experience and expertise.'	
(de Hoog, 2020)	The Bouwteam is a temporary collaboration agreement during the design phase in which the participants – _including at least the client, contractor and designer – _cooperate towards a feasible design with an associated risk log and a building contract. To this end, each of the participants perform the tasks related to their experience and expertise while retaining their independence and responsibility.'	
(Gido et al., 2021)	'A Bouwteam is a partnership between client (OG) and contractor (ON) for construction projects. A contractor is involved as a cooperation partner at an 'early' stage. As a collaboration partner, this party participates in the design phase and/or preparation phase (construction team phase) of a project from a certain project stage and contributes the required complementary expertise, for example about manufacturability, design and realization and (realisation) costs'	'The aim of this way of working together was to reduce preparation time, control technical and organizational interfaces and ensure continuity of production in the construction process. The goal of the construction team is to jointly arrive at an optimal integrated design and agreement for the realization phase and realization supported by all parties involved.'
(Hertstein, 2021)		'The goal of the construction team is to collaborate in the design phase whereby each participant in the construction team contributes his specific experience and expertise on an equal footing, while retaining his own independence and responsibility.'

C. Risk Management Process

In literature



Risk management process explained



- Project Risk Environment: In this phase, the objectives and goals of the project should be jointly shared amongst the participants, even while it is expected this is intrinsically done within the Project scoping and Project Management practices. Also, the key participants and stakeholders should be identified and their roles and level of responsibilities they assume within the project. Finally, it should be set clear which are the risk tolerance levels, extent, and depth of the risk management process to be performed during the project.

- Planning: Producing a risk management plan implies asking a set of thoughtful questions that will help to define how to conduct the risk management activities (Massaad, 2021). This will also help identify the techniques to be used in the process, the periodicity with which the review of risk will be performed, and its prioritization. The key benefit of this process is that it ensures that the degree, type, and visibility of risk management are proportionate to both the risks and the importance of the project (PMI, 2017).

- Identification: This stage involves a critical forward-thinking review of the potential sources of risks and trying to figure out why these might be triggered. Amongst the different ways to identify risks, one is to revise the project's chronological development and identify the risks in each phase (Nicholas & Steyn, 2017). The aim is to identify all practically and realistically risks (D. Hillson & Simon, 2020), their causes and possible owners (del Caño & de la Cruz, 2002b). Consequently, as the project moves on, more information becomes available, and the possibility to foresee upcoming situations becomes more feasible.

- Analysis and Evaluation: This step is concerned with developing an understanding of each risk, its consequences, and the likelihood of those consequences (Purdy, 2010). Many risk analysis methods are available, but these can be broadly divided into qualitative, semi-quantitative, and quantitative methods (Zhou et al., 2019). It is essential to know that the selection of the technique should be suited to the project characteristics and the resources available within the organization. This step should be complemented with a thorough appraisal by the experts on the results done using any analysis techniques.

- Response – Control and Planning: The response and planning address the alternatives to deal with the risks identified in the previous step. Control is a measure modifying risk, including processes, practices, or actions to alter them, although eventually, they might not exert the intended effect (ISO, 2009). This step concerns the development of specific actions with a sufficient definition to allow a practical implementation (Nicholas & Steyn, 2017).

- Monitor: Once the risks were identified and appropriate measures to deal with these were established, the following step is to supervise whether the risks have been triggered, what is the situation after applying the response measures, or if there is a change in the risk exposure due to updated status of the project or new information. In this step, a continuous review should be performed with alternative periodicity in search of unknown emerging risks or previously unidentified ones included in the tracking registers (D. Hillson & Simon, 2020).

- Post-Project Assessment: Once the project is finished, no new risks should continue emerging or be triggered. This step is the closure process to learn from the project experience (del Caño & de la Cruz, 2002a). It offers the possibility to create a source of expertise from which further projects can be benefited (D. Hillson & Simon, 2020).

D. Questionnaire for the interviews

TU Delft

Questionnaire for interview

MSc. Thesis – Developing a Risk Model for Bouwteams

Date: *<dd/mm/yyyy>*

Interviewee: *<Fill in name>*

1st Section- General Questions [approx.8']

1. *Name?*
2. *Educational and Career Background?*
3. *Years in your current position?*
4. *Including the project <Name of project>, in what type and how many projects using Bouwteam you have been involved?*

2nd Section- Background Information [approx. 6']

5. *Which party of the project in question is your employer and which was your role in the project?*
6. *In which stage of the Bouwteam you were involved for the project <Insert Name of Project>?*

3rd Section- Case study Project Information [approx. 30']

-Introduce the Interviewee to the section according to the description in Case Protocol

7. *Which methodology was followed during the Bouwteam for the Risk Management Process?*
8. *Which was the party responsible for maintaining the risk file?*
9. *How was the process of identifying risks? Did this include risk sessions/meetings?*
   If yes:
   a) *How often the sessions were held?*
   b) *Who participated in these sessions?*
10. *Do you think the risk assessment process was evenly oriented to all types of risks? (e.g.: Organizational, Political, Financial, Legal, Technical)*
11. *Were there risks identified before the contractor was involved in the Bouwteam?*
    If yes:
    a. *Did the contractor assess these pre-identified risks?*
    b. *Did the contractor include/modify these?*
12. *Were there any risk risks known to you not included in the risk registers?*
    If yes:
    a. *Which ones and why?*
13. *Did the team use a standard list of risks to assess those affecting this project?*
14. *How did you decide which risks should be included in the risk file?*
15. *What risks can be considered critical for the Bouwteam?*

1

4th Section- Risk Model [approx. 32']

-What is understood as the Risk Model for this research will be explained to the interviewee before moving to this section. -

--- Allocation of risks related

16. *What criteria or principle was used to decide to what party the risk should be allocated?*
17. *Which risks in your opinion should have been allocated to another party?*
18. *What conditions will make your organization willing to assume responsibility for other risks?*
19. *How was decided what risks should be shared between the parties?*

-A Likert scale will be used on-screen to ask the interview to rate their experience about this aspect-

20. How would you react to the following statement? *"I consider that my organization was satisfied with the allocation of risks established for this project":*
    - Strongly disagree
    - Disagree
    - Undecided
    - Agree
    - Strongly Agree

    Why?

--- Control of risks related

21. *For the type of risk <insert category acc. to risk file>, how the response measures were chosen? [An example will be given on a case basis]*
22. *To what extent do you think these responses were effective?*
23. *What other measures could have been applied as a response to these risks?*

--- General to the model

24. *To what level should risks be reduced before moving on to the implementation phase?*

--- Closing

25. *How would you describe your general experience with the use of Bouwteam relative to the risk management aspects?*

2

E. Informed consent form

Consent form 'Analysis of project <*Include name of project*>'

You are being invited for an interview for the Thesis project: 'Developing a Risk Model for Bouwteam', part of the graduation research in the MSc. Construction, Management & Engineering program for the Delft University of Technology. Before you decide to participate, it is important that you understand why this research is conducted and what it entails. Please read this form carefully.

What is the purpose of this research? As part of my thesis project, I will analyze the risks identified when Bouwteams are used as Project Delivery Model. Particularly, I am interested in the mechanism of allocation of the identified risks (how these are distributed between the parties involved in the project) and their control measures, and how these two evolved with the different phases of the design. The problem identified triggering this research is that the recently developed models for Bouwteams (DG2020 and KBN2021) do not present any specific insight on how the allocation and control of risks should be done between the participants. In addition, during the literature review, no sufficient insight was found on other studies addressing this problem, thus giving academic relevance to this research. On the practical level, the goal of this research is to produce a risk allocation and control model that can be used in projects using this PDM to evaluate quickly and effectively the risks based on a pre-defined model. The methodology to perform this research is first a literature review, and the following phases will consist of a Multiple-case study, and lastly an expert review on the outcomes.
Who is the interviewer? This research is being conducted by Francisco E. Correa Galdeano as a graduation assignment for the master's degree Construction, Management & Engineering at the Delft University of Technology.
Who are the interviewees? For this research, participants in the project <*Include name of project*> on behalf of the Client, Consultant, and Contractor are invited to contribute with their expertise in the process of Risk and Contract Management.
How the provided information will be used? The interviews will be recorded, and transcripts will be created to be used in the data analysis phase. The transcripts will be anonymized, but references will be made to the position and years of experience of the interviewee in the organization. The video recordings will not be shared beyond the study team, and the information will be stored securely. Lastly, the anonymized results of this study will be published in TU Delft Repository for future research and learning. No personal information that can identify you will be published or shared.
Are there any risks associated with this study? There are no risks associated.
Can I withdraw from the interview? Participation in this interview is voluntary and you can withdraw at any time.
When and where does the interview take place? The interview will take place remotely through MS Teams on a date of more convenience for the interviewee.
Language of the Interviews? The interviews will be done in English.
How long will it take? The interview will last approximately 60-90 minutes.

Please tick the appropriate box

Participation in the research	Yes	No
I have read and understood the invitation email. I had the opportunity to ask questions about the study and they were answered to my satisfaction.	☐	☐
I voluntarily agree to participate in this research and understand that I may decline to answer questions and withdraw at any time without giving reasons.	☐	☐
I understand that participation in this study includes an interview, where data is collected through video recording, transcripts, and written notes.	☐	☐
I understand that participation the collected data generated will be stored securely.	☐	☐
Use of information from the study		
I understand that the information I provide may be used for academic and practice publications, seminars, presentations, expert sessions, symposia, etc.	☐	☐
I understand that the personal information collected will not be shared outside of the research team.	☐	☐
I agree that my information may be quoted in the channels mentioned above.	☐	☐

1

I would like to receive the results of this study. ☐ ☐

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By signing this form, you indicate that you have carefully read the participation form and that you agree to participate in this study.

Signature

_____	_____	_____
Name Participant	Signature	Date

I informed the participant about the study to the best of my ability, to ensure that the participant knows what he/she is consenting to.

