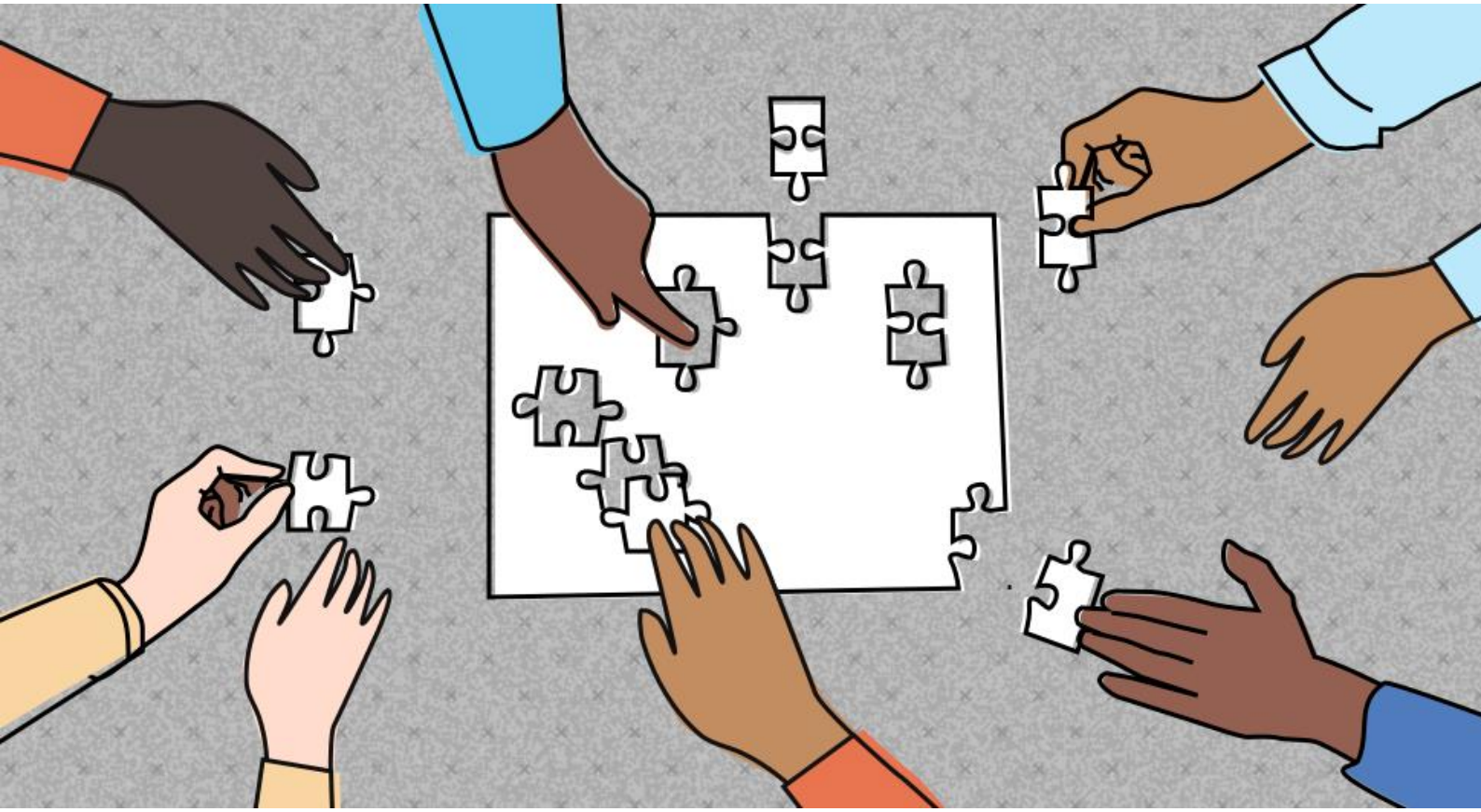

ANALYZING THE COLLABORATION TOOLS USED IN THE DUTCH BOUWTEAM CONTRACT FORM AND COMPARING IT WITH SIMILAR INTERNATIONAL INTEGRATED CONTRACT FORMS OF FINLAND AND UK

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Picture front page: Customer Collaboration Over Contract Negotiation (Jeremy Jarrell, 2018)

MSc. Thesis

Analyzing the collaboration tools used in the Dutch Bouwteam contract form and comparing it with similar international integrated contract forms of Finland and UK

An explorative study into the collaboration tools used in integrated contract forms for infrastructure projects

By

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in partial fulfilment of the requirements of the degree of

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PREFACE

This report is a culmination of the last seven months of exciting research into the topic of collaboration. I can, now, proudly say that I have completed my master's from one of the most prestigious universities in the world. I have always been the kind of sociable person that likes to be around people, work in a team, listen to other's opinion and collectively arrive at a solution to any problem. It was, then, no surprise that when I was presented with the opportunity to pursue my thesis on collaboration, I instantly seized it without thinking twice. A popular perception of Contracts Management is usually restricted to the legal aspects of a contract. But, what additionally makes a contract successful, is the people who form the team as well as the environment created to improve collaboration. Integrating this ideology into my thesis was the most fascinating part for me. It not only gave me the chance to interview project practitioners from different parts of the world, but also enabled me to gain insights into the way people work in these projects.

This journey wouldn't have been half as pleasant without the support of my committee members. First of all, I would like to thank my first supervisor Leon Hombergen for his efforts to reach out to his network and eventually connect me with PRO6 managers. My company supervisor Joost Merema and I have known each other for almost a year. We had a lot of meetings even before my thesis officially started and I thank him for patiently guiding me at every step of my research. I am grateful to my second supervisor Louis Lousberg for helping me refine the concepts of my thesis in order to give it a strong foundation. I would like to thank my committee chairperson Prof. Hans Bakker for his meticulous review (*tot in de puntjes*, as they say in Dutch) of every report I sent which ultimately had a huge impact on the overall quality of the final report.

A special mention to all the interviewees who took time out of their busy schedule to give a virtual walk-through of their respective projects through detailed insights and honest interactions during interviews.

Last but not the least, I would like to thank my parents and brother for their unconditional love during my thesis, and my friends who had my back and served as a calming force during the tense moments along this journey.

I sincerely hope you have a good time reading my thesis and have plenty of takeaways!

Saurabh Varanasi

Delft, May 2021

EXECUTIVE SUMMARY

Introduction & Ideology

It is a well-known fact that the construction industry operates under high levels of complexity and uncertainty, which gives rise to challenges such as ineffective communication, lack of trust, insufficient support from the higher management, etc. Collaboration has demonstrated to be a solution to all these problems. Collaboration occurs when two or more participants work together to achieve a common outcome whilst recognizing that each party has different business objectives. Literature has shown that in order to stimulate collaboration, there are certain tools such as early involvement of all parties, co-location of all parties, team building activities, hiring a facilitator, etc. which are effective. This research revolves completely around these collaboration tools adopted predominantly in the design phase of infrastructure projects using integrated contract forms. However, merely introducing the concepts of collaboration in a contract does not guarantee effective collaboration between parties. The interpersonal team dynamics and environment created to enhance collaboration play a very important role. Keeping this ideology in mind, this research explores the ways in which team members interact with each other during the project in the form of the various tools that were employed to achieve collaboration.

Research Objective & Question

In line with the above reasoning, the objective of this research is twofold: *first*, to analyze the collaboration tools used in the Bouwteam contract form in the Netherlands, Alliance contract form in Finland and NEC4 contract form in the United Kingdom; *second*, to look at possibilities of improving the collaboration by recommending a set of collaboration tools inspired by each other. As a result, the main research question was framed as follows:

Are there any collaboration tools followed in the integrated contract forms of Netherlands, Finland and UK which can be adapted to each other to improve collaboration?

Research Methodology

In order to go about answering this question in a structured manner, the research was divided into five phases, namely *Literature Review, Data Collection, Cross-case analysis, Expert Validation and Final Recommendations*. A case study approach was adopted to collect data. In addition to interviews, the RECAP tool developed by Suprapto was used to gain insights into the projects. It consists of six criteria which further have been broken down into sub-criteria and indicators that speak about a particular aspect of collaboration. A total of four projects were chosen: 2 Bouwteam, 1 Alliance and 1 NEC4. After studying each project individually, a cross-case analysis was performed to compare the four projects in terms of the collaboration tools used.

Findings from cross-case analysis

This analysis revealed that the Bouwteam projects believed that jointly creating collaboration plans at the beginning of the project by all parties helps in making collaboration very explicit and thus making adherence to agreed tools easier. The Alliance and NEC4 project, however, did not consider it essential to make such plans but instead banked on co-location, honest

communication of problems and tacit agreements to enhance collaboration within the team. One of the Bouwteam project and the Alliance project performed better than the other two projects in terms of increasing clarity of collaboration and assessing collaboration in the pre-tender phases and tender phase respectively. When it came to conducting periodic follow up meetings followed by extensive methods to assess and maintain team satisfaction, the Bouwteam projects were superior. However, with reference to early involvement of subcontractors and having a clear meeting structure coupled with clear definition of roles and responsibilities, the Alliance and NEC4 project accomplished better results.

Final Recommendations to practitioners

Based on the scope for improvement identified in the case studies, a set of recommendations have been proposed to each contract form. These are the most important collaboration tools, which, when applied in the suggested manner, will stimulate collaboration in the project. Below are the recommendations given for each contract form:

A. Bouwteam

1. Co-location in Big Room throughout the project
2. Increased involvement of subcontractors in the design phase
3. Clear definition of roles and responsibilities

B. Alliance

1. Trust-building by clients
2. Joint creation of collaboration plans
3. Use of questionnaires and surveys to measure team satisfaction

C. NEC4

1. Use of a relational contracting expert in the pre-tender phase
2. Assessing collaboration in the tender phase
3. Appointing an external collaboration coach for the project

Although the tools have been segregated into contract forms, a practitioner is recommended to examine the consolidated list of all the 9 tools while conceptualizing a project, before thinking about the structural aspects of a contract form. This way, he/she is able to decide, in advance, the required style of working together and desired environment to be created for thriving of collaboration in the project.