_____	_____	_____
Name Researcher	Signature	Date

Contact details researcher [Francisco E. Correa Galdeano, E: f.e.correagaldeano@student.tudelft.nl, M: +31645221585]

F. Criteria applied to pool of projects

Projects inside W+B

				Criteria						
Source	Name	Type of Project_ Cat 1	Type of Project_ Cat 2	Availability of data - Risk Registers *	Availability of data - Participants *	Availability of data - Contract between parties *	Bouwteam	Connection type to realization	Status of project	Size of Project (Contract Value)
W+B	Reconstructie Cruquiusbrug	GWW	Road and Transport	✓	✓	✓	✓	✓	✓	✓
W+B	Dijkversterking Wolferen-Sprok	GWW	Dykes	✓	✓	✓	✓	✓	✓	✓
W+B	Circulaire RWZI Terwolde	GWW	Water & Waste resources	✓	✓	✓	✓	✓	✓	✓
W+B	Bouwteam herinrichten Langegracht/oude Herengracht Leiden, onderdeel van de	GWW	Road and Transport	✓	×	✓	✓	✓	✓	✓
W+B	Dijkversterking Hansweert	GWW	Dykes	×	×	✓	✓	✓	✓	✓
W+B	Design and Construction of the Hertz facility at ESTEC	Non-Residential Construction	Industrial	×	×	×	×	×	✓	✓
W+B	Waterfabriek Wilp	GWW	Water & Waste resources	×	×	×	✓	N/A	✓	✓
W+B	Nieuwe Waterwerken Zoutkamp	GWW	Hydraulic	×	×	×	✓	✓	×	✓
W+B	De Nieuwe Zijde Noord (ondereel Oranje Loper)	GWW	Road and Transport	×	×	✓	✓	×	✓	✓
W+B	Beweegbare bio-based fietsbrug Ritsumasyl	GWW	Road and Transport	×	×	×	✓	✓	✓	✓
W+B	Kademuren Amsterdam Oostenburg	GWW	Hydraulic	✓	×	×	✓	×	✓	×
W+B	Vervangen Brug & Sluis te Driemond	GWW	Road and Transport	×	×	×	✓	N/A	×	×
W+B	Entree ondergrondse parkeergarages en fietsenstalling Kijkduin-Bad	GWW	Road and Transport	×	×	×	✓	×	×	×
W+B	Gemaal Bergboezem Berkel	GWW	Hydraulic	×	×	×	✓	×	✓	×
W+B	Kadeversterking Lappenvoort Oosterland	GWW	Canals	×	×	×	✓	N/A	×	×
W+B	Renovatie Prinses Beatrixbrug Naarden	GWW	Road and Transport	×	×	×	✓	N/A	✓	×
W+B	Bouwteamsamenwerking zuidelijke pontaanlanding Ijpleinveer	GWW	Canals	×	×	×	✓	×	✓	×
W+B	Zoetwaterfabriek en Collectieve zuivering	GWW	Water & Waste resources	×	×	×	✓	✓	×	×
W+B	Elektrificatie busstations Noord en Amsterdam Centraal	GWW	Road and Transport	×	×	×	✓	×	✓	×
W+B	RWZI Houten ozoninstallatie	GWW	Water & Waste resources	✓	✓	✓	✓	×	✓	✓
W+B	Herinrichting Jan Gijzenkade (SOPI)	GWW	Road and Transport	×	×	×	✓	×	×	×

Projects outside W+B

				Criteria						
Source	Name	Type of Project_ Cat 1	Type of Project_ Cat 2	Availability of data - Risk Registers *	Availability of data - Participants *	Availability of data - Contract between parties *	Bouwteam	Connection type to realization	Status of project	Size of Project (Contract Value)
Outside W+B	Het Swettehûs Fryslan	Non-Residential Construction	NRC-Public & Civic spaces	✓	✓	✓	✓	✓	✓	✓
Outside W+B	Nieuwbouw Theater aan de parade Hertogenbosch	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	✓
Outside W+B	Azc Gilze	Non-Residential Construction	NRC-Hotel & Restaurants	×	×	×	✓	N/A	✓	✓
Outside W+B	Huis voor de Stad Helmond	Non-Residential Construction	NRC-Public & Civic spaces	×	×	×	✓	N/A	✓	✓
Outside W+B	De 'Grote Kruising' herinrichting Algeracorridor	GWW	GWW-Road & Transport	×	×	×	✓	N/A	✓	✓
Outside W+B	Renovatie gemeentehuis Dronten	Non-Residential Construction	NRC-Public & Civic spaces	×	×	×	✓	N/A	✓	✓
Outside W+B	Bouwteampartners Nieuwbouw Talentencentrum Breda	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	✓
Outside W+B	Jan Tinbergen College	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	✓
Outside W+B	Laboratoria Duboisdomein 30 Maastricht University	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	✓
Outside W+B	Nieuwbouw WRZV-hallen te Zwolle	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	✓
Outside W+B	School Avignonlaan 11	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	✓	✓	✓
Outside W+B	Multifunctional accommodation Ontmoetingsplein Germenzeel in Uden for SAAM	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	✓
Outside W+B	Bouwteam ten behoeve van verbouw entree en optioneel huisvesten bibliotheek Muziekkwartier	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	✓
Outside W+B	Reconstructie Biltlaan en Koningin Julianabrug	GWW	GWW-Road & Transport	×	×	×	✓	N/A	✓	✓
Outside W+B	Het Huis van Albrandswaard	Non-Residential Construction	NRC-Public & Civic spaces	×	×	×	✓	×	✓	✓
Outside W+B	Hydraulische uitbreiding RWZI Retranchement	GWW	GWW-Water & Waste Resources	×	×	×	✓	✓	✓	✓
Outside W+B	Sanering voormalige stortplaats Woltersum	GWW	GWW-Earthworks	×	×	×	✓	N/A	✓	✓
Outside W+B	Centrumplan Didam Montferland	GWW	GWW-Road & Transport	×	×	×	✓	N/A	✓	✓
Outside W+B	Nieuwbouw Integraal Kind Centrum De Kreek in Zwaag	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	✓
Outside W+B	Sporthal Plus Nijmegen Noord	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	✓
Outside W+B	Nieuwbouw IKC De Tol Leidschendam-Voorburg	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	✓
Outside W+B	Nieuwbouw Brandweer Sloterdijk	Non-Residential Construction	NRC-Public & Civic spaces	×	×	×	✓	N/A	✓	×
Outside W+B	Nieuwbouw IKC-Zuidoost ZIEZO Maastricht	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	✓
Outside W+B	IKC de Ploeg en IKC de Marke	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	✓
Outside W+B	Verlegging en Reconstructie Broekdijksestraat en Bredesteeg -Tiel	Non-Residential Construction	NRC-Public & Civic spaces	×	×	×	✓	N/A	✓	×
Outside W+B	Bouwteam en renovatie zwembaden De Randoet & Het Puzzelbad Gemeente Drimmelen	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	×

Projects outside W+B (continued)

				Criteria						
Source	Name	Type of Project_ Cat 1	Type of Project_ Cat 2	Availability of data - Risk Registers *	Availability of data - Participants *	Availability of data - Contract between parties *	Bouwteam	Connection type to realization	Status of project	Size of Project (Contract Value)
Outside W+B	Bouwteam Wasinstallatie Bodemassen	GWW	GWW-Water & Waste Resources	×	×	×	✓	N/A	✓	N/A
Outside W+B	Bouwteam aanpak boordvoorzieningen Kanaal Almelo - De Haandrik	GWW	GWW-Canals	×	×	×	✓	N/A	✓	✓
Outside W+B	Nieuwbouw Rafaelschool Utrecht	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Nieuwbouw en renovatie Briant College Arnhem	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Herinrichting Esplanade Almere-Stad Centrum	Non-Residential Construction	NRC-Public & Civic spaces	×	×	×	✓	N/A	✓	N/A
Outside W+B	Nieuwbouw en renovatie Winkler Prins Gemeente Veendam	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Herinrichting Lange Wemen Hengelo	Non-Residential Construction	NRC-Public & Civic spaces	×	×	×	✓	N/A	✓	N/A
Outside W+B	Nieuwbouw en renovatie Museum Arnhem	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	✓
Outside W+B	Building on Zernikedreef Hogeschool Leiden	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Nieuwbouw en renovatie van de John F. Kennedyschool Maastricht	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	×	N/A
Outside W+B	Integraal bouwteam Nieuwbouw Leonardo College	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Zwembad "De Schelp" Bergen op Zoom	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	N/A
Outside W+B	Bouwteam non-ferro scheiders en metaalverwijderaars	Non-Residential Construction	NRC-Industrial	×	×	×	✓	N/A	×	N/A
Outside W+B	Nieuwbouw Citadel College Lent	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Vernieuwbouw Annie MG Schmidtschool	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Bouwteamopdracht Herontwikkeling Fruitweg 17 Den Haag	Non-Residential Construction	NRC-Public & Civic spaces	×	×	×	✓	×	✓	×
Outside W+B	Gevelrenovatie Metzo College	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	×	N/A
Outside W+B	Hessenpoort, Nieuwleusenerdijk-Paderbornstraat Zwolle	GWW	GWW-Road & Transport	×	×	×	✓	N/A	✓	×
Outside W+B	Verbouwing Postkantoor / Museum Van Bommel Van Dam te Venlo	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	×
Outside W+B	Bouwteam demo-micro's en proevenloods Ge(O)zond Water	GWW	GWW-Water & Waste Resources	×	×	×	✓	N/A	✓	N/A
Outside W+B	Centrale Huisvesting Stadsbeheer Nissewaard	Non-Residential Construction	NRC-Public & Civic spaces	×	×	×	✓	N/A	✓	×

Projects outside W+B (continued)

				Criteria						
Source	Name	Type of Project_ Cat 1	Type of Project_ Cat 2	Availability of data - Risk Registers *	Availability of data - Participants *	Availability of data - Contract between parties *	Bouwteam	Connection type to realization	Status of project	Size of Project (Contract Value)
Outside W+B	Logistiek Park Moerdijk	Non-Residential Construction	NRC-Industrial	×	×	×	✓	N/A	✓	N/A
Outside W+B	Zuidelijke pontaanlanding IJpleinveer	GWW	GWW-Canals	×	×	×	✓	N/A	✓	N/A
Outside W+B	Dialogue Centre Wageningen University & Research	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	IKC Clematislaan	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Center Ceramique Maastricht	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	N/A
Outside W+B	PCBO Schothorst Amersfoort	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Nieuwbouw Insp. W.P. Blokpoelschool De Haagse Scholen	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Nieuwbouw NEF DOKWURK in Dokkum	Non-Residential Construction	NRC-Industrial	×	×	×	✓	N/A	✓	N/A
Outside W+B	Herinrichting Viskade aan de Halkade	GWW	GWW-Canals	×	×	×	✓	N/A	✓	N/A
Outside W+B	Bouwteam verhardingen provincie Utrecht	GWW	GWW-Road & Transport	×	×	×	✓	N/A	✓	N/A
Outside W+B	Renovatie RWZI Oosthuizen	GWW	GWW-Water & Waste Resources	×	×	×	✓	✓	✓	N/A
Outside W+B	HWBP Zuid-Beveland West bij Hansweert	GWW	GWW-Dykes	×	×	×	✓	✓	✓	N/A
Outside W+B	Nieuwbouw KC Vredenburg Arnhem	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	×	N/A
Outside W+B	Nieuwbouw Yuverta (ex CITAVERDE) College Roermond	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	N/A
Outside W+B	Nieuwbouw IKC Het Simmelink Eibergen - Arnhem	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	×	N/A
Outside W+B	Nieuwbouw basisschool "Het Open Venster"	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	×	N/A
Outside W+B	Middenboulevard “De kust gezond” Scheveningen - Woonrijp maken - fase 1	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	×	N/A
Outside W+B	Nieuwbouw regenboog school Nieuwendijk Altena	Non-Residential Construction	NRC-Education & Research	×	×	×	✓	N/A	✓	✓
Outside W+B	Reconstructie IJsselmondse knoop	GWW	GWW-Road & Transport	×	×	×	✓	N/A	✓	N/A
Outside W+B	Verbouw en verduurzaming onderwijsgebouw de Sportcampus (Gemeente Utrecht)	Non-Residential Construction	NRC-Entertainment & Sports	×	×	×	✓	N/A	✓	N/A