Limitations of research & Scope for future research

Some of the limitations of this research are that the recommendations proposed are not very effective while working remotely in these times of the pandemic, the focus is only on the design phase and not the construction phase and only one project was studied from Finland and UK each. For a researcher aiming to build upon the results of this thesis and further explore the topic, it is recommended to study the collaboration tools used in the construction phase as well in order to get a comprehensive list of tools that will guide a practitioner throughout the project. It is also advised to study the collaboration in integrated contract forms in countries such as Australia and Hong Kong which could lead to more improvements to the overall contract forms.

Structure of the report

Chapter 1 starts off with an introduction to the concepts of collaboration, collaboration tools, the integrated contract forms and the context of the research. Based on an identified problem or research gap, the research objective and research questions are stated. This is followed by the research methodology and the chapter is concluded with the scope of research. *Chapter 2* presents the findings from literature, particularly the importance of informal mechanisms in the project over formal ones in the contract to stimulate collaboration and tools which have a positive influence on collaboration. *Chapter 3, Chapter 4 and Chapter 5* describe the collaboration tools which were adopted in the case studies of Bouwteam, Alliance and NEC4 respectively. *Chapter 6* contains the cross-case analysis of the four projects and gives commentary on which project performed well and not so well in which particular aspects of collaboration. Following this, *Chapter 7* is the place to find the recommendations proposed to each contract form on how the collaboration can be enhanced. *Chapter 8* documents the comments and opinion of experts on the cross-case analysis and recommendations. Finally, *Chapter 9* takes a helicopter view on the findings of this study. It starts off with the importance and relevance of the results along with recommendations for practice, then goes on to cite the limitations of this research, and finally concludes by answering the research questions along with a personal reflection to end the thesis.

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List of Figures and Tables

1.Introduction

This chapter aims to first introduce the topics of collaboration, early contractor involvement and some relational aspects of contracting. This is followed by conducting a Problem Analysis and stating the Research Objective on the basis of which Research questions are framed. The chapter concludes with the Research Design and the Scope of this research.

The construction industry is a complex one, predominantly due to the size of projects, number of parties involved, long durations and high levels of uncertainty (Wu, Zio and Zhao, 2017). Reasons such as lack of trust, ineffective communication and unfair sharing of risks between the owner and contractor are highlighted as the main challenges, for which collaboration has been demonstrated as a solution (Faris et al., 2019). Studies have also shown a positive correlation between a healthy collaborative relationship and the end-result of a project (Lloyd-Walker et al., 2014; Eriksson, 2008).

Lofgren and Eriksson (2009) investigated how collaboration tools affect collaboration and their effect on project performance. Examples of such collaborative tools include joint objectives, workshops and team building activities, joint project office (Naoum, 2003; Bayliss et al., 2004; Eriskssson, 2008), hiring a facilitator (Jeffries et al., 2014) or a cooperation coach/psychologist to conduct periodic checks of the relationship (Cheung and Rowlingson, 2005). Bayliss et al. (2004) concluded that if implemented in the right way, these tools have the potential to foster and maintain a collaborative spirit among project team members.

An important aspect of the collaborative relationship between the Client and other parties that are a part of the project is the early involvement of the parties in the development of the design. Suprapto (2016) stated that assembling teams with suitable capability and applying collaborative practices such as team integration and joint risk management must happen in the early phases of the project. In their study of collaborative relationships in sustainable construction projects, Wu, Zio and Zhao (2017) claimed that early intervention of contractors is a typical characteristic of such projects in addition to multidisciplinary collaboration. Improved buildability of design, effective risk management and a collaborative relationship stimulating innovation are some of the highly ranked benefits in a study by Eadie (2014).

The concepts of early contractor involvement and collaborative relationships are fostered in integrated contract forms such as Bouwteam (Netherlands), Alliance and New Engineering Contracts (NEC). Bouwteam (also known as Construction Team in English) is a collaborative model in which the main contractor participates in the design development as a consultant, contributes his expertise on the implementation of the design, and is promised to be the first one to make an offer for the implementation (Chao-Duivis, 2012). In the Annual Report Netherlands 2011-12, when market parties were asked which contract form aids in avoiding failure costs, almost half of them answered Bouwteam, the main reason being that more attention is paid to project feasibility in the design stage (Bouwkennis BV made parts of this report (pp. 118 to 128) available for the purpose of the investigation done by Chao-Duivis (2012)). Alliance contracting is another type of a collaborative contract form in which clients, contractors and designers are integrated in a single contract wherein they agree on the fundamental belief that all wish for the best outcome for the project and each contribute their unique skills and expertise to come up with innovative solutions. The features of an Alliance are *cooperating and acting in good faith, early involvement of contractors, collective problem*

solving and decision making and open book accounting of costs (Hayford, 2018). Similarly, the NEC philosophy is also based on unique processes for collaboration, trust, improved flexibility and clarity of the contract. This is expressed in Clause 10.2 of the NEC4 contract which states that the parties must work in "*a spirit of mutual trust and collaboration"*.

However, it is important to note that merely introducing the concepts of collaboration and trust in a contract is not sufficient in itself to guarantee effective collaboration between parties during the course of the project. It is the project team and the environment which facilitate collaboration. This is supported by Suprapto (2016) where he concludes that collaborative contracts do not necessarily translate into better project performance but instead through relational attitudes and the resultant inter-team behavior. Additionally, in a survey of 120 industry professionals conducted in UK in 2016, a majority of the respondents did not feel that the better collaboration among parties was the result of contracts becoming easier to understand or less detailed (Masons et al. p. 18). A good contract could be ruined by a bad project team or a bad contract could be successfully delivered by an excellent project team (Van Wassenaer, 2017).

1.1Context

In line with the above thought, this study aims to focus more on the way the various teams work together within a project in a collaborative set up of integrated contract forms like Bouwteam, Alliance and NEC. The research is done in collaboration with PRO6 managers, a management consulting firm which provides integrated project management services and advice in the construction industry. It was founded in 2007 and is headquartered in Amersfoort, Utrecht. They have provided their consultancy and construction services and successfully completed numerous projects, some of which include business hall in Zwolle and the Koning Willem Alexander Tunnel in Maastricht (NL). They have been actively involved in Bouwteam projects in the Netherlands as a representative of Clients. Joost Merema (Contract Manager at PRO6 managers) has co-authored the new Model Agreement Bouwteam DG 2020 along with four other members of the Construction Society. Having worked extensively in the field of collaboration in Bouwteam projects, PRO6 managers is interested in understanding the collaborative tools used in international integrated contract forms of Finland and UK and looking at possibilities of adapting some of them to the Bouwteam contract form to improve it.

1.2Problem Analysis

Several studies have been undertaken which analyze the culture of the Bouwteam contract form in construction projects in the Netherlands (Van Riggelen, 2019, Nader, 2019, de Hoog, 2020). These studies analyze the current state of collaboration in Bouwteam projects, investigate how it can be improved and come up with relevant success factors. They are limited to, however, understanding and improving the Bouwteam collaboration culture but do not have any international perspective to it. Rahmani et al. (2013) conducted research on the use of early involvement types of contracts in countries such as United Kingdom, Australia, New Zealand, etc. But, this research is limited to explaining the procedural and contractual aspects of the contract.

Although Bell, Kaats, Opheij (2013) did attempt to develop an integrative framework which provided guidance on the various stages of collaboration, they identified scope for further strengthening the coherence of their approach and carrying out research on the success factors under each of the five lenses of their framework. A lot of research has been done on assessing

the linkage between attributes of collaborative working and project performance. Greenwood and Wu (2012) established a similar relationship to provide practical implications of how project performance might be improved. Lloyd-Walker, et al. (2014) and Bond-Barnard et al. (2018) studied how the culture of no-blame and trust are drivers for encouraging innovation which ultimately improves project performance. But, all these studies come up with recommendations in a very general context without a cross-country comparison which may or may not apply to the Bouwteam contract form.

Van Limbergen (2020) conducted an interesting study on the motives of client behind applying the collaborative criteria, describing instruments and formats that are used to assess the contractor's collaborative behavior and made validated recommendations to improve the procedure for these behavioral team assessments by comparing observations from Finland and United Kingdom and applying them to the Dutch context. Although it does study the Bouwteam model in the context of international contracts, the focus is more on the assessment criteria for selecting contractors for the design process rather than the collaborative tools during the design phase. In the study by Ten Hoeve (2018), the particular clauses of NEC4 which can stimulate collaborative behavior between Client-contractor in a Dutch construction setting are investigated but the focus is not specifically on Bouwteam.

Also, while there is an abundance of literature on the existing collaborative tools and their influence on the project success (Van Wassenaer, 2017; Wong, 2007; Pinto, 2006), the results of which will undoubtedly be useful for this study, there are not many scientific papers which put these into an international context and compare them with each other to suggest potential improvements.

1.3Research Objective

Based on the identified research gaps, the main objective of this study is divided into two sections; *first* is to analyze the collaborative tools used in the Bouwteam contract form in the Netherlands, Alliance contract form in Finland and NEC4 contract form in the United Kingdom and *second* is to look at the possibilities of improving the collaboration by recommending a set of guidelines with effective collaboration tools inspired by literature and those of integrated contract forms of Netherlands, Finland and UK.

1.4Research Question

The research objective has been translated into the following *main research question*:

"Are there any collaboration tools followed in the integrated contract forms of Netherlands, Finland and UK which can be adapted to each other to improve the collaboration?"

In order to answer the main question, four *sub-questions (SQ)* have been framed. These help divide the research question into manageable blocks and answering them leads to answering the main question.

SQ1: What are the tools which positively influence collaboration?

SQ2: What are the collaboration tools used in the Bouwteam contract form in the Netherlands?

SQ3: What are the collaboration tools used in Alliance contract form in Finland and NEC4 contract form in United Kingdom?

SQ4: What are the differences in the collaboration tools between these integrated contract forms of Netherlands, Finland and UK?

1.5Research Design

The research design has been divided into five phases which is then summarized in the form of a flow chart in Figure 1.

Phase 1: Literature Review

An external desk research method was adopted to collect data from existing literature on collaboration in general and in the context of integrated contract forms of Bouwteam, Alliance and NEC4. Tools having a positive influence on collaboration and in turn project outcomes were gathered and structured into categories. To be able to find suitable and relevant literature, a variety of keywords like "Bouwteam contract", "Early Contractor Involvement", "Collaboration", "Collaborative contracting", "Alliance contract", "NEC contract" were searched for in search engines such as Scopus, Google scholar, TU Delft library and TU Delft repository.

Sub-research questions answered: SQ1

Phase 2: Data Collection

First, interviews were conducted with experts in the field of collaboration to get insights into the recent trends of collaboration which could be studied in international projects. Next, a multiple case study approach was followed to collect information about the collaboration between different parties in the integrated contract forms of Netherlands, Finland and UK. Case studies were considered a suitable method to approach this research because of the complexity of integrated project environments and the need for in-depth understanding of the dynamics between the project delivery model, dimensions of collaboration and the performance-related factors (Eriksson et al., 2019).

A total of 4 projects was chosen. Two to three participants were interviewed from each project. The first interview with a participant (around 15 minutes in duration) was to introduce the topic of the research and the methodology. The RECAP assessment form developed by Suprapto (2016) was sent to them to give their rating. Once the responses were received, a detailed semi-structured interview (around 1.5 hours to 2 hours in duration) was conducted based on a questionnaire developed from their responses, literature and the interviews with collaboration experts.

Phase 3: Cross-case analysis

After data collection, a cross-case analysis was performed to compare the collaboration tools in all the projects. Recommendations were given as a result of this analysis.

Sub-research questions answered: SQ2, 3

Phase 4: Expert Validation

The recommendations and cross-case analysis were validated by the experts in the field of collaboration.

Phase 5: Final Recommendations

Based on the comments by experts and the results of Phase 3, final recommendations to improve the collaboration in the integrated contract forms of all three countries have been proposed.

Sub-research questions answered: SQ4

Phase 5 also answers the main research question: *"Are there any collaboration tools followed in the integrated contract forms of Netherlands, Finland and UK which can be adapted to each other to improve the collaboration?"*

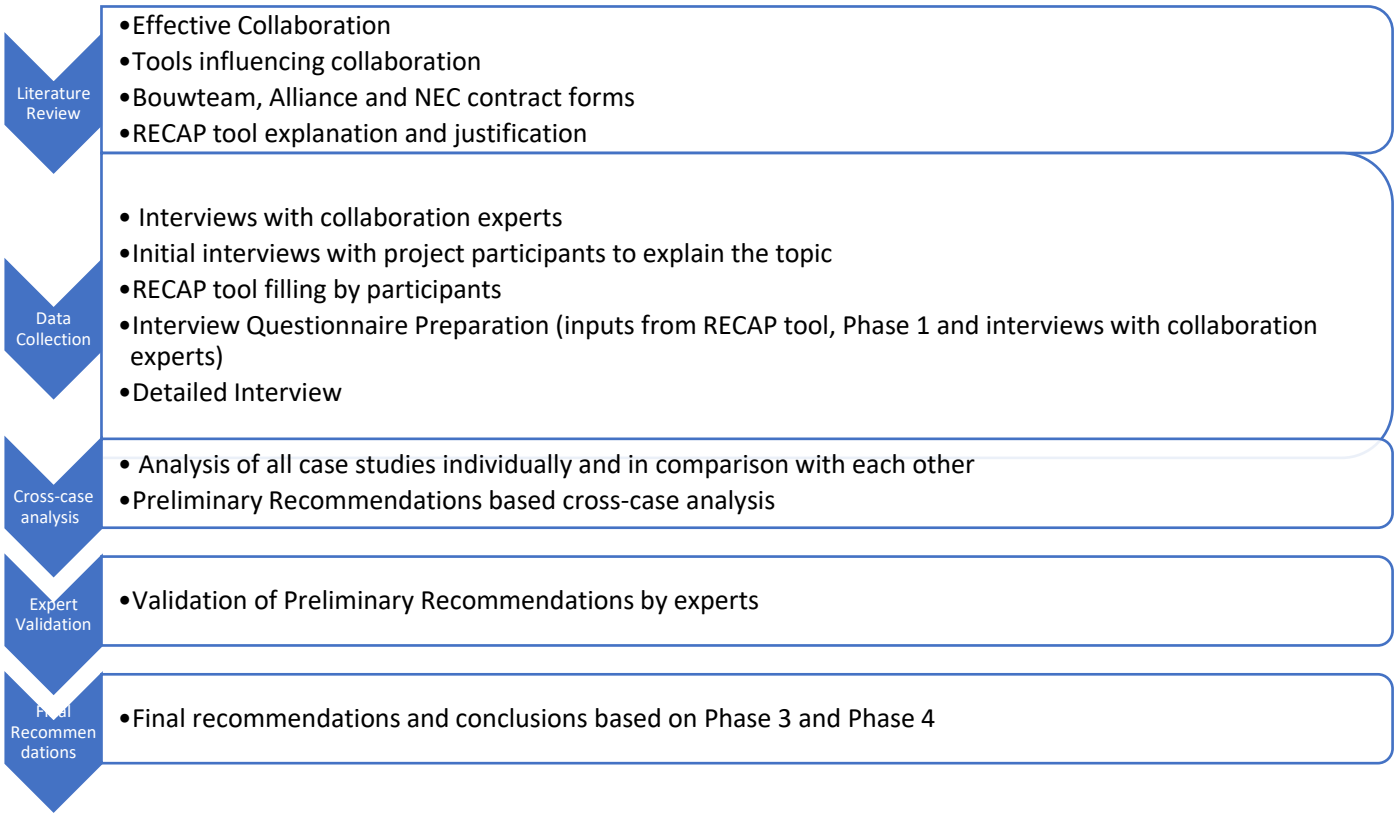

Figure 1: Research Design flowchart

1.6 Scope of Research

This research is restricted to the study of infrastructure projects of Netherlands, Finland and UK, which preferably are in the construction phase or have recently been completed. The reasons for choosing these countries and the particular contract forms are explained in Chapter 2.4. Also, this research aims to study the collaboration until the end of the design phase. Although it is intended to capture the perceptions of representatives from the Client, Contractor and Designer of a project through interviews, the interaction with other parties like subcontractors and external stakeholders will also be analyzed as there are provisions to do so within the RECAP tool (this will be explained in Chapter 2.5).

2. Literature Review

The purpose of this chapter is to elaborate on the findings from literature. First, the concept of collaboration is introduced, effective collaboration is defined, tools which positively influence collaboration are discussed. Then, the various integrated contract forms and the motivation for choosing Finland and United Kingdom (UK) are discussed. The chapter concludes with the explanation of the RECAP tool and its various indicators including the motivation for choosing this tool for this research.

2.1 Collaboration

The word collaboration is derived from the Latin words 'con' meaning together and 'labora' meaning work – "Working together" (Van Wassenaer, 2017). In the contracting context, collaboration occurs when two or more participants work together to achieve a common outcome whilst recognizing that each party has different business objectives (Van Wassenaer, 2017). The focus of the research is on the collaborative relationship between Client, Contractor and Designer of the project. Literature on collaboration is found through interrelated concepts such as collaborative contracting, alliance or partnering and according to Suprapto (2016) these concepts share some characteristics such as open communication, trust, knowledge sharing and joint problem-solving. Even though collaborative working was previously defined as *parties working together for mutual advantage, through which they can achieve greater benefits than by working separately*, Greenwood and Wu (2012) identified the need for extra efforts to operationalize the above definition into measurable constituents. The basic idea is to synergize the skills, competencies and expertise of all parties involved in realizing common objectives.

The need for collaboration has been called for several times in previous studies. For example, Erikson et al. (2008) have observed that the construction industry is a high risk multi-actor business that has received criticism for its relationships between parties, primarily due to lack of trust, imbalance of risk sharing, poor collaboration and ineffective communication.

2.2 Importance of collaboration in integrated contract forms

The balance between collaboration and governance (control) varies from project to project (Mills and Davis, 2016). The formal contract specifies how to prevent claims and disputes, how to manage risk-sharing between parties (Faems et al., 2008). Van Wassenaer (2017) observed that contracts, generally, are used to advise on what should be done if things go wrong rather than guide, direct and ensure that things actually go right. Several studies have shown how the formal contract can get in the way of collaboration. Kamminga (2015) observed that in complex project set ups contracts are often drafted with the intention of stressing on the parties' commitment to their obligations using legal instruments, which in most cases leaves no room for collaboration or any form of discussion. If the parties of an integrated team are committed to building and maintaining a successful collaborative relationship, the relational aspects of the contract will have a greater influence than formal governance mechanisms (Lee and Cavusgil, 2006).

A lot of literature states that this process of building a collaborative relationship must start in the early phases of the project. Van Wassenaer (2017) asserted that the key is to align interests and objectives, create issue resolution ladders, deciding lines of communication right at the beginning of the project. This is similar to the Project Start-Up (PSU) phase of a Bouwteam project, wherein the project is introduced to all the members of the Bouwteam and they are motivated to start the project off on a high note (Van Riggelen, 2019). Kamminga (2015)

defines three dimensions of norms, namely, *business relationship* (which thrives on the preservation of trust), *economic deal* (short-term and long-term economic interests of parties drive behavior) and *The Contract* (which dictates how parties must behave with each other). The importance of understanding and aligning these differing norms of the various parties in the integrated team in *the early phases of the project* is stressed upon. Das and Teng (2001), however, have a different opinion of the above. They believe that through the process of building relationships, repeated interaction, co-location the team members become more committed to the integrated team, thus creating trust.