G. Documentation analyzed

Documents analyzed

Documents	Project A	Project B	Project C	Project D
Call for tender	X		X	X
Tender Guidelines		X		
Bouwteam agreement			X	X
Integrated plan of approach	X			
Demand of specifications				
Risk registers	X	X*	X*	X
Others	Annex to contract-Risk Allocation	Annex to contract-Risk Allocation		

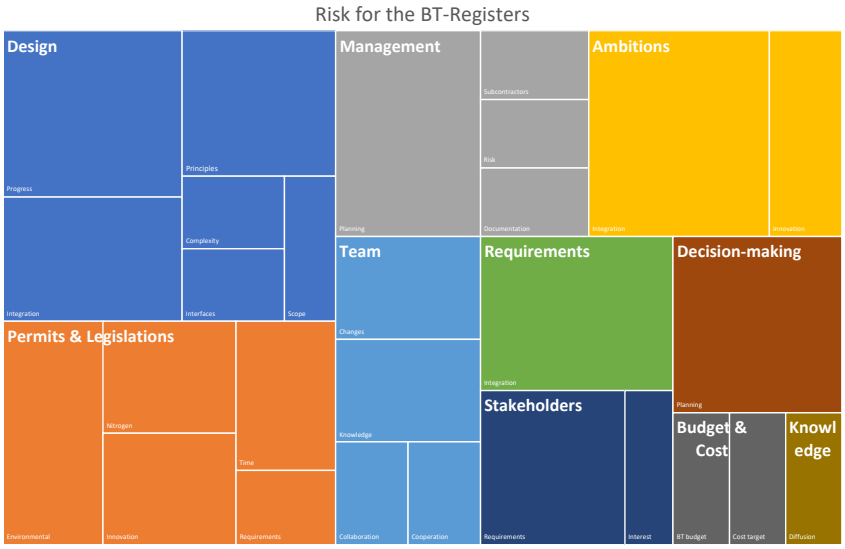
* Contractor version

H.Risks for the Bouwteam and Control measures across the projects

From registers

Ambitions - integration: ***-Innovation***	*A_R_1:"Objective of maximum circular construction not or insufficiently achieved"* *A_R_2:"Objective of energy neutral not or insufficiently achieved"* *A_R_3: "Objective of low-maintenance construction not or insufficiently achieved"* *A_R_10:"Ambitions are insufficiently fulfilled* *A_R_29: "Innovative solution(s) from ON do not fit within the requirements and standards (insufficient support from Client)"*
Decision-making planning	*A_R_5: "Not good decision making"* *A_R_6: "Design is delayed because no definitive choice is made about design"* *A_R_7: "Integration of [sub-design element] for [design system]"*
Design -Planning ***-Complexity*** ***-Interfaces*** ***-Principles*** ***-Scope***	*A_R_8: "ON does not achieve its planned progress* *A_R_9: "Delay design process due to late decision-making [design element]"* *A_R_11: "[Design element] is more challenging than previously thought"* *A_R_12: "Interfaces between different parties are insufficiently controlled"* *A_R_13: "IFD is not being applied sufficiently"* *A_R_14: "Scope of [design element] unclear"*
Knowledge -Difusion	*A_R_17: "Knowledge developed during the project is not or insufficiently available to OGs and market parties"*
New legislations -Nitrogen	*A_R_18: "Nitrogen problems lead to PIP stagnation and later licensing"*
Permits -Environmental ***-Planning*** ***- Requirements*** ***-Innovation***	*A_R_19: "Construction team (ON) does not receive an environmental permit"* *A_R_20: "Environmental permit is not granted"* *A_R_21: "Environmental permit is not granted on time by the competent authority [As a result of late request on the permits…]* *A_R_22: "Environmental permit is not granted in time under the Nature Management Act (WNB) [As a result of calculations not meeting requirements…]"* *A_R_16: "Part designs innovations are not approved* *A_R_15: "Licensing authorities restrict innovation"*
Planning – Management ***-BT phase*** ***Cost - BT phase***	*A_R_23: "Project team does not manage planning sufficiently integrally"* *A_R_24: "Deadline [Date] (end of Bouwteam / accepted DO) will not be met"* *A_R_25: "Construction team phase takes longer than planned and/or costs more money than estimated (execution agreement)"*
Process – Design ***-Knowledge***	*A_R_26: "PIP procedure takes longer than planned"* *A_R_27: "Too little quality of contractor at system and process level"*
Risk management – Process	*A_R_28: "Project team is insufficiently risk-driven"*
Stakeholders – Requirements ***-Interest***	*A_R_30: "The Water Board is introducing new requirements with regard to water transit"* *A_R_31: "Other, administrative, interests hinder project planning progress"*
Subcontractor – Management	*A_R_32: "There is no integrated management of the main contractor/combination towards subcontractors/ suppliers/specialists"*
Team – Cooperation ***-Changes*** ***-Collaboration***	*A_R_33: "Insufficient cooperation between OG-ON"* *A_R_34: "Changes in project team Client, also the Bouwteam"* *A_R_35: "Collaboration is not going well"*
Budget & Cost -BT Phase ***-Target***	*A_R_4:"Bouwteam budget insufficient* *A_R_36: "Target budget not sufficient"*
Design – Integration ***-Plannning***	*B_R_36:"Coordination with other projects"* *B_R_38: "Solution transitions do not meet requirements"* *B_R_37: "UO not ready in time"*
Stakeholders – Requirements	*B_R_39: "Unforeseen requirements from the Stakeholders"*
Team – Changes	*B_R_40: "Team changes"*
Ambitions - Integration	*C_R_41: "The project is not optimally designed, realized and managed in a circular manner"*
Decision-making – Planning	*C_R_42: "Variant choice influenced design process"*
Design – Integration	*C_R_43: "Design does not meet the minimum requirements for landscape integration of the municipality of [where the project will be established]"*
Documentation– Management	*C_R_44: "Document management of the project is not in order"*
Knowledge – Team	*C_R_45: "Insufficient available capacity and knowledge of project employees"*
Permits - Planning	*C_R_46: "Permits were not issued on time"*
Planning – Management	*C_R_47: "Planning management is insufficient"*
Process – Design	*C_R_48: "System Engineering is applied incorrectly or inefficiently to this project"*
Requirements – Integration	*C_R_49: "Modules do not meet [Patented technology] requirements"*
Design – Planning	*E_R_50: "Elaboration of the design is not structured according to a plan drawn up in advance"*
Ambitions - Innovation	*E_R_51: "Little innovation in progress"*
New legislation – Nitrogen	*E_R_52: "Nitrogen"*
Permits – Environmental	*E_R_53: "Environmental permit objections"*
Requirements – Integration	*E_R_54: "Inventorying and integrating user requirements into the design is difficult and delayed"*

	E_R_55: "The verification shows that the requirements from the various PVEs have not yet been incorporated in the DO design"
Stakeholders – Requirements	*E_R_56: "Involvement versus interference"*



From interviews

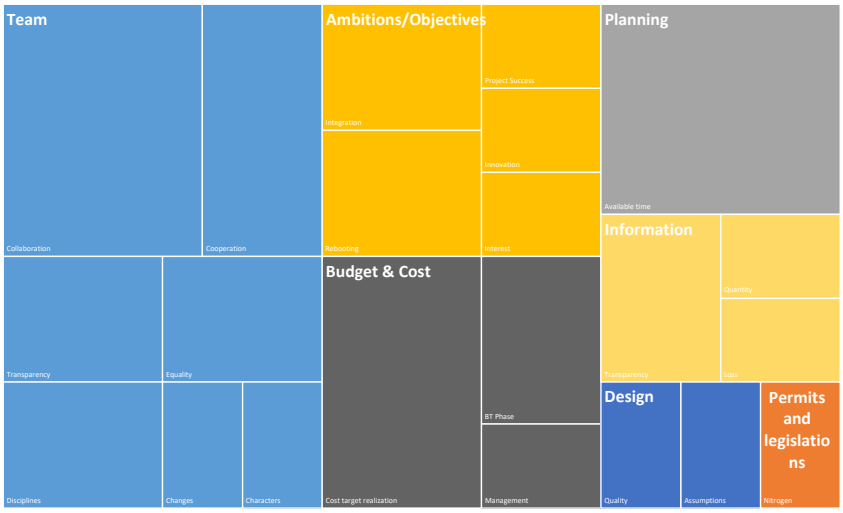
A_OG1	A_OG2	A_ON1
"I think the Financial aspect of the whole Bouwteam… if the final quotation for the realization of the project is higher than expected" *"It is very difficult to stop the efforts if an agreement is not reached, because there are some further steps or process that have been already initiated by the Contractor"*	*"Not meeting the ambitions… If you have excesive checks on the design is sometimes difficult to achieve certain ambitions, for example innovation"* *"The financial aspect, as it seems that the construction can be more expensive than originally expected"*	*"Money… The client allocated a budget for this project and we are now over this figure"* *"The initial expected budget is not realistic or according to the requirements or ambitions for the project"*

B_OG1	B_OG2	B_ON1	B_ON2
"The assumptions for the project were not clear at all, which took us a lot of time, it's always time-related" *"Risks are very often time-related. Not image, or quality. It's always time-related"* *"Stikstof- Nitrogen <related policies> were a problem"* *"Every time related issue, and especially the decision-making process of the Water Board"*	*"The quality of the people that are involved in the Bouwteam... So it is all about collaboration and you need the right competencies to do it smarter, better and faster"* *"There is a lot of people changing the team, so the continuity of the people in the Bouwteam is also a risk"* *"There is a big risk to make the Bouwteam succeed about people not being transparent enough"*	*"The most essential is working together… even on an individual level"* *"Not having the same perception of project success"* *"Even though you have different interests, you must be able to formulate mutual goals"*	*"The available time… You need to plan and assign enough time for the different phases of the design and the different process related to planning and price calculation"* *"Also was crucial to work together, before COVID… in the same physical environment"* *"To work on equal basis between the participants"*