2.3 Tools which positively influence collaboration

Shelbourn et al. (2007) concluded that for "effective collaboration", there must be an equilibrium of three strategies; business, people and technology.

Figure 2: Strategies of Effective Collaboration (Source : Shelbourn M. et al., 2007)

In addition to the above, based on several studies, the following are the various categories of tools which positively influence collaboration:

1. **Shared ambition and Joint objectives**: A shared ambition is at the heart of any cooperative relationship; it is like a compass for the participating members (Bell J., Kaats, Opheij, 2013). It also acts as a bond that helps overcome differences in culture and attitude of working (Douma et al., 2000). At the start of the project, different stakeholders will have different objectives for the project. It is vital that all these objectives are taken together to arrive at joint objectives that reveal the entire project's objectives (Van Wassenaer, 2017).
   This also calls for commitment from all team members which is a willingness to believe in the goals and values of the project (Bond-Barnard et al., 2018). Commitment is shown to be one of the success factors for collaboration (Dietrich et al., 2010). Tools such as using a common team name, logo, uniform without the mention of individual company names for all communications within the project may seem trivial but can go a long way in increasing the bond between teams to have a shared ambition (Jefferies et al., 2014).
2. **Interests and mutual gains**: Kahane (2010) has shown the importance of having dialogues on interests of every party in the collaborative relationship. Similarly, (Lunnan et al., 2011) have found a positive correlation between alignment of team aspirations and increased reciprocity between teams. Bell, Kaats, Opheij (2013) also acknowledge the fact that, practically, team members are not motivated enough to speak openly about their interests primarily because they don't know each other. In such a

scenario, they have suggested using the expertise of a facilitator to create an atmosphere in which the team feels comfortable to share their interests.

3. **Relationship dynamics**: Relation dynamics relates to people working together in teams. Understanding these dynamics is essential because the success or failure of alliances depend on them (Douma et al., 2000). Individual characteristics vary hugely within a team. People are not puppets, they do have influence (Bell, Kaats, Opheij, 2013), and the interpersonal skills will eventually affect the quality of collaboration. Their study also highlighted a personal dilemma which people go through as a result of the complexity of the collaboration, known as the 'split loyalty' – a situation where one is confused about upholding the loyalty to the integrated team even when it falls afoul of their individual companies' interests.

   Building an environment of **trust** is another indispensable exercise for the success of collaboration. However, Wong (2007) pointed out that trust is a feeling that one person has for another and while there can be processes that help generate this trust, it all depends on human behavior. Another observation is that trust is earned by doing what one says one will do on a continued basis (Bond-Barnard et al., 2017). In the context of Bouwteam contract form in the Netherlands, (Chao-Duivis, 2012) mentions that a successful Bouwteam requires extensive attention to knowledge and information sharing with a characteristic that it remains open and transparent.
4. **Process Management**: Achieving effective collaboration alone is not sufficient. It does require momentum and progress. Lack of clarity on what comes next may frustrate the collaborative process because the absence of short-term progress causes the enthusiasm and drive to fade away (Bell, Kaats, Opheij, 2013). There should also be a mechanism in which feedback is given to team members and job satisfaction periodically monitored (Van Wassenaer, 2017).
5. **Conflict resolution**: As complexity and diversity in a project team increases, conflicts arise and resolving these conflicts is positively correlated to collaboration quality (Dietrich et al., 2010). Van Wassenaer (2017) observed that an important aspect about conflict is that people must admit that if a solution cannot be reached, it must be escalated to a level where the issue can be resolved. It's therefore necessary that the project facilitates mechanisms which incentivize the team members to follow this procedure. A solution proposed by him is to create *issue resolution ladders* during the workshops in the PSU phase wherein various levels of decision making and time frames in which issues need to be resolved or moved up the ladder.
6. **Support from higher management**: The project managers of owners and contractors must manage the relationships and relational attitudes between the senior management of both the owner and the contractor (Suprapto, 2016). Although this is also cited to be one of the most costly resources of collaboration, it is vital to establish a longer-term relationship between the parties. An added advantage of keeping the 'top level' of an organization informed and engaged in decision-making is that they are available to deal with escalated conflicts to avoid arbitration (Van Wassenaer, 2017).

Having said that, (Shelbourn et al., 2007) also warned that effective collaboration depends a lot on the context of the proposed collaboration. A collaboration strategy needs to be developed that does not solely rely on sophisticated information and communication technologies. Also, as pointed out in Chapter 1, it is the attitude of the team and the way they work together that matters.

2.4 Types of Integrated Contract Forms – Bouwteam, Alliance and NEC4

Bouwteam (Construction Team)

Bouwteam is a partnership in which the participants – while retaining everyone's independence and responsibility – work together on the preparation of the project. For that purpose, every participant is obliged to make the best possible use of his specific experience and expertise (Chao-Duivis, 2012). It is based on a collaboration agreement during the design phase of a construction project, in which at least the client, contractor and designer are present to collaborate (Van Riggelen, 2019). The collaboration in the construction team is a collaboration of a temporary nature, which ends when the implementation phase is reached.

In a study by Stam (2016), due to the presence of a hierarchical relationship between the Client and Contractor/Subcontractors and the absence of specific relational aspects, the Bouwteam contract form was not considered a relationship contracting arrangement. However, there has been an evolution of the relational aspects of Bouwteam over the years. This is supported by the *Model contract Bouwteam DG 2020* which defines Bouwteam as: *Agreements which are based on the premise that the agreement is not only legally motivated, but also from a sociological point of view*. Contractually speaking, Clause 5.1 and 5.3 of the same model specify that participants have to work in a coordinated manner with each other, they must act flexibly, proactively and transparently, there is timely discussion of mistakes, everyone must have an eye on the goals of the Bouwteam and legitimate interests of the other participants. That is the reason it also refers to this type of an agreement as 'relational' or 'collaborative' contracting. Explicit attention is paid to attitude and behavior of the parties involved; both in good times and bad times as in disputes.

Following are the benefits of Bouwteam as identified by many studies (Nichols, 2007; Eadie et al., 2012b; Edwards, 2008):

1. Contractor design inputs received early
2. Early knowledge of costs
3. Collaborative relationship that stimulates innovation
4. Focus on value and quality
5. Improved buildability of design,

The different phases of the Bouwteam are as follows:

a. Project Start-Up (PSU): Once the members of the Bouwteam are selected in the tendering phase, they get together to align all the different ambitions, expectations and visions of collaboration and the way they want to work together (Van Riggelen, 2019). This is also supported by (Wondimu et al., 2016) where he adds that the goal of this phase is to define a common goal for the entire team.
b. Design Phase: Based on the initial ground work done by the Client prior to commencing the tender process, a contractor can be involved in a Bouwteam either during the preliminary design, final design or detailed design. Like mentioned earlier, the main benefit of this arrangement can be reaped in this phase, i.e., using the practical knowledge of the contractor and other suppliers to optimize the design and costs of the project (Van Riggelen, 2019).
c. Price negotiations: As mentioned in Chapter 1, a characteristic of the Bouwteam model is that the contractor who is a part of the design phase is the first and only one to make

an offer for the construction phase (Chao-Duivis, 2012). But, when it comes to government clients, it is mandatory that there is competition. For this reason, when submitting prices during the tender phase, contractors are asked to include prices for both Bouwteam phase as well as construction phase, given that the design is sufficiently developed to make an estimate for construction (Chao-Duivis, 2012). If the design is not sufficiently developed, price negotiations will take place with the selected provider.

Alliance Contracts

A commonly used definition of project alliances is given by the Department of Treasury and Finance Victoria (2010, p. 9): *"Alliance contracting is delivering major capital assets, where the Owner works collaboratively with Non-Owner Participants (NOPs) wherein all parties are required to work together in good faith, acting with integrity and making best-for-project decisions. Working as an integrated, collaborative team, they make unanimous decisions on all key project delivery issues. (…) All parties jointly manage risks within the terms of an 'alliance agreement', and share the outcomes of the project".*

The five core features of an Alliance which differentiate it from traditional construction contract forms are (Hayford, 2018):

a. Remuneration regime – The remuneration scheme and risk allocation aligns the commercial interest of all the participants in a better way.
b. Formation of a *virtual* organization – Known as the Alliance team, this integrated team comprises members from both owner and non-owner participants without any apparent boundaries between them.
c. Early and continuous involvement of all parties from the beginning of the design to the project completion
d. Unanimous agreement in all decisions taken
e. No blame and no dispute clause under which every party agrees that it will have no right to bring legal claims against any other party in the alliance

One of the key differences between an Alliance and Bouwteam is the aspect of equal allocation of risks among all the parties in the integrated team. Parties share benefits and risks and the surplus is divided between the participating Alliance partners (Bruggeman et al., 2010). Parties collaborate on equal terms and the Client is intensively involved in the building process (Bruggeman et al., 2010). This concept of equality existing in an Alliance and not entirely in Bouwteam is echoed also in (Chao-Duivis, 2012). Despite these differences, the author believes that given the recent developments and increase in more relational elements in a Bouwteam contract (as recommended by the Model contract Bouwteam DG 2020) and the presence of similar collaborative tools used even in an Alliance contract, there exists an opportunity to compare the collaborative tools used in both and suggest potential improvements.

<u>Alliancing in Finland</u>

In the early 2000s, the Finnish construction industry suffered budget and time overruns in many projects, many contractors went bankrupt, parties opting for arbitration for resolving disputes, etc. This gave birth to the desire to have more transparency, efficiency and collaboration in the construction market (Guide to Contract Alliancing in Construction, 2019). In 2007, studies were seeking ways to foster innovation in projects by means of procurement (Lahdenperä, 2007). The Finnish way of Alliancing was inspired by the Australian Alliancing but had to be

adapted to meet the requirements of the European Procurement Laws (Guide to Contract Alliancing in Construction, 2019).