C_OG1	C_ON1	C_ON2
"Working together. That's the biggest challenge. If you do not work like a Bouwteam, it's never going to result well… You have to be open and share things" *"I think the biggest risk of a Bouwteam is that people not work together the way it's intended"*	*"The personal characters, that can be considered critical because you have to cooperate"* *"Indecisiveness"* *"We all have expectations… The exchange of information can create confusion and misunderstanding"* *"You need to produce less information, but very good quality information… We have to downsize the quantity of information"*	*"The cooperation in the team"* *"Not meeting the ambitions or goals of this project [Circularity/Modularity]"* *"Not being able to do the design within the planned time"* *"The quality of the resulting product of the Bouwteam phase could not be sufficient"*

E_OG1	E_OG2	E_ON1
"Cooperation. It's really about the people who are working in the Bouwteam, that's the biggest success factor in the Bouwteam… Not the technical risks. They come later in the process" *"But also information… that you are transparent"*	*"Lack of cost management because there's no competition"* *"There is a risk for the client that when obligations are not met and you cannot sign the realization agreement, you will have to select a new contractor for the remaining design and implementation"* *"Transparency"* *"Lack of cooperation"* *"Loss of information between the parties"* *"Clashes between disciplines"* *"Price certainty comes rather late after the final design phase"* *"The threat to success is the transparency between client and contractor"*	*"Critical were of course that we had in the beginning we had quite little time"* *"And the second one was the secondhand materials"* *"…there was the risk that we might not make it within the budget. But that was an outcome of the time and the quality".*

Risk for the BT- Interviews



Control strategies for risks groups

Risk Group / Risk control strategy	Ambitions	Budget & Cost	Design	Management	Permits & Legislations	Requirements	Stakeholders	Team
Consultation/Advisory	3		4	2	10		1	1
This strategy concerns the appointment or involvement of an specialist within the team group. Within this strategy it was also found as a response that a particular part of the scope would be resolved by one of the subcontractors or participant of the technical group.								
Consultation/Advisory [External]	4		3		1		2	
This strategy involves the consultantion with an external organization, approaching and keeping a close contact with licensors agencies.								
Contract provision	1		1					1
Within this strategy measures outlining specific contract provision were found, such as the appointment of a specific subcontractor, the adjustment of								
Contract provision - Award Criteria	2							
Within this strategy measures concerning the inclusion of elements as part of the selection for the Contractor were found.								
Cost assessment		3	1					
The measures found under this strategy involved the determination of a continuously updated cost assessment for the design.								
Create awareness	1			1	2			1
Under this category, the measures found are related to promote consciousness on important aspects such as cooperation, planning and the risks of the project								
Define process	3	1	3	4				1
This category refers to the description of the process or principles to be used during the design process, the discussion of these amongst team members								
Engage stakeholders			2		2		1	
Measures related to promoting the communication amongst stakeholders to incorporate their views and perspectives in the design, planning and the								
Evaluation of alternatives	3	1	1				1	
Under this stragegy, measures concerning the analysis of alternatives were found. Including methods as the use of Trade Off Matrix, Scenario analysis as well as discussing possible technical solutions for specific design								
Examine Expectations	1	1		1			2	
Measures under this strategy concerned the coordination and explanation on the desired end product, the discussion of expectation and formulation of								
Follow requirements	1					1	1	
These measures concerned the methodic follow up of principles, requirements and the description of the products								
Formalization phase/design/decision	2		2	1			3	
Within this strategy measures related to the recording of agreements and demarcation of the scope were found.								
Further research	3		1		2			
Measures about the study on similar past cases, possible available options or methods to achieve the objectives and reaching solutions were found.								
Increase review				2				
The measures found under this strategy concerned the revision of awarding criteria for the BT, and checking up the agreement for the BT phase								
Inventory staff capacity & personalities			1	1				2
Under this category, measures relate to the development of a deployment planning, performing a capacity analysis of the staff for the BT phase and								
Organization network					2			
The measures under this strategy first concerned the connection between the BT and higher levels of the parenting organization, and also establishing organizational mirrors between Client/Contractor organization.								
Parallel process			2	1	2	2		
Control actions in this group related for example to the initiation of a leading process without having the end product ready.								
Rapid decision making		1	1	2		1		1
Measures found on this strategy related to the creation og a core group for decision making, the timing for this decisions, how the agreement is assessed and to whom it should be communicated								
Reasonable planning and schedule management			3	9	1			
Control measures here related to the frequency of review for the planning of the BT phase, the discussion on the current status of the planning and the development of an integrated planning between Client and Contractor.								
Requirement validation	2		2					
The measure on this strategy concerned the check of requirements for specific design elements or the intended ambitions and the consultation of								
Team development	1		1					4
Within this strategy measures provided concerned the training of the team members, the use of tools to measure collaboration, cooperation guidelines								
Technical review					4			
The mitigation actions related to carry out the calculations to obtain the necessary permits, on a timely manner.								
Test & Monitor	2		4	3	3			1
Measures in this strategy related to the development of test on feasibility, ecological impact, quality assurance, documentation; and also the monitoring of the design process and the budget of the BT phase.								
Working together	3			1				2
For this strategy, measures are related to the establishment of a common place and periodicity to work and actively look for one another when questions arise.								
	32	7	32	28	29	4	11	14

I. Proposition 3 in the interviews

The Bouwteams as PDM involving from an early stage contractor in the process will help decrease the risks before moving on to the implementation phase

Interviewee	Statement	Supporting reason	Challenge to this aspect [when mentioned]
A_OG1	–	–	–
A_OG2	*I think it's better than a traditional kind of way*	*Because I think when **you have different points of view** by client, engineering firm and contractor **you will do a quantification of risks, that will be better. And also, I think the number of risks will be better. Not only the qualification of a specific risk, but also it will cover the entire project**. So, I think about is a good way to improve risk management*	–
A_ON1	*I think it helps decreasing the risk during the design phase. Not for nothing in the North region we do a big part of our works under the BT approach. So we believe in it, in working together with the client*	–	–
B_OG1	*If we would have done this by ourselves I don't think it would have this level and the quality of the risk management, or the risk file, because is high.*	*The main advantage that's **because of the party the constructor is involved in a Bouwteam and then the risks are so much more specific and related***	*But **the costs of a Bouwteam are higher.** Because if you do it alone, as [Client] with the involvement of [Name of Company], let's say an engineering company, the costs of the second phase (of design) are lower.*
B_OG2	*I think definitely helped decreasing the risks throughout the design phase. We don't have a risky project now, and let say is way less risky than we had without its use. From the organization I can say they are happy because the risks are way less than when you do it traditionally.*	–	–
B_ON1	*Positive, the first thing I would say is you have the time to take measures and to see what the outcomes of the measures are.* *…* *When you look from our perspective, so from a market organization perspective it's definitely worth it, because for us the allocation is clear. The risk we are responsible for us ,we are fine with it. We are OK with it. It's a low risk profile for the market.*	***You have the opportunity to follow a strategy where you implement stages of risk measures**. And that allows you to take the right amount of measures needed to reach the risk profile you want. **Now we were able to do a small research, see if it was effective and then scale up***	*There's a tendency to stick to this method, but there will be more focus on the budget, yet of the first phase. **Control of budget, or an incentive for the market to join in the budget for the first phase***
B_ON2	*I'm quite positive. Because I think in [Project B] we managed to reduce the risk profile of the project quite good. We made a well balanced allocation in the contracts. I think we managed to tackle a lot of risk in the bouwteam phase*	*But in Bouwteam phase **we had time to make shared make good and decent plan for the risks**.* ***So you can have open discussion.** Sometimes when there's a risk, there are more possibilities. Maybe there's a possibility to reduce all the rest, but maybe that's quite expensive and you have maybe option B is 'OK, uh, you can manage 90% of the risk, but it's maybe 10 left, that's half cheaper, but yet then you have an open discussion with the client: 'OK, what? What's what is acceptable? Is it worth to reduce all the risks, but pay 1,000,000 more?'. **Or you can have the open discussion about options you can lay on the table and together you can make a decision***	–
C_OG1	*Actually, if the bouwteam works, it's nice*	*Because you have **both sides on the table and it brings out and brings more depth into your risk register.** Because it's not only the clients view, but also the contracts is few and that combination is really nice, it's powerful*	–
C_ON1	*Definitely does, because what I've seen is that all the information exchanges.* *...* *So in my opinion, yes the Bouwteam is in my opinion a good way of a addressing the risk involved in a project*	*Because **we have a different perspective, we can give feedback.** You can narrow quite quickly to the level that you want to have.*	–
C_ON2	*I am enthusiastic in general about working in bouwteam*	*Because **you can make use of the knowledge of several parties***	*To have a **good cooperation**, and is very important for you to **trust each other***
D_OG1	*You can collaborate with the contractor to identify the risks and also allocate the risk in a good way*	–	*But the **main ingredient of a Bouwteam is trust.*** *…* *But I think during the Bouwteam **it's a another mindset you need**, so it's in a **different manner than the Design and build contract, for example***
D_OG2	*I think a Bouwteam is a really good project delivery model to get the optimal design, which optimally meets the requirements of the end user*	–	–
D_ON1	*In a kind of experimental project like that It is very good.*	–	*As you call it a team and **if you are really equal**, on equal levels, then the Bouwteam is good, I think.*

J. Validation Session

Questions to be adressed during validation session

EVALUATION OF THE INDIVIDUAL ELEMENTS IN THE MODEL

Element of the Model 1- Risk groups and risk for the Bouwteam

*The elaborated risk groups and their description are presented on the screen to the participants with their descriptions.

1. *To what extent are these risk groups relevant for the Bouwteam?*
   On the different risk groups:
   Less relevant<————> More relevant
   Follow up question
   a. *Could you suggest why risks relevant to the design group are usually more identified in the registers?*

2. *How would this change if the project used another contractual setting? (e.g: D&B)*

Element of the Model 2- Risk allocation decision

*The diagram for the allocation decision is displayed on the screen

3. *What advantages could you foresee in sharing risks between the participants of the Bouwteam?*
   Follow up question:
   a. *How would you implement a strategy to share risk during this design phase?*
4. *What kind of obstacles do you see in implementing shared risks in the Bouwteam?*
   Follow up question:
   a. *How can these obstacles be tackled?*
   b. *Would you suggest the advantages of using this could outweigh the obstacles?*

Element of the Model 3- Control strategies for the risks

*For each risk group, the control strategies will be presented on the screen. The following questions will show up next:

5. *To what extent the presented strategies can be used to manage the risks of this group effectively?*
   Less suitable<————————>Suitable
6. *What kind of obstacles do you see in the implementation of this strategy?*

In addition, can be asked:

a. *Are you aware if similar strategy has been applied in Bouwteams you have been involved before?*
b. *Could you suggest another strategy to tackle the risks in this group?*

EVALUATION OF THE GENERAL APPLICABILITY OF THE MODEL

7. *How would you implement the model presented in a Bouwteam contract?*

8. *To what extent the elements of this model could contribute to the Joint Risk Management?*

9. *What advantages could the implementation of this model have for the Bouwteam and the risk management process for the design phase?*
   Follow up question:
   a. *To what extent the use of this model could enhance the discussion over hot-spot areas that might make the Bouwteam phase fail?*
   b. *To what extent the use of this model can increase the awareness of the Bouwteam members regarding the RM process?*
   c. *Do you believe the elements in this model could help as guidelines on how to deal with the risks for Bouwteams?*
10. *What (other) features could be included in a risk model for Bouwteams?*
    Follow up question:
    a. *What added value you see in the implementation of this model?*

11. *What would be the barriers to implement the model presented in this session?*

12. *Do you have any further comments?*

Summary answers to questions – Validation Session

1. To what extent are these risk groups relevant for the Bouwteam in your opinion?

E1: "I think they're they are all relevant. Ambitions and objectives maybe not, or less. The Permits, those are those are all subjects you can see on. You can see in your risk Matrix. I've seen all those, all those uh risk uh groups in risico register."

"I think that they are all relevant. Ambitions and objectives I don't know because ambitions should be in the Bouwteam and the purpose of the Bouwteam is to hold on those ambitions. If you can't have those ambitions of our objectives, your project might be failing or something like that, so that difficult one for me. But all the others I completely agree with are all relevant for your risk management so I submitted it."

E2 **(Talking about *Permits & Legislations* group):**

"In terms of preparation, but also about scope they are quite simple, there is a procedure. There is quite clear legislation on, for instance, what are the requirements for entering into a legislation procedure. They're quite objective. It's more you just have to decide who's going to do the permits, who's going to do the different documents. Is it relevant for a Bouwteam? I don't really think so. You just have to do it. And of course, there are risks involved, but they're quite objective risks." … "So for me it's I think it's a low risk or it's not really for the Bouwteam".

E4: "It's relevant for each project, but it's not special for a Bouwteam so it's like, OK, that's the t requirements and you have to deal with, but it's not different in Bouwteam or whatever."

(Talking generally about all the risk groups):

"Some of these items are always related to a design process. So, for instance stakeholder requirements, it's always a challenge to keep them updated and to keep them also involved in the development of the design. So that is yes, important in the Bouwetam, but it is because a Bouwetam is about making a design together with the contractor. That's special about Bouwteams compared to a Design Team who's developing into design. In both cases, Stakeholder requirements are a risk because there are a lot of stakeholders. And they're making changes in a very late stage, or they want to make changes. And they can be very unpredictable in terms of behavior. So it's a general risk for a design team, and it's also risk for Bouwteam."

E3: "If the team is working good together, then all the other ones are more chances than a risk. But if the team is not working together then you are just in the traditional contracts, cold and then all the other parts will be a risk. But when the team is working together, then you get the good start for Bouwteam and then probably you get your ambitions bigger or higher than then there will be without the Bouwteam."

"Cost & budget I see like a camel in number 3 but that's also, I think a learning curve because I see now that all the planning phase. I don't know what's the phase where you get all the permits and the design completed, when you do the big part of the engineering. It's more expensive in a Bouwteam. This phase is more expensive in the cases I've been, which have been going over budget, but it's still working backwards in the realization phase. Therefore it's a risk for this phase, but I think it's a learning curve. You have to know that this phase will be more expensive and then you run it back in the other phase."

"It's the same for the planning I usually they're the same camel shape. I had the same problems because you're working with two to three teams together and therefore it will take longer, but better in the earlier phase."

"Stakeholder requirements, I see that that's also on the end and I had also pointed on the end. I think that's a risk because the client is talking to the environment with multiple stakeholders itself and you have the client, the contractor, maybe an engineering company and they have all different opinions and therefore it's harder to get the stakeholder requirements or get them fixed."

E4: "I just focused on what's for a Bouwteam very important to deal with and that's like working together, so stakeholders"

2. How would this change in projects which are using another contractual setting?

E1: "You've got the same angles most of the time. You have the same risks. So, I think I think it's it would be the same only responsibilities for the risks."

"When you have a Bouwteam Overeenkomst there should be more collaboration. Most of the time when you are further in your own in other phase, in the D&B phase, it sometimes it's more difficult, the edges are sharper or how do you say it's... It's more distinguished cause you have, the collaboration is less because you have…" "Is very focused on collaboration and after we should also be talking about collaboration, but it's on a different scale, there are real rules involved after that Bouwteam Overeenkomst phase."

E2: "I think team would score a lot less for me. For a Bouwteam is also very much about cooperation and it has a lot of potential, the Bouwteam setting, you know, with the contractor involved in the design phase, but not being the boss. But then one of the key elements should be a good working team, and to really be a team. And in a traditional process or like you're in the design build process, it's a lot simpler. From the beginning the contractor is the boss in the design phase."…"And in this, he simply decides, and he hires engineers, architect and well guys start working. So that's different... and then a risk factor like a team is a much less important."

-The expert was questioned about the *Team* group being particular to the Bouwteam-

"Yes, absolutely, yeah."

E3: "You can get all the risks, I think. These risk groups will happen as well, but with a different score. You saw the contract of the requirements like in the middle up; then it's more at the end in my opinion because you get more discussion and the contractor is new with the requirements and the clients knows the background of the requirements in the contract. They (Contractor) don't, so there will be a lot more uncertainty within these requirements. Stakeholder management will be less for example"

(about Team risk group): "I think that's more a Bouwteam risk because you have to collaborate as one team and in traditional contracts it's just like the client or the contractor making the design and sent it to the client, who is just reviewing it."

E4: "The difference between the Bouwteam and design and build is that with design and builds you have to think in advance more what is the contractor and what can he do? What can he make? Well, what kind of opportunities he has? With design and build you really think that over in an earlier phase and a Bouwteam you really you don't have to. You have to also in advance. But it's more fluid. You can also talk it through. You can make appointments. When you say 'OK left is more important for me, or right It's not that important' You can discuss it more and that's the advantage of this. You can pinpoint what's important for you, but it on the other hand. And it's also fluent like this. It's not really focused or. So you can really shuffle a little bit from one side to the other with the Bouwteam and with the design & build, it is what it is, and if you want something else you have to pay a lot."

"What's more important a Bouwteam, when you are working in a Bouwteam, that the team you're really dependent on the right mindset of the contractor and then the client. It can work very good, but can also work very bad when you are really are opposite of each other. In the bouwteam you have less risks on design and requirements integration I think."

"And I think like the rest difference not that much, maybe the ambitions and objectives of the project is for about team, a little bit different, but I think the biggest the biggest difference it is in the team, the risk for team"…"Especially like working together and then how are you going to manage that and what's the quality of your cooperation and stuff like that"

3. What advantages could you foresee in sharing risk between the participants during the Bouwteam phase?

E1: "When you have shared risks you both want to reduce the risk." "You work together to reduce risks and that's the main advantage. So you all have the same goal to reduce risks."

"Both parties should have influence on the risks if they don't have any influence on the risk, then you shouldn't have a sharing risk scheme"

E2: "Better control of the risk. That's perhaps also the it the advantages of the Bouwteam sharing risks." "One of the implicit advantages is that by doing so, you're explicitly talking about risk, and that's an advantage as well. Because if you want to share them, you have to talk about them and everyone becomes aware of the risks and you're also obliged to think about it."… "I was thinking it might also lead to a better cooperation because then you're able to give the risk to someone who's the best able to control the risk. So it might lead to a more balanced risk file. I would I think those are the advantage"

E3: " When a risk is for both parties, both parties feel responsible and feel the responsibility, so you are forced to work together to get the results for that risk. So it improves the teamwork. When it's typical for the client or typical risk for the Contractor and there was input needed from the other party there is no pressure for the other party to mitigate that risk. Then when it's combined risk, both parties feel that they need to put effort into that mitigation of the risk."

"It's a very good thing to just have combined risk because then you get the integrated part in this in this phase. And you could say every risk we can do during the bouwteam should be an integrated risk for both parties. And then after that you get back to a more traditional contract and then you can make separate parts again."

E4: "For risks, it's important that uh, the risk are allocated to the party that can influence and the party that has the control of it. And with the bouwteams, for a lot of risks both parties, contractor and client are in control. Somehow a little bit or more or 50/50 or 25/75. And you can really share them on every level you want. With design and build for instance, it's more black and white. With a Bouwteam you also have a gray aspect where can join and you can help each other to mitigate those risks."

Follow up Question: How would you implement a strategy to share risk during this design phase?

E1: "We have design loops and I think every design loop you should evaluate your risks and you should talk about the allocation of those risks and for risk management, you should be aware of all the risks."

"Risk management should be that you name, or you must inform you should be aware of the risks in the project, and you should. And the goal of risk management is to reduce those risks you have."

E2: "What you normally do when you start the Bouwteam you have a PSU and you talk about: 'What are the products? What do we deliver at the end of the Bouwteam phase? How we make in the smartest possible way? How do we get to these results from A to B? Who's doing what and what are milestones in? How are we going to control this?'. So what's the participation of each party involved with developing all these products and I think the same process accounts for costs, but also accounts for a risk management file. OK, we're going to gather all the risks we can see, give them a structure, think about who's controlling what risk'. So you talk about this during this phase."

E3: "There are some options I think, and then it's what I already said it's getting a contractual discussion when it's going to be over money, over the cost, and one option is that you have different causes of risk and that can be managed by different parts. It's the same for the for the Consequence. And there you can get different parties, or at least like in percentage of different parties like it's 60/40% for the causes. So when a typical cause is producing this risk, or the other ones are mitigated, but these others were not, then maybe you can manage it on that way. But then it's still like a OG or ON approach. The other one is that you can put an incentive on the contract when all these types of risks are mitigated... You have a risk budget at the beginning of the Bouwetam for this type of risks, and you could say, if we manage these risks between both parties it gets a portiong of this shared fond from the risk budgets, then there is an incentive to get both acting together into this item."