New Engineering Contract (NEC)

The New Engineering Contract (NEC) is a family of contracts that originated in the United Kingdom and is created by the Institution of Civil Engineers. There have been four editions, the first in 1993, second in 1995, third in 2005 (NEC3) and the most recent in 2017 (NEC4).

Using NEC3 requires all parties to enter into a contract with a collaborative mindset. The chief characteristic is that it focuses on trust and cooperation. Clause 10.1 states that *The Employer, the Contractor, the Project Manager shall act in a spirit of mutual trust and cooperation*. However, there is no clearly defined meaning for the phrase 'in a spirit of mutual trust and cooperation' (Rowlinson, 2015, pp. 19-22). The contract is written in plain non-legal English which makes it easier to comprehend.

NEC4 is an evolution of the successful NEC3. It was specially designed to support innovation through digital advances and encourage collaboration (NEC Contract, n.d.). Some of the changes introduced in NEC4 are (Eggleston, 2019):

a. The risk register has been re-named to 'Early Warning Register' and stipulates periodic meetings for early warnings which includes even subcontractors
b. A new option for resolving disputes in the form of Dispute Avoidance Board has been introduced which has been founded to motivate the team to resolve conflicts mutually.
c. A secondary option supporting the use of information models and digital engineering models is added. The contractor now has to provide an information model execution plan.

2.5 RECAP (Relational Capability) Tool

Mohammad Suprapto completed his PhD research in TU Delft Netherlands in 2016 on the topic of the relational quality of client-contractor relationship in collaborative contracts and providing revealing insights on ways in which their collaboration could be improved. He developed the RECAP tool to evaluate the relational capability at inter-firm and inter-team levels. Relational capability is defined as the ability of two parties to align and integrate their knowledge, vision and ambitions to serve the project in a better way (Suprapto, 2016). The tool also envisaged an overview of critical success factors of collaboration in relational contracts.

It consists of six criteria; *Front-end definition, Collaborative Practices, Relational Attitudes, Teamworking quality, Project Performance, Relationship Continuity*. Every criteria except front-end definition and relationship continuity have been broken down into sub-criteria, each of which is assigned a set of indicators that speaks about a particular aspect of collaboration. The tool has been modified slightly to suit this study (Details and reasoning explained in Appendix 1a).

Before applying this tool to case studies, the author also had a discussion with Mohammad Suprapto to understand his motivations and assumptions while developing it. This gave the author a better understanding of the meaning and concepts behind the indicators present. This tool is sent to interviewees after the first interview. Once it is filled and returned, their responses

are used to conduct the semi-structured interview. Table 3 in Appendix 1c defines the criteria used for this study.

Motivation for choosing the RECAP tool for this study

As a part of the literature review, there were quite a few studies which proposed frameworks to improve the collaboration between teams within a project. Van Wassenaer (2017) came up with a list of 17 criteria for project success which include collaborative criteria like *Clear Objectives, Trust Building, Team Motivation, Well defined communication processes, Early dispute prevention*. Bond-Barnard et al. (2017) identified several factors which influence the degree of collaboration in a project team, namely, *Relationships, Coordination, Proximity, Commitment, Conflict and Incentives*. In an attempt to propose a framework that was more practically applicable, Bell, Kaats, Opheij (2013) came up with an integrated framework of five lenses to be kept in mind for effective collaboration; *Shared Ambition, Interests and mutual gains, Relationship Dynamics, Organizational Dynamics and Process Management*. Although all these studies provide frameworks for assessing the nature of collaboration in a project, the author believes that RECAP tool captures all the aspects of collaboration in one place which serves as a solid framework to assess the collaboration tools used in integrated projects. It is in a very structured format and this will form the basis of the interview questionnaire for all the case studies. Although the tool was intended to get a difference in perception of Client and Contractor on the various aspects of collaboration (Suprapto, 2016), in this research it will be used to understand the collaboration culture of the project, the different tools used to stimulate collaboration while also assessing in the background if there is a difference in perception of different parties.

2.6 Details of Case Studies

Below are the criteria used for selecting case studies for this thesis:

1. The project should be an infrastructure project (Rails, Roads, Tunnels, Bridges, etc.).
2. Minimum contract value of the project should be 10 million euros.
3. Construction phase of the project should be either underway or completed recently (which essentially means that at least the design phase should be completed).

A summary of the four projects selected is given in Table 3.

Sr. No.	Name of Project	Type of Project	Contract Form	Country	Project Code (used in this thesis)
1	Oranje Loper	Bridge renewal	Bouwteam	Netherlands	**B1**
2	Michiel de Ruijtertunnel	Tunnel modifications	Bouwteam	Netherlands	**B2**
3	Rantatunneli	Tunnel construction	Alliance	Finland	**F1**
4	A46 and Anstey lane improvement	Highway modifications	NEC4	United Kingdom	**U1**

Table 1: Basic details of Case studies

2.7 Summary of the chapter

A working definition of collaboration, along with its importance in integrated contract forms were explained. Literature showed how formal control (or commitment to the legal instruments of a contract) is many cases harms collaboration. The process of aligning interests of all parties should be done from the beginning of the project. Then, the tools which have a positive effect on collaboration were explained. Arriving at joint objectives, building trust, conflict resolution and support from higher management are stated as some of the most important tools. The criteria and sub-criteria in the RECAP tool along with the motivation to use it was explained. This was found to be a comprehensive tool encompassing all aspects of collaboration.

3. Case Studies of Bouwteam projects

This chapter discusses the data obtained from the two Bouwteam case studies.

3.1 Project B1: Oranje Loper - Bridges, Amsterdam

Context

This is a bridge renewal project wherein nine fixed bridges that have been found to be in a poor condition in the city of Amsterdam will be partially renewed while simultaneously maintaining their historic aesthetic qualities. The Bouwteam consists of the Client and two Main Contractors while the design was jointly done by both the Main Contractors.

Representatives Interviewed:

Interviewee 1 from Client (Project Manager with over 10 years of experience)

Interviewee 2 from Main Contractor 1 (Project Manager with over 25 years of experience)

Interviewee 3 from Main Contractor 2 (Project Manager with over 10 years of experience)

Below is a summary/key highlights of the collaboration tools used in the project (for detailed description, please refer to Appendix 2):

1. Tender Phase

→ A relational contracting expert was hired by the Client to develop their vision on collaboration before the tender phase.

→ Two collaboration coaches/psychologists were present during the tender phase to assess the way in which participants work collaboratively with each other and help the client in the selection process. These coaches were also present throughout the design phase where they carried out periodic collaborative health checks of the team.

2. Front-end definition

→ The project start-up phase (PSU) was done by organizing many sessions where parties shared their visions, ambitions and expectations of cooperation. Things like what they found important, which elements would be used for collaboration, what collaborative instruments they would co-develop were at the center of focus. It was totally around three months in duration. The main challenge which was faced during this phase was that all the sessions were conducted online due to ongoing pandemic.

→ The process of arriving at these common plans, as discussed with one of the coaches, was as follows: First, the parties would present their version of the collaboration plans in what they called a "Pitch to Partners". After listening to everyone's pitches, each party was asked to reflect on the other party's plan by stating which aspects they liked and which they didn't and finally give a ranking to each of the collaborative instruments thought of by each party. Extensive dialogue was used to come up with final collaboration plans.

→ Interviewee 2 found the practice of requirements being identified in the design stage a little strange. His observed practice is that usually requirements are ready before parties start tendering for a project.

3. Organization Structure

→ The main decision-making team with respect to progress of the project was known as the "Core Team" (Kern Team). It consisted of around 10 members including all the three main organizations. There were different fields of discipline within the core team like Technical Management (Design), Project Management, Project Control, Environmental Management, Contract Management and each discipline had their own team (also consisting of members from all three organizations) who were performing the day to day activities for their particular discipline.

→ But, work was not confined to silos. If there was an issue which the Design Team needed to be cleared by the Environmental Management team, there was direct communication between the two. The people within a team would connect with other Bouwteam members when required and not just work with their core team area in-charge. There was no fixed hierarchy existent.

→ Then there was the *Benen op Tafel (BOT)* meeting which was a kind of top view of the Bouwteam to check whether collaboration within the Bouwteam was going as per plan or not. It consisted of the Project Managers of the three organizations who met once a month. The *Directie Overleg* consisted of the Board of Directors from the three organizations. This meeting was around twice or thrice a year. They were the advisory board at the highest level and they checked alignment of different parties and their long term commitment.

4. Team Integration and Joint Working Processes

→ Even though the role assignment of the project managers and some technical managers was an issue initially, there was a clear system in place to select Bouwteam members before beginning the onboarding strategy. First, the requirements of the role were mutually agreed, then the person with suitable capabilities was interviewed jointly and only those who satisfied the criteria were selected.

→ Various collaborative instruments were designed to facilitate collaboration. These are categorized into 'must haves and 'nice to haves'. Some of them were *celebrating success* (an example of this is if a milestone has been achieved, the good news is shared across all platforms such that all achievements are given recognition which eventually boosts the morale of the team members), *collaboration coaches, buddy system, Keep-Start-Stop Reflection Moments* (will be explained later), etc. It was not the case that all instruments were used all the time. A dynamic approach was adopted to activate the instruments when required.

→ However, Interviewee 3 felt that there should have been more informal reward schemes for good performance.

→ Conducting reflection meetings was a key aspect of this project. There were Keep-Start-Stop meetings (or Project Follow-Up meetings) conducted once in every two months.

→ The coaches prepared a questionnaire which had collaborative indicators that people had to rate on a scale of one to five. Some of the indicators were: "We are open and honest with each other", " Atmosphere in the team is good", "We are working as one team", "I am currently enjoying the project"

→ Gradually as the 'one-team' principle was established and clearly understood by all team members, people understood the philosophy that in case they were blaming someone in the

team it automatically meant they were blaming themselves. Hence, everyone agreed that it made more sense to come up with solutions rather than blaming anyone.

→ A stakeholder engagement diagram (explained in Appendix 2) was developed to determine the degree of influence a particular stakeholder would have on the project.