"I know from one of the Bouwteams where I was, we just split all the risk in the multiple causes that could trigger the risk. And one was for the client and one was for the contractor. Then we just split the risk of two different risks and one was for the contract and one was for client. So that's how we managed it then and then you get just your typical SCB approach and that it was finished. But then everybody sitting on their own chair again and just finishing their risks and not tackling in a combined way."

"You have the Bouwteam phase, and then afterwards you get like a more contractual traditional contract, where the client is reviewing and the contractor building the design they made during the Bouwteam, and there you get your traditional OG or ON risico. And during the Bouwteam, so during the phase where we make the design, the permits, you have more shared risks in my opinion earlier."

"If you rank the causes like you have an allocation on every course, then you see which one is where the joint risks come from. But then you still get the contractor/Client discussion about it like it's your cause and not my cause, blah blah. And then you're still not working together... So then the whole idea behind this model is gone so."

E4: "You start with a good risk register. Which is based on facts. So you really know what you're talking about? What are the risks for this project? And then you have to see. 'OK, who can influence mitigate or decreasing the effect? Who can control them? And when you really pinpointed out that for each risks, then it's really logical how you can divide those risks."

4. What are the obstacles to implement this type of mechanism for share risk?

E1: ". I don't know if there is a risk you've got a shared risk so NEC-4 contracts you have a Pain/Gain mechanism."

"Fines for the contractor but if he's finished earlier, he can gain some amount. If he finishes earlier."

"It can stimulate to finish his work earlier. But it can also have a negative effect because if the collaboration in Bouwteam does not work or of the contractor can't finish the project earlier then he just might be a little bit lazy because then he can't win the game anymore.

"Yeah. It might also be very difficult to have shared risk because you don't know who's really responsible for the risk. "

"No, not only for the cost, but also time and quality. And that's all kind of stuff because. If a risk is for the client or a risk is for the contractor, that's very easy because everybody know where is where the risk is. But if you have both the risks, then it's very difficult to how do you deal with those risks then when they happen?"

E2: "Perhaps not enough awareness that risk management is a very important aspect of the bouwteam. There's not enough attention or awareness that also risk management is very important, you know. That that could be an obstacle."

"But what the might be an obstacle and I had a lot of discussions in one of my projects about insurance. And that came from the contractor and he made an objection but the proposition we did for sharing risk. You know, there was a 50/50 sort of set up sharing. And I still don't really grasp where the real problem was because we thought we had a very balanced sort of shared risk idea. And we kept it. You know, there was a cap on. There was a limitation on the amount of risk we had to take. So we thought 'well that should not be a very much problem' there was not unlimited or something but still he had a big discussion he said with the insurance company."

(talking about using as a strategy for its implementation a way of incentives[reward] on a contingency sum to mitigate the risks)

"Sort of common risk.... How do you call it... Don't know the English word. You know, you add up all the risks you have and then you have also an amount of euros and at the end you just conclude: 'OK, we needed some euros, but what we don't need, we share'. That I've never done that in the Bouwteam because it might also lead to a wrong incentives. They keep looking at how much euros are left in this in this bag, Yes. And that what is my gain at the end? What's in it for me? And of course that not the best for project attitude that you want to have, so I'm not so fond of these type of incentives, no. Just sort of implicit bonus, you know.

E3: "how do you manage the joint risks because there is still a contractual discussion between us who's gonna be… It's all working very good. If everything is in perfect harmony and etcetera and the cost are not going over budget. But when there is a sudden problem by the clients or by the contractor. And the client has no budget left. You get the discussions and then it's shared risk or... Managed jointly, but then you get the discussion for who is now really responsible and who is gonna pay. And yeah, that's what triggered me on this"

"The only thing is the contract discussion about it. But if you manage that one, I think it could have an advantage for some risks"

"Other, maybe obstacle is in the end, you want to have one party, or at least one person who is feeling the need to do something about that risk showed. Who is really responsible for that risk? And if you have a party in particular, which is responsible for the risk he knows the financial consequences and will be doing anything possible to mitigate that risk. But if you don't have a financial purpose to do it then maybe there is also it there will be more forgotten because there is no pressure to taken them over"

E4: "Bad cooperation between the client and the contractor. And especially when they have hidden agendas. For instance, when you have a risk and then on first glance you can see this is the risk and the contractor is thinking, 'OK, But when if I take take 50% of this risk, and the risk is continuing, then I can do more work'. You cannot always see what are the hidden agendas behind it. And that's really a risk in the Bouwteam, but what's very important is an open mind working together group, and the open atmosphere is very important and that you can understand each other's motivation. When you really understand each other and you can really discuss that in with open minds, then it's gonna be no problem. But when you have hidden agendas, then it's gonna be bad relationship with a lot of wholes and you don't see the project future clearly anymore."

(Talking about the implementation of a similar strategy in a case):

"For instance we have one project in a Bouwteam and there we really said 'OK the risk for each risk we considered 100% client, 100% contractor. But sometimes also 80% for contractor and 20% client and then we also said 20% client because the client can influence those aspects. But then when you have different aspects then you can also split the risk in sub risks or their different causes and say 'OK for this course client this is responsible, for the other course is the contractor' But some causes it's 50/50 because then the team is needed for reducing the impact when the risks is there and really happens. So you really have to be detailed in the risk register for dividing that kind of risks."

5. To what extent the presented strategy can be used to effectively manage the risks of this group?*

a. Ambitions/Objectives -> Consultation/Advisory [External]

E1: "When you have a risk, you have a list of 20 risk or something like that. And you put as control strategy every risk you put as control strategy, consultant, advisory, external and every and you can put it in on every Risk."

"but I will also recommend it cause this is a lot of work for the engineering offices. So I can recommend this as W+B."

"But I think there are also disadvantages of this control strategy because it takes a lot of time. It takes a lot of time and a lot of money. And because you have to arrange another external advisory or consultancy firm it takes a lot of time to do it in all the risks."

"But I'm positive for the control strategy of external advisory groups or it's a possibly about that. But yeah you hope that with collaboration to do it together and not not going to some other office"

E2: "That might help. It's not the real solution, but it could help. If you add another company, you add another advisor, so it makes the organization bigger. And if you have a Bouwteam that has well trained professionals I think you would have all the needed capacity in terms of professional knowledge"

E3: "there's also my opinion and four as well."

E4: "It's small because beforehand, you really have to think it over and really pinpoint out what's what is your ambition and what's really what's the must haves and what are the nice ones to have. So you don't need a consultation over an external party for it. You have to really think it over before you start the Bouwteam, what's really in the bottom of your project on quality, on quantity, etcetera."

b. Permits&Legislations -> Consultation/Advisory [External]

c. Budget & Cost -> Cost assessment

E1: "Yeah, I should say very. There's one thing we also have to do in the bow teams we have to make SSK Ramming every design loop."

"now it's just they ask to make cost estimation an SSK Ramming, and most of the time, the contractors, they are not very used to the SSK systematic, so now it's good that you arrange something for the cost control during the Bouwteam Overeenkomst."

E2: "It's not enough, for instance, to say to the contractor, 'OK, periodically you update your cost assessment and you also have to talk about his assessment'. You must review his assessment as well with your own experts and expertise, whether you hire that or not. From both sides you have to look at the cost. Because only his assessment is not enough, you have to check if the scope is fully involved, is everything in it and you have to look at the prices that he's taking. You have to look at the margins the Contractor is taking in the SSK estimate. So it's not enough only to say, 'OK we have some milestones in the planning and all these milestones you adjust your cost assessment' That's not enough."

"You have to very carefully document all the decisions you make in the design process. Just they all have an effect on cost. And that has to be checked. It has to be integrated. It has to be part of the updated assessment."

"So you have to be aware of 'What type of decision did we take? Where can I see the consequences coming back into the cost assessment, all that milestone?' There has to be a complete cost management system. And of course elements like you said 'determine the SSK, estimate for each design phase, the range of variability and the estimate for each phase'" "The last is one of the elements that the contractor is in most cases, not qualified because if you say the contractor is doing the cost estimate... The way he's doing it is actually very simple he's calling his subcontractors and ask them how much you are you gonna charge them."

"And I often see that contractors, they make an estimate like they are having to perform this tomorrow you know and that's completely different from the things that the experts do."

"We discussed this in the course with 17 colleagues, they all say cooperation during the development of the design, everything's going very smoothly. You know people are excited and working together very properly until we get to the cost and then it starts, well most of the time, becoming complicated. Then in most of the cases, we have a problem, you know becoming too expensive. Then you must discuss, 'OK, what are we going to do? Where are we going to prep this cut in the scope or no. And then the, discussion starts."

"But contractors, they often say to the client. 'No, this is the design. Dot. Can be changed? No. Then what?... It cannot become cheaper. You know, it's much harder to have a discussion on cost related to scope so. And they sometimes also are quite disappointing in proposing measures. They're saying, 'oh, this, this would lead to savings of €100,000' and then they work it out and then it's only 20,000. They're not very good at it, but it happens."

E3:"We did it like this. We made some starting points at the beginning for the VK and there was also calculated by the... so during the verkeningsphase or the phase before the Bouwteam phase, it was calculated by in this case ourselves (W+B) and then it was recalculated by the contractor just to make sure that we have the same start point. Then every design phase and also that was a joint action."

E4: "Is really like the only solution is ask a third party and what are the costs. Just ask a third party what do you think it costs; and it should be a third party who is respected by both parties."

d. Design -> Consultation/Advisory

E3: "Therefore it could be good only if you don't have the knowledge in your own your own team. I think if you have just traditional contractor and a a traditional client. Then it's good to get somebody extra within the team to make sure that you get your ambitions fulfilled in the design."

E4: "It can be, these measures is really depending on the kind of project. But that's really depending on the kind and type of project and really the crucial aspects of the projects that's really tailor made, what's fitting in here for it."

e. Design -> Test&Monitor

E3: "Normally, as you say, every loop you must do a feasibility test, by the client or by the contractor. So therefore I should rank this like a 5."

f. Management Planning -> Reasonable planning and schedule management

E1: "Controls are reasonable planning and scaro management control measures and nothing that's also suitable."

"it depends on how risk, how risky is the project. If you got a very risky project with a lot of you know a lot of risks in projects and the chance of that risk happened is also bigger. So if something happens in your project the time to finish it can be longer and if it's very simple."

E3: "A reasonable planning is also adding all the risks because otherwise even when you have a planning it's not possible to manage the planning because there will always be some risks that occur, so you have to make sure those are always also within the planning."

g. Requirements integration -> Parallel process

E2: " I'll score this four and not 5, because the design process, even in a building team phase is it's not 100% controllable. If you carry out these measures. But they are good and they will certainly have a big effect, but it's not 100% guarantee."

E3: "We used it in some projects, I think."

E4: "That's really is the right one"

h. Stakeholders requirements -> Formalization phase/design/decision

E2: "The last one can be very effective because you're putting up a fence for you. Guarding actually the at least the part of the scope of the design cannot be touched by this effect."

"this only works if you have a solid agreement that the involvement of the stakeholder will be reduced during the development of your design. That's I think that's a part of the... If you don't do that, this will not be always accepted. But it can be a very effective measure, absolutely. "

E1: "You can read record it, but if they don't agree."

E2: "you're doing two things if you do this with stakeholders, first you make it very explicit that they want something and you say yes or no and you document it. So that in the latest stage, after three months, they cannot come back to it and say 'Oh yeah, we want this' and then you can prove. 'Listen, we have the discussion three months ago, this was the outcome. We're not going to discuss it again, right?"

E1: "but then he still can say I don't agree."

E2: "But that's the dynamics with the stakeholders... How far can they go? You know if the if they say yes, OK, yes, we acknowledge that we have had this discussion three months ago but we still won again have to have the discussion because we have a new policy, or whatever, or new insights? Or then, then you have trouble anyway. Yes, that's right. Yeah. But it can be a measure by at least a document or record it and prove that you had it before and the outcome was clear and you're not going to discuss it again?.

"It's very recognizable. Because stakeholders have a very short memory."

" It's part of their strategy. You know, they raised the question and have discussion and the outcome is negative then and then 2-3 months after they try it again."

E1: "They will come back, yes."

E2: "I think I think I'll also score this one a 4. Because, you have to do this and it is effective, but it's not a guarantee."

E3: "I had a 5 as well because I think this is the way to make it really structured. So that you have a formal process for all parties within the Bouwteam. It's clear how decisions are made based on stakeholder requirements and therefore it's a good measure."

"The decision on all the requirements or on all the wishes from stakeholders is not with the outside stakeholder itself it's within the project. The clients and the Contractor together, they're making an advice and they decide whether a stakeholder requirement will be implemented in the contract or not in my opinion."

"So to make sure everything very explicit and who is gonna talk with the stakeholder, what he's gonna do. And then you have all the information to make a good decision. This should be explicit and therefore I should say it should be a standard formalization on how you do it. That's my opinion.

E4: "You always have to be really pinpoint what are the requirements, but also the wishes of your stakeholders and what you going to do with it or what did you do with it and the communication on that aspect is from crucial."

i. Team -> Team Development

E2 (on the use of engager app): "Yep. I used it in the at least the one project I remember." But it's only an illustration, of course, because it's nothing more than the questionnaire has to be filled in every week on Friday, just a short couple of questions, not to make it too difficult. So well it's an illustration. You know, it's one of the instruments to at least talk about kind of corporation. You can use it as a subject when you have a PFU for instance, you can talk about it. That's the that's the main the main goal."

E1: "I didn't know about that."

E2: "I don't think if this is enough, when you look at the measures you show here"

E1: "I agree. These are tools to stimulate collaboration. And it's not the key I think for collaboration."

E2: "For instance, another examples of measurements. Define a location for work in in the same rooms for instance."

"I think it's important to not only have these courses together, but for example, have a volleyball game together in mixed teams, you know, do something beside work in order to get to know each other. That's also, I think, a very effective measure, another one. But I don't see this very often is that within the organization of the project in order to keep the spirit up."

"Also try to differentiate on what level, for instance, discussions about costs are taking place. If you have the technical members, try to keep them in their task or having a technical discussion. And from just having a discussion on costs regarding the technical measures on the level higher. Because discussions on cost influence cooperation a lot and collaboration especially at the end of the building team. Then, so it's also organizational measures. Through this"

E1: "In my experience, most of the time discussions about details, you can all you can all do it in collaboration with contractors and clients. But if we talk indeed about costs and responsibilities then it's then it becomes very difficult to collaborate"

E2: "Other measures can be... Appoint a building team coach. This person has to look especially these kinds of elements, you know, and he has to guard, for instance, that everyone is doing the job as it was intended to do at the beginning"

"Make clear in the organization, who's doing what? What's your responsibility in the building team and when it during the building team phase, when it gets mixed up it also affects the collaboration because then it becomes a bit skinny."

"if you have a whole package then I'll definitely score a four. I think it'll absolutely enhance the collaboration."

E3: "these are very important ones. There should be somebody also from the clients working on the design for example, because he knows everything about how it should be done. And because after the design is finished, the client does get this dyke back and he has to maintain the dyke for example, and he has common the knowledge about that one. Make sure he's part of the team that's making the design so then it's going to be a good cooperation"

6. What are the obstacles you might see on implementing the strategies we were reviewing before?

(about the Consultation/Advisory [External])

E3: "if your team gets bigger and bigger in my opinion that's a disadvantage. Everybody has their own opinion about how the work should be done and many captains on one ship doesn't go always to the right direction. That's one of the disadvantages to the first two I think."

(About Budget & Cost -> Cost assessment)

E3: "Is not really an obstacle, but it needs of transparency from all parties. So in an early phase, all parties including the Contractor has to share open information about their amount of profit they want to realize within this project. That can be an obstacle. But if you make good agreements about that one, it shouldn't be an obstacle, in my opinion."

(about the strategy Management Planning -> Reasonable planning and schedule management)

E1: " I see now reasonable planning and schedule management and yeah, it's also a discussion, that's always discussion what is the meaning of a reasonable planning you know". "This are most of the time assumptions on my previous projects.

E2: "An obstacle for planning, for instance, is that often on a management level, there's a desire to be faster… They don't want to put out a message that is a bit too honest. That the bridge will not be ready before, for instance, recreational season."

"So they make a sort of wish planning and we know them all probably far too positive, but let's start and then we'll see. So that can be an obstacle in the implementation."

(about Stakeholders requirements -> Formalization phase/design/decision)

E2: "obstacles in terms of how can you control the stakeholders. Especially external stakeholders, like certain interest groups they can be very autonomous. And they play a role, but they might play a role, not accepting the rules. And when you think you've made an agreement with them in a certain way. You don't control everything and control the stakeholders."

E3: "One obstacle there is that if you really formalizing and decisions are being held back it affects your schedule because then you don't get further it because the decision-making is pulling you back, but that's always in risk."

(about Team -> Team Development)

E2: "There's an obstacle of putting in the wrong people."

"People who have a different perception of... How you should work together, for instance, in an engineer working with a contractor. Then there might be some misunderstanding about the role of the perception or the expectation or there's simply no click between people you know, instead of loving each other, they irritate each other. And then we put them together."

(when question about how could this be tackled somehow differently)

E2: "You're really honest and you have also strong lead, you could say OK we'll start, we have a PSU, cool and then the management management looks at the team and they might conclude well 'One of these guys or girls? I don't think we should put them in the team'. You know, there's absolutely no click. There's only irritation, for instance and we decide we put in some someone else"

E1: "You start and you don't know the people who are working on the project and also a while you can come to conclusions that some things or people don't work with each other or you have to do something. So it's hard, to have a control strategy about it and it's part of the evolution of your project. So you need to reevaluate constantly."

7. **How would you implement the model presented in this session in a Bouwteam contract?**

E2 (1st Session): "What you could do with the start of the building team phase is sitting together with the contractor and all the participants and then put in: What's your homework as a Client and what risk have we identified? What are the risks identified by the Contractor in the tender procedure? Because they most probably will be questioned about risks and risks in the building team phase. So we put them together and perhaps in a meeting or something you can invent more risks at the start and then only risks applying at the building team phase."

E2 (2nd Session): "This is a very good instrument when you start Bouwteam phase. You know I always start at least I tried to start with a sort of consolidation phase. So before we start, we have to do some homework and we have to talk about some things. And one of the important things is the risk management file. Normally people always dive into the content, and they make a long list of all the risks and the measurements etcetera. So they really start making a risk file. But this is this is much more structured in terms of, 'OK, what are the main risk groups we have? What can we do about it? So it gives a better structure. I've seen risk files with sometimes 120 risks. And then you start reviewing these risks and after an hour you think 'what a job'. What makes you tired and it's not very effective.

"In a lot of building phases, you make a sort of project management plan when you state the operation plan or collaborative plan or whatever they call it and you try to grasp the measures you take in order to have a controlled process and also good working during the Bouwteam phase and these as you take this structure at least you end up with control strategies. And they should comply with, for instance, how are we going to perform cost management? You know then this is a nice input for this."

"One of the appendices is about risk management, and the articles in our model relates to you should do something, not something you should perform risk management in the building team phase. And this could be in the appendix as a sort of basis, 'OK, this is how we're going to work' And of course for the real project this could be of help absolutely, yeah"

E1: "Run the process every design loop. Because, you know, you know more about the projects also and more about the risks and things you have to investigate during those design looks"

E3: "this should be part of the contracts itself. On how we gonna do the risk management and this other allocation possibilities. So this way you know beforehand what is done."

"It could be an option also, during the dialogue phase you can ask them what your allocation for the risks. The decision about these risks if you present them only the risks without the allocation and then ask the contractors 'how do you see against this risk, is this one we can mitigate together? This is one you can mitigate?' and of course the control strategies you can ask them that as well, that's what's been also done there

8. **To what extent the elements of this model could contribute to the concept of joint risk management?**

E1-Risk for the Bouwteam & Risk Groups

E2-Allocation Decision

E3-Control strategies

E1: "I waited it both on four so you talk now (E1&E2), and the allocation decision I should put it on the three, I think I put it on the two, I can't. I was too strict with that I think your diagram it could help but, I don't know if it helps a lot"

E2 (referring to the Allocation decision) " I also see some dynamics in it you know, it's not a strict thing you do at the beginning and then it's ready. You have to do it to during the development of your design. I would say the allocation decision can also be dynamic. It contributes to the joint risk management but I think the others are more effective. That's why I scored them higher."

E3: "The main issue still in my opinion is how we manage the risk together. But what I would have said, it's very good for the control strategies. I think there is really helping because you are controlling the risk together and you have both an advantage to control it and shame for the first one."

E4: "Like I find it a little bit difficult for the first two aspects and the risk for the Bouwteam and the risk groups. I can interpretate it in different ways. So that's a little bit… But I think it's very important to pinpoint out the risks and what kind of aspects are in this. So getting clear but it is yeah. But I'm also the risk manager, so I'm not thinking that's really important, but it should be."