→ However, Interviewee 1 and 3 felt that sometimes information communication was not transparent. There were cases where information was withheld.

→ A common logo was developed for the Bouwteam which aided the collaboration.

→ In order to challenge the team if their design generated value for money or not, they got the final design reviewed by other members outside the Bouwteam within the respective organizations.

3.2 Project B2: Aanpassingen Michiel de Ruijtertunnel - Amsterdam

Context: The Michiel de Ruijtertunnel (MRT) is a part of the Amsterdam Road Tunnels Programme (AWA). The MRT is a class D road tunnel for car traffic in Amsterdam-Centre. The modifications works include increasing the fire resistance of the concrete in the tunnel to 120 minutes, replacement of fixed cameras with movable ones and various adaptations to the control, operation and monitoring. The most critical aspect of this project is that work is carried out only at night because the tunnel has to be opened without fail to traffic in the morning. The Client is the Municipality of Amsterdam Metro and Tram while the main contractor is Engie Infra and Mobility BV. In addition to the two teams, the tunnel management organization, maintenance contractor and cooperation coach were also an integral part of the Bouwteam. The Bouwteam phase was conducted between April 2020 to September 2020.

Representatives Interviewed:

Interviewee 1 from Client (Deputy Project Manager with over 5 years of experience)

Interviewee 2 from Client (Project Manager with over 10 years of experience)

Interviewee 3 from Contractor (Deputy Project Manager with over 5 years of experience)

Below is a summary/key highlights of the collaboration in the project (for detailed description, please refer to Appendix 3):

1. Front end definition

→ During the tender phase, there were no workshops or exercises to assess the collaborative working of the participants because the Client did not think it was necessary to invest resources in that since the project complexity was not high.

→ Most of the understanding of project goals and objectives occurred through an extensive dialogue during this phase.

→ The Project Start-Up (PSU) was a one-day online event which was used to get to know each other on a personal level. An external sketch artist was hired to make drawings based on all the discussions made during the day. These pictures were then put up in the meeting room for everyone to see to give an impression of the day and to be constantly reminded of.

Collaboration rules were jointly established by both teams like having short communication lines (always call before sending an email), no hidden agendas, etc.

→ A Bouwteam plan was developed jointly by the client and contractor using the implementation plan (made by the client before the tender phase to specify their vision of cooperation) and the contractor's plan of action.

→ The PSU and project follow-ups (PFU) were mediated by a collaboration coach jointly selected by both parties.

→ During the Bouwteam phase, not only was the design finalized but also extensive work plans of the construction phase were created ranging from scheduling to risk management. The Bouwteam phase consisted of around 20 members.

→ Interviewee 2 felt that since many of them were working on a Bouwteam project for the first time, definition and distribution of roles and responsibilities was challenging. Interviewee 3 commented that stakeholders like tunnel management organization and maintenance contractor should have had better role definitions at the beginning.

2. Organization and Meeting Consultation Structure:

→ The Project Management Team consisted of one project manager and one deputy project manager from both Client and Contractor. The Management Team consisted of one representative from the various organizations like client, contractor, tunnel management organization, maintenance contractor, design team, etc. The Kern Team or core team consisted of the entire Bouwteam.

→ There were many periodic meetings conducted throughout the Bouwteam phase: *Bouwteam meeting* to discuss an overview of the project once a month. This was attended by the entire Bouwteam. *Benen op Tafel (BOT)* meetings were also conducted once a week only with the Project Management Team. There was no specific agenda for this meeting as any aspect of the project could be discussed. The idea was to just be open and honest with each other. *Stand Up* meetings were conducted once a week where the Management Team would participate. Things like progress, planned actions, interdependency of tasks, etc. was discussed but not in a very detailed manner. Two *Work Track meetings* (one for design and work preparation and the other for contract and pricing) happened simultaneously bi-weekly. All the main decisions of the project were taken in these meetings.

→ All the interviewees felt that this particular meeting structure was too complex. There was an overlap of information and agendas and this led to some unproductive meetings. In the end, they ended up having lesser meetings than planned. Despite the corona situation, the team met one day a week in the client's office.

3. Joint Working Processes:

→ One of the main subcontractors (for camera installation) did not participate in the Bouwteam phase because of a traditional mindset. They were not used to the Bouwteam concept of giving engineering services during this phase and then not having the guarantee of being selected for execution.

→ The contractor would come up with certain ideas or concepts for the design which would first be pitched to the clients in an early stage, inputs were received from the entire team and

then would be further developed by Engie. The client was not present merely for approval. They were a part of reviewing the design from early on. Most of the workshops conducted during the Bouwteam phase were technical.

→ A Project Follow-Up (PFU) was conducted once a quarter. These sessions were used to assess how the collaboration was going in the project. They were facilitated by the collaboration coach. Team members were asked to mention what they were happy and sad about. Each one had to write compliments about another member. The importance of giving praise was stressed upon by the coach.

→ A Project Barometer was used to assess the satisfaction of the entire team. It was an excel sheet which consisted of columns for team members to fill about what they felt was good, what could have been done better, questions about whether they felt their opinion was heard, whether the collaboration was working and similar personal satisfaction related questions.

4. Inter-team working:

→ There was a lot of trust within the teams. Interviewees 1 and 2 believed that as the Client they had to take the initiative to make themselves open and vulnerable to the team to be trusted. Examples of ways of developing trust are explained in Appendix 3.

→ At first, the team was surprised with this way of working and trusting each other. They were used to being more cynical about other parties' motives. These examples made it easy for people to adapt to the new style of working.

→ Interviewee 3 was of the opinion that the client and contractor were not there to support each other always in a problem because he believed there were certain boundaries created in the project due to the fixed amount payment to the contractor during the Bouwteam phase. He believes if there was a shared budget with a bonus system, the collaboration would have been better.

4.Case Study of Alliance project in Finland

This chapter discusses the data obtained from the Finland case study

4.1 Project F1: Rantatunneli Tunnel, Tampere, Finland

Context

This project concerns relocating Highway 12 in Tampere to a new alignment and a tunnel between Santalahti and Naistenlahti, according to the road plan of 2011. The project was completed in September 2017 with a total value of approximately 200 million euros. It was the second Alliance project in Finland. The pilot project was initiated just to test the contractual model and its documents since its main source of inspiration was the Australian Alliance model. But, this project was considered much riskier than the pilot project because of the inherent risks predominantly due to the tunnel being in the center of a very busy residential district. The technical equipment used was very complicated and previous tunnel projects had not performed well. That's the reason the Alliance model was chosen since it was proven to provide certain cost management and yield significant results through close collaboration between parties. The Alliance consisted of the Client, the Main Contractor, a Specialist Designer and another Designer for road planning and other designs.

Representatives Interviewed:

Interviewee 1 from Client (Project Manager with over 20 years of experience)

Interviewee 2 from Contractor (Project Manager with over 10 years of experience)

Interviewee 3 from Contractor (Senior Design Supervisor with over 30 years of experience)

Below is a summary/key highlights of the collaboration in the project (for detailed description, please refer to Appendix 4):

1. Tender Phase

→ The Alliance consisted of an Alliance Executive Team (AET), which was the highest decision-maker of the Alliance and is responsible for Alliance Management. Below it is the Alliance Project Team (APT) whose task was to manage and coordinate the daily activities of the Alliance. The APT was resourced with the necessary skills and expertise and was capable of quick and flexible decision making.

→ The tender phase evaluation criteria had a weightage of 75% for collaborative quality criteria like leadership and alliance capabilities, ability to learning from mistakes. The remaining 25% was for the fee offer.

→ The Client had appointed an external alliance facilitator, who also served as an alliance expert, who coached the owners' personnel and participated in the preparation of events related to the procurement. He helped develop the Client's vision of collaboration by benchmarking based on Australian alliance model. He planned all workshops that were conducted during the tender phase, designed their content, and was present during the workshops to help the client give scores to participating companies.

→ The alliance facilitator was also present during the development phase where he would plan and design team-building workshops, check if promises are kept, if all parties were given equal

chances and giving comments if teams were improving in collaboration as compared to their performance in the tender phase or not. Continual improvement was an important principle used in the project.

→ Criteria like 'self-reflection' were assessed in the following way; at the end of the workshop, parties were asked to write on walls what they thought of their performance on a personal level, small group level and in relation to how it was like working with others. 'Learning from mistakes' was assessed in the following way; parties had to write down their biggest mistakes ever committed. Interviewee 2 said it was a fun exercise because people had to dig deep into the mistakes committed in the past and the lessons they learnt from that.

→ During the tendering phase, the companies were asked to name all the key persons or decision-makers whom they would be bringing into the Alliance organization. The priority was the find the best team at all times. They had to prove that those individuals were capable of making important decisions related to the project.

2. Inter-Team Working

→ All weekly meetings took place in one common room known as the Big Room. In these sessions, the main contractor was always available to sit with the designer and discuss feasibility and constructability of the design. There was no requirement of making phone calls or sending emails to anyone because they all were present in one room. Although, most of the subcontractors and suppliers for this project came from the same company as the main contractor, a few subcontractors were also involved in these big room sessions to discuss identified critical elements in the design.

→ The objectives of Big Room were fast information flow, transparency and openness of operations, and stimulating conditions for innovative operations.

→ The workshops ensured that they were not overcrowded as it would then be rendered unproductive. For example, only the critical designers (i.e., those with one hundred percent workload) were situated in the Big Room at a time. The alliance facilitator was tasked with assisting the project team and its members in coaching new employees for the alliance, evaluating the alliance's operations and making proposals for development measures to the AET and APT.

→ The environment in the Big Room sessions during the development phase was such that it was a big facilitator of innovations. An example of an informal mechanism is place was that if anyone came up with an innovative idea, they would definitely not have to execute it. This cancelled out any kind of hesitation or psychological barrier or the burden of seeing the idea through which a team member would have before coming up with an idea. This increased the reporting of good ideas.