9. **What advantages could the implementation of this model have for the Bouwteam and the risk management process during the design phase?**

E1: "I hope less risks. It also stimulates the awareness of risk management, I think and that's I think that's a good thing"

E3: "The major advantages is that you are working more integrated to mitigate the risk. That's the main advantage you have and that you're both responsible, so there is a common ground to work together. And that's, I think the whole idea behind a Bouwteam, working together to get the solution better"

E4: "I think transparency is very important and using a model, it's the way of making a process transparent for all parties. If it is this model or what kind of model that doesn't matter in my opinion. But you should have a clear model. So in advance everybody knows how are we going to deal with risks and how are we going to share them and allocate them?"

Follow up question: What is the additional value of implementing this model to the already existing process of the Bouwteam?

E2 (1st Session): "I think so... Its just what I've seen of it right now. It's a much more evolved from the simple RISMAN approach you know because that's what sometimes you have to use RISMAN. OK then we use RISMAN and that's it. And then we go to make a a risk file"

"RISMAN is only the method. And what I've seen now of the model, is that at least it has categories."

"And if you if you have these categories, you also have to think about, 'OK, how do I how do we fill in the categories?; Do we understand the same meaning when we speak about certain category?'."What I notice in a lot of Bouwteams when we talk about risk, we right away start about talking about technical risks or perhaps the procurement process." "But when you define these categories, you have to talk about the categories and that's I think that's an advantage as well."

E1: "At this moment you have also RISMAN glasses. And I think with this model you introduce more glasses, so we might have a better insights on the risks."

E3: "By making both parties during the tender phase or after that make the decision about what is common and what are shared risks. Both parties working together and also letting both parties to think about the control strategies. That you really have a common idea behind all the risks."

"By doing this in this presented way, like first risks, and then the decision making and doing this together because then you have also compromise about what are all the risk and who is responsible, or are we both responsible? And then for the control strategies then you are working together and then this model also helps you to get a common view on the risk. So everybody knows exactly the same. How is everybody standing in in the game. So that's I think the most advantage of this model also"

10. What other features you would include in a risk model for the Bouwteam?

E1: "Pain and gain mechanism."

E2: "Risk model comes from the fear of things going wrong. So you have a negative approach. You know, I think about this can go wrong that can go wrong. You can also have a positive approach and that's a bit from the best value theory, you could also look for opportunities together no?" "How can we enrich the project and use the opportunities instead of looking with dark glasses what can go wrong? We could be looking with pink glasses like we say what can we do better? How can we make it more fun to work together? So that's the opposite of a risk model."

E3: "You have a lot of opportunities for both parties. Sometimes one parties help with that but the other party can help with the opportunity for the client maybe or the other way around and then also mix that team better"

E4: " A way of follow up on the mitigation measures. Where are we standing on these measures is very important. The transparency of everything in my opinion. When you have something like an all online management tool where you can really get it right with a good review on status of all kind of it's very important."

11. What would be the barriers to implement the model presented in this session?

E2: "People don't understand it. People don't believe in it and they don't see the extra value. They might think it costs, it might cost them too much time. So the effort apply into this is too big. People use their own standard method and they all they have been doing that for years and if has been rewarding, why do something else?"

E3: "If you do it altogether, I think it can help you get a good start for the risk idea behind the bouwteam phase. But do it together. Not making it like the clients deciding this are all the risk we want to do together. And then say this are your risk condition my risk but make it one, make it a also a whole product."

E4: "And if it's the 1st time to implement even though it can be accurate, but when one party or even one person only put like 25% of his input in the model and he doesn't put in everything. Then your whole model is worthless. So if you do it, you have to do it the whole way for the 100%. Also the quality you might have a very high standard quality model, but as soon as you don't do everything in it, then even your model can be thrown to the bin. It's not good when some person used it two months ago or so something, put all the new information on that so it really be like accurate and met all the information you need. So it's an everything or nothing on this one."

"And then and then it's a lot of effort, so do we want to invest that into your project? And that's always a difficult question because you cannot compare. What if we haven't done it? What would be the effect? Or what if we do it? What will be the effect? You never know.

Because you don't have the comparison, between those two situations."

12. Do you have any further comments?

E2 **(talking about projects were the Contractor is involved in the design using UAV or those that connects with an UAV-GC for the realization):**

"In the second situation the contractor will also look at his own risk in the execution because he has to be contracted with the UAV-GC. Which has quite an risk profile for him. So what I noticed in practice that he tries to minimize, for instance, technical risks and he is also able to do that because he's making the design in the building team, that's really different from the situation where the engineering firm is working directly for the client."

(Talking about the use of BT to mitigate risks for the Execution phase):

"I think a very interesting topic because we discussed that yesterday as well because that's still an expectation. That a Bouwetam will lead to less risk in the execution phase and less fuss and less disturbance in terms of planning and cost in the execution phase. But I haven't seen any proof yet. There's hasn't been any study on this and it's only that's a qualitative expectation."

E4: "I don't know if you're categories are the right ones, that's really where I have my doubts about it and I understand how you gott them, but I think, maybe it's also because I'm really used about other types of risk categories, but that's the only remark I have for it. Llike the categories in the RISMAN method, they are quite clear. So there is kind of overlap between your categories which makes it a little bit difficult for me. But for the rest I think it's a fine model."

K. Possible modifications to basic agreements models

The points outlined here could work as potential modifications to the agreements in to encompass missing elements which are necessary for the risk registers, the use of joint risk management and the inclusion of the elements in the Model outlined in this research. In **Bold** letters, the articles or sections of the existing provisions in the original agreements. There is a distinction between the DG 2020 and the KBN 2021, as these two agreements model do not possess the same detail of description for the documents or activities to be done regarding the RM practices. The *Plan of approach* is a document describing several approaches towards the activities that will be done throughout the Bouwteam phase. Processes generally outlined here are related to verification and validation of resulting products, design process, management of interface, and risk management, between others. Within this, the team should clarify the points mentioned in this box at least.

Document	*Model of agreement DG 2020*	*Model of agreement KBN 2021*
Main agreement	**§ 2- Contract documents and Ranking.** **Art. 2:3 Understanding** **Risk file- An overview of 'identified risks'** with a distinction between risks for the design phase and those foreseen for the execution, **further elaborated as follows:** (A) A unique identification number per risk; **(B)** A properly formulated risk statement with **a description of the risk** (and possibly categorized in groups); (C) The cause leading to the identified risk (possibly with identification number); **(D) The probability of occurrence of the risk;** **(E) The likely consequence (in time, money, and other consequences) at the occurrence of the risk;** (F) The allocation of risks following the guidelines drawn in the Plan of Approach; **(G) The** adequately defined **control measures to be applied to mitigate the risk or its impact before the risk occurs** (with identification number liked to the causes); **(H) The residual risk (residual risk) after application of the control measures; and** **(I) The allocation of the residual risk (possibly with an (additional) control measure).**	**§- Obligations of the Client and the Contractor in the construction team.** **Art 4.1 The** Client and **Contractor will perform the activities marked below in the construction team:** ... • **Drawing up a risk file with associated mitigating measures and risk allocation.** The minimum content is defined as follows: (A) A unique identification number per risk; **(B)** A properly formulated risk statement with **a description of the risk** (and possibly categorized in groups); (C) The cause leading to the identified risk (possibly with identification number); **(D) The probability of occurrence of the risk;** **(E) The likely consequence (in time, money, and other consequences) at the occurrence of the risk;** (F) The allocation of risks following the guidelines drawn in the Plan of Approach; **(G) The** adequately defined **control measures to be applied to mitigate the risk or its impact before the risk occurs** (with identification number liked to the causes); **(H) The residual risk (residual risk) after application of the control measures; and** **(I) The allocation of the residual risk (possibly with an (additional) control measure).** **Art 4.3. In the construction team, the following marked activities will be performed by the party designated for this purpose below:** ... **•Other activities:** The Client and the Contractor will carry out the Risk management following the process in the Plan of Approach (possibly Appendix).
	Explanatory notes: The basic agreement model does not state whether the team should focus on risks for the design phase and those of the execution. Explicitly stating the division between this could avoid the team's sole focus on execution risks. It gives equal importance to those that could have been identified during the design phase. 2.3a. The basic agreement does not reflect on the use of an identification number per risk. According to (Leva et al., 2017; Patterson & Neailey, 2002), this is one of the minimum contents that should be provided within the Risk Register. This would also apply to remarks 2.3c. and 2.3g. will allow a more consistent tracking of causes and the respective measures. 2.3b. and 2.3g. To enhance the quality of the risk file, the 'adequately defined' term is introduced. For these two aspects, it has been advised to use the *<risk metalanguage>* (D. Hillson, 2000; D. A. Hillson, 1999) that accommodates the two purposes. 2.3f. The allocation of the risk should be done pursuant to the guidelines drawn in the Plan of Approach, an Annex to the agreement where the steps to follow and how the team will proceed in its tasks are explained. This is not a mandatory product of this agreement but should be considered its inclusion.	Explanatory notes: Art 4.1. The basic agreement of this Model specifies the tasks of doing the Risk file only to be a Contractor one. However, it is believed that this should be a joint effort between the phase participants. Furthermore, the minimum elements of the risk file are the same proposed in the DG 2020 agreement (Leva et al., 2017; Patterson & Neailey, 2002), including how the risks and control measures should be formulated (D. Hillson, 2000; D. A. Hillson, 1999).
	§ 3- Construction team objective: **Art. 3:2** **(c) A Risk file**, jointly elaborated with the assistance of the Participants of the Bouwteam.	
	Explanatory notes: 3.2c. The basic agreement includes the Risk file as an objective; however, it should also be specified this should be jointly elaborated between the participants. This practice has been previously addressed in the literature (Clemens, 2021; de Hoog, 2020)	
Plan of Approach	Include as part of this document, in the Project Control and for Risk Management section, the following definitions: –Risk file and minimum content of the risk file: see *DG 2020* Art. 2.3. or *KBN 2021* Art 4.1. –Risk for The Bouwteam: *Effects that can compromise the deliverables expected of using a Bouwteam as Project Delivery Method, or how such deliverables are achieved.* –Process for Risk management using the diagram of *Risk Model for Bouwteam.* +Which have been the initially identified risk by the Client. State, using the *E1-Risk for the Bouwteam & Risk groups* of the Model, will be the groups to be analyzed throughout the design stage of the project. +Define the allocation of risks based on the *E2-Allocation Decision.* State whether the team is opting for a shared-risk strategy or not, and define the allocation principles that will rule during this phase. Risk allocation can be further elaborated on and tightened up in consultation when necessary. +Make use of the *E3-Risk Control Strategies* for the risk groups identified as minimum actions to be taken to reduce risks during this phase. +Periodicity of the joint risk sessions +Who will participate in these sessions	

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