→ The reason why the communication of mistakes or errors was so efficient was because there was a system in place which facilitated this behavior. A person admitting to his own mistake and showing that he/she learnt from that mistake and perhaps also has a possible solution is rewarded instead of punished.

→ However, Interviewee 1 felt that communication of progress, targets, daily information should have been more graphic and involving more visuals. It could have been used to do a quick check on where things stood and what the areas of improvement were.

→ Interviewee 3 mentioned that there was an issue of committing resources from the design team because they were working on various projects simultaneously. The senior management of the design team did not communicate this properly at the beginning of the project.

3. Involvement of external stakeholder community

→ There was a high and active involvement of the residents around the tunnel location in the design phase. The doors of the Big Room were open to anyone living in the city of Tampere at all times from Monday to Friday. They were invited to these sessions through social media platforms and other media events. They were constantly kept in loop about what the previous and current progress was.

4. Client Involvement

→ Interviewee 1 mentioned that as a client he was easily approachable and reachable and also appreciated welcoming new ideas and opinions. Even during the construction phase, he practiced remembering the names of the people working on the site and inquired about how people felt about the project. However, he would have preferred to have more mechanisms in place to measure the satisfaction of the project team.

5.Case Study of NEC project in United Kingdom

This chapter discusses the data obtained from the UK case study

5.1Project U1: A46 and Anstey Lane improvement scheme

Context

This 10 million euros project involved increasing lane capacity, widening of two slip roads, improving adjacent pedestrian and cycle routes, installing new traffic signals, street lighting and drainage. The Client of the project was Leicestershire County Council (LCoC) and was designed by the council's in-house engineering services team. Leicestershire City Council (LCC) and Highways England (HE) were among the other funders, making it a complex web of stakeholders. The council awarded the project to Galliford Try (GT) through a two-stage NEC4 Engineering and Construction Contract (ECC) Option C (target contract with activity schedule). The project was under the Medium Schemes Framework (MSF3) acting on behalf of the Midlands Highway Alliance (MHA) which is an alliance of local authority members based in and around the Midlands (which is the central part of England). Galliford Try is one of the member organizations of this Alliance and the governing contract for this particular project was the NEC4 type.

The Early Contractor Involvement (ECI) phase lasted 18 months while the construction phase began in August 2019 and ended in July 2020.

Representatives Interviewed:

Interviewee 1 from Client (A Project Manager with over 10 years of experience)

Interviewee 2 from Contractor (Senior Site Agent with over 5 years of experience)

Below is a summary/key highlights of the collaboration in the project (for detailed description, please refer to Appendix 5)

1. Front-end development

→ Key persons from the contractor were already known to the client, hence there were no workshops during the tender phase to assess the collaborative behavior and capabilities of the contractor. The understanding was based on the relationship built over the years

→ Since this was the first NEC4 contract for the contractor, their bid manager was used to the traditional form of working separately in a non-collaborative manner. But, the client expected the contractor to work collaboratively with them even during the ECI phase to clearly understand the goals and objectives while giving design inputs from a constructability point of view. Interviewee 2 feels that the Client should have made this requirement more explicit at the beginning of the tender phase to align expectations.

→ There was no separate Project Start-Up phase before the beginning of the ECI phase. Joint activities like creating the project charter and the inter-team building event were done towards the end of the ECI phase to set the tone for the construction phase.

2. Team Integration

→ The entire team was integrated as a single unit. There was an atmosphere of openness and no communication hierarchy. Even subcontractors could directly approach the client to talk about project related matters.

→ Selection of subcontractors was a result of joint interviews by client and contractor

→ Recognition was given in terms of appreciation in weekly newsletter sent out to the public, verbal exchanges and email exchanges. These helped boost the morale of the team.

3. Joint Working

→ During the ECI phase, the contractor was co-located in the client's office. The ECI phase had around 10 people from client, contractor, main subcontractor, and other key stakeholders.

→ Extensive workshops were conducted with Leicestershire City Council and Highways England on critical components in the project like traffic management and handing over respectively. The workshops were successful not only technically but also in establishing a relation of trust between the key stakeholders of the client and contractor.

→ Collaborative boards with color-coded post-it notes for each party were used during the weekly meetings to manage progress.

4. Engagement of external stakeholder community

→ A dedicated public liaison officer was appointed by the contractor to engage with stakeholders in the surrounding areas of the project. Joint community events were conducted at a local shopping center nearby to communicate the benefits of the project and answer questions of the public

→ Mendelow's Matrix was used to classify stakeholders based on their importance and level of engagement. A nearby hospital was found to be the most important stakeholder since access to the hospital was critical. Meetings and consultations took place between the project team and hospital representatives.

5. Inter-Team Working

→ Viewpoint was used as a shared folder containing all the updated documents and information useful for the project.

→ Interviewee 1 felt that immediately and honestly communicating problems to everyone in the team was a major success factor in the project. There was no element of surprise.

→ There was also an environment of trust where a change request by the client was immediately executed by the contractor without waiting for an official instruction because they knew the instruction would follow soon.

6. Construction Phase

→ The most striking feature of the construction phase was the presence of an open plan system. It was a dedicated single-storey common space/office area for the entire team including the Client, Contractor, Main subcontractor and other key stakeholders.

→ There were no separate offices for project managers or other personnel of any team, but instead open spaces (with no divisions) where everyone within was free to walk in and talk to a member of another team.

→ This helped in strong communication both on a technical level as well as personal level and also in the induction of new members to the team.

→ There was a feedback monitor (a touch screen) in place where people would just have to tap how happy they were on a scale of 1 to 5 and answer other simple questions to gauge the satisfaction.

→ There was also a healthcare system in place to assess the general well-being of the team. A doctor visited the site once in six months to raise awareness on health issues, talking through difficulties and ways in which stress can be relieved.

6. Comparison of collaboration tools of Bouwteam, Alliance and NEC4

The goal of this chapter is to compare the collaboration tools in Netherlands, Finland and UK (based on the case studies presented in the preceding chapters) with each other and also with literature (discussed in paragraphs in a box under each category explained below) to determine the extent to which it is supported or unsupported by literature.

6.1 Cross case analysis

1. Appointing a collaboration expert in the Pre-Tender Phase

Project B1 appointed a relational contracting expert before the tender phase to help develop the Client's vision on collaboration. The principle was to seek the advice of an expert who could challenge their way of thinking and make scientifically backed decisions instead of assumptions.

Project B2 did not have any such system in place because the team was of the opinion that the complexity and scope of the project did not merit such an extensive process of shaping and detailing collaboration ambitions.

Project F1 adopted a similar approach to that of B1. There was an externally appointed alliance facilitator who participated in the preparation of events related to the procurement such as designing the content of the workshops, their schedule and the selection criteria for the tender phase.

Project U1 is similar to B2 in the sense that it did not avail the use of a collaboration coach or expert during the pre-tender stages.

Although not specific to the pre-tender phases, Allison et al. (2019) recommend having an external consultant/coach to improve the communication among the various internal groups. In their study of success factors in Alliancing Contracts, (Cheung and Rowlingson, 2005) recommended the use of a coach or a psychologist to maintain the team spirit by having informal chats with the team members individually.

2. Assessing collaboration in the Tender Phase

Project B1 used collaboration experts during the tender phase to do individual and team assessments of participating companies. They would help the client assess the collaborative working of participants by an extensive process of conducting workshops, case studies, and dialogues. Details of the assessment criteria and process of selection have been explained in Appendix 2. The same collaboration coaches continued even in the PSU and design phase.

Project B2 did not have an elaborate assessment process. There was no collaboration coach during the tender phase. The assessment of participants was based on the plan of action submitted by them. This had a chapter on collaboration but there were no exercises or workshops to test the collaborative skills. Instead, there was extensive dialogue between the client and contractor to discuss project goals, making client expectations and other critical project-related topics clear. The collaboration coach stepped in during the PSU phase and continued in the design phase.

Project F1 had an alliance facilitator during the tender phase (the same person who was also present during the pre-tender phase) who helped in conducting various workshops with the participants to test skills like problem solving, self-reflection, learning from mistakes, etc. Real project issues, instead of fictitious cases, were given as exercises in these sessions to test the problem solving skills. More about the process can be found in Appendix 4.

Project U1 did not have any collaboration workshops during the tender phase because key representatives of the contractor were priorly known to the Client since they were a part of the Midlands Highway Alliance (more details in Appendix 5). The understanding was based on past relations.

3. **Central Theme of the project in terms of collaboration**

Project B1 was very clear at the beginning that collaboration would be made very explicit through co-developed cultural and structural plans for the Bouwteam. They did not expect the team to be self-motivated but instead created the environment that motivates them. That is why many collaborative instruments were created right at the beginning of the project during the PSU phase (refer to Appendix 2 for more details). The inputs for the instruments came from all the parties and only after it was mutually agreed upon were they finalized into the common plans.

Lavikka et al. (2015) and Lahdenpera (2012) emphasize on the importance of organizational mechanisms (like joint decision-making, workshops, co-location of teams, etc.) to act as a facilitative mechanism in addition to the relational contract itself.

Project B2 was similar to B1 in the fact that they, too, believed in making collaboration very explicit through co-developed plans. The client's implementation plan and contractor's plan of action were combined to form the joint Bouwteam plan.

Project F1 conducted a lot of collaborative assessments in the tender phase and verbally stressed on the importance of collaboration, but there were no common plans developed by the Alliance to list down the collaborative practices that they aimed to follow in the project. A project plan and value for money reports were made to document the practices adopted during the design phase and implementation phase.

Project U1 followed the NEC4 contract which had a clause that encouraged an atmosphere of collaboration, trust, openness, etc. but like F1 they too only verbally stressed on the benefits of collaboration instead of coming up with common plans. The only common document highlighting the team's core values was the project charter (can be found in Appendix 5), and that was developed only at the end of the design phase.

Stressing the importance of teamwork more than anything else, as followed in U1, has been done in many studies. Van Wassenaer (2017) claims that successful projects can only be achieved if all parties involved are willing to work together as a team. Even Lencioni (2002) puts it this way: *"Not finance, not technology. It is teamwork that remains the ultimate competitive advantage, both because it is so powerful and so rare".*

4. **Project Start-Up Phase**

Project B1 had an extensive PSU phase. It lasted around 3 months where the Bouwteam came up with their versions of the common plans, discussed them and amalgamated them into one

common document (details in Appendix 2). This phase was also used to communicate the project goals and objectives clearly and to also get to know each other on a personal level.

The effects of a PSU phase have been documented in literature. Van Wassenaer (2017) explains how a kick-off/PSU/partnering workshop, that is facilitated by a third party coach, will be attended by key personnel of the project team and include team building exercises. The role of the facilitator is to ensure that all the parties get an equal say in critical project matters so that no 'strong voices' dominate and also to check if all parties have understood the project goals or not (Allison et al., 2019).

The PSU in Project B2 was a one-day online event (due to the corona situation) where people were grouped into teams to get to know each other and solve exercises together. Ground rules were established (explained through images in Appendix 3), a broad road map of the project was created and inputs received for creating the Bouwteam plan. Interviewee 3 believed that the design team should have been more integrated in this phase for them to have been more clear on Bouwteam principles and the project objectives.

Allison et al. (2019) observed that many designers who worked in an integrated project environment claim that because of the trust and the collaboration with contractors, it allows them to be more creative.

Project F1 did not have a dedicated PSU but instead called it a kick-off session where the Client communicated the goals and objectives of the project clearly to the alliance and discussed the principles of the alliance.

Project U1 also did not have a PSU. The only team building event which they had (where they played fun games like Escape Rooms to get to know each other) was at the end of the design phase right before entering the construction phase.

5. Meeting Structure

Project B1 had an organization structure that consisted of a core team of which each core member had his/her own specialized team like design, stakeholder management, project control, etc. The strength of the Bouwteam in the design phase was around 60. There were many weekly and monthly meetings (details in Appendix 2) conducted with different groups of teams to discuss various project aspects. Interviewee 2 felt that while the meeting structure in itself was not complex, the amount of people in a meeting were too many. For example, 12 people in the core team meetings should have been reduced to a maximum of 6 to 8 people to have an operational team with sufficient decision-making power. Project B2 (strength of Bouwteam in the design phase was 20) had a similar set up in terms of number of meetings but the interviewees felt that many meetings were redundant since there was an overlap of information. They would have preferred lesser but more productive meetings.

Project F1 had a simpler organization structure. The Alliance Executive Team with the senior management of all organizations and the Alliance Project Team looking after the day to day activities of the project were the two broad groups (strength of alliance in the design phase was 50). Weekly meetings to discuss project issues and progress were conducted in the Big Room in which all the members were co-located. Other workshops and meetings with the various sub-design teams happened on an as-needed basis. Only those people that were needed for meetings would be required to attend.

Project U1 also had a simple organization structure. There were only 20 people in the integrated team during the design/ECI phase. ECI meetings were held weekly to discuss design issues and work plans with subcontractors.

6. Onboarding strategy for new members

Project B1 had a detailed onboarding plan for new members joining the Bouwteam based on joint interviews by client and contractor to assess behavioral and technical competency (details of the selection process mentioned in Appendix 2). This was clearly defined in the Bouwteam plan.

Although Pearce (2007) argues that on-boarding has received relatively less attention in the practitioner world, B1 shows that there are effective onboarding techniques being used in the Netherlands.

Project B2, F1 and U1 did not have such an explicit onboarding strategy. They did conduct interviews of new members jointly with the whole team but it was not mentioned in any common documents developed by the team. It was more like project charters or other forms of communication which summarized the principles of the team which were used to bring the new members on board.

7. Early involvement of subcontractors

Project B1 had decided in the early stages which subcontractors would be used for the project in the construction phase but their involvement in the design phase was minimal.

Project B2 involved one of the main subcontractors in the design phase but the other was not willing to participate in giving design inputs because of the lack of awareness of the Bouwteam contract form and the uncertainty of getting the contract to construct/supply materials.

Project F1 had a high involvement of subcontractors in the design phase to discuss identified critical elements in the design. Rules were created jointly by the Alliance to select subcontractors. They attended the Big Room sessions and gave inputs to develop the design.

Project U1 also had a lot of involvement of subcontractors and were jointly selected by both client and contractor. During the design phase, even program of delivering works was discussed with subcontractors in various workshops.

The importance of contractor-subcontractor relationships is evident in the fact that subcontracting still accounts for 70 to 90% of works in terms of contract value (Hartmann, Caerteling, 2010). The integration of subcontractors is key to achieving any productive collaboration in the supply chain ((Kumaraswamy et al., 2010). Love et al. (2002) has shown evidence of how alliance-type contractual arrangements have helped in collaboratively managing the supply chain. Despite this, Manu et al. (2015) point out that considerable research is still lacking on how to achieve trust-based collaboration in the construction supply chain.

8. Team Integration

All the projects studied observed no apparent boundaries between different companies who formed a part of the integrated team. Every team member was allowed to approach the Client directly to discuss any aspect related to the project without any hesitation. They worked as a single unit to solve project issues and approve designs. For the projects B1 and B2 the corona

situation made it difficult to coordinate online but otherwise the team cohesion was good. Interviewee 3 of B2 felt that the fixed sum compensation for the contractor in the design phase acted as a boundary and sometimes came in the way of achieving complete integration. In F1, the Big Room served as an ideal place for collaboration because all teams were co-located. When simultaneous meetings were happening in different rooms, if the presence of someone was required he/she could drop into the next room for giving his/her inputs and immediately return to doing his/her work. In U1, the contractor's team was co-located with the client in their office building. A separate room was given to the contractors. Interviewee 2, however, felt that since the client office had people from outside the project as well, the contractors were sometimes looked upon as outsiders.

9. Project Follow-up (PFU) sessions

PFU's served as reflection meetings in both B1 and B2 which were conducted once in every quarter and were very effective in maintaining the collaboration within the team. These meetings were facilitated by the collaboration coaches. It served as a health check-up of the project. The process of conducting these meetings is explained in Appendix 2. All team members honestly expressed what they felt about the collaboration in the project and at the end it would be decided as to what the team should keep doing, stop doing and start doing. In B2, the coach stressed on the importance of giving compliments to each other during these meetings as it helped boost the morale of the team. In B1, a questionnaire was circulated to collect information about team satisfaction whereas in B2, a project barometer was used. The responses would be analyzed and feedback sessions would be conducted to check how the collaboration could be improved.

In F1 too, such reflection meetings were conducted on a periodic basis but the ways of collection of data from the team was in the form of simple 'yes' or 'no'. Continual improvement was an important principle in the project. These meetings were also mediated by the alliance facilitator who would check if promises are being kept, if all parties are given equal chances or not and giving comments on whether the teams' collaboration performance improved with respect to the tender phase or not. Feedback sessions were conducted similar to B1 and B2. However, Interviewee 1 felt that there should have been more frequent and tangible measurement of data for level of satisfaction.

Project U1 did not have any reflection meetings during the design phase. The interviewees believed that they did not require meetings because of the open and honest atmosphere where everyone could speak their mind freely. During the construction phase, however, they had a feedback monitor screen placed outside the office where people would answer questions digitally about team satisfaction. These responses were collected and discussed in review meetings.

The feedback sessions conducted in Projects B1, B2 and F1 are similar to the 'plus/delta' technique in which a piece of paper is given to the participants to write a plus side for something which they learnt or which should be repeated because it went well and a delta side for something they are still confused about or should be improved because it did not go well (Houlihan and Click, 2012; Allison et al., 2019).

10. Recognition and Rewards

Due to the corona situation the interviewees of Project B1 said that having such informal schemes for rewards was difficult. Despite this, they felt that there could have been more efforts applied in this area. There was a culture of appreciation for good performance, people were not afraid to admit to mistakes, videos were made by project managers to highlight the good work done by the team in the previous week, etc. but it could have been done more often and in a better way. B2 also did not have many informal mechanisms in place for rewards and recognition for good work, although there was a culture of giving compliments to each other in PFU's.

F1 performed very well in this area. There were many effective informal reward schemes for reporting of good ideas, owning up to mistakes and/or coming up with a solution for it, etc. All these have been explained in detail in Appendix 4. In U1, recognition was given through email, verbal exchanges and special mention for good performance in the newsletter every week. Because of the open plan system (explained in Appendix 5) and mixed seating concept, such things were rarely hidden.

The benefits of recognition and rewards have also been identified in literature. Ganta (2014) observed that acknowledging good work encourages employees to perform better. Employers could recognize workers by tracking progress and providing feedback about how they have improved over time. This, in addition to public recognition (as practiced in U1), conducting friendly competitions, etc. are also stimulating factors that drive productivity (Ganta, 2014).

11. Early involvement of the external stakeholder community

In B1, the professional associations in the areas surrounding the project were actively involved in developing the design. They were not merely informed but even allowed to participate in it. For example, competitions were arranged to paint the outer side of the bridges. A detailed stakeholder engagement diagram was developed by the team to determine the degree of influence. More details on this can be found in Appendix 2. In B2, the communication with external stakeholders was mostly one-way. They were only informed about how the project would affect them through letters, advertisements, short films, etc.

F1 also saw a big involvement of stakeholders. They were invited to their Big Room sessions to share any concerns related to the project. Details of the art competitions held and other ways of engagement of stakeholders is mentioned in Appendix 4. U1 also used a stakeholder engagement matrix known as Mendelow's Matrix to decide the importance of stakeholders and how they should be communicated with. A dedicated public liaison officer was responsible for communicating project progress to the community in the form of newsletters, press conferences, look-ahead programs and photos.

12. Reactions of the team to the culture of trust and no-blame

Trust can be defined as a function of the predictability and expectations of others' behaviors which affects the performance through activation of cooperation (Tyler, 2003). Lumineau (2017) extended this definition by adding an element of distrust to it: *Trust is defined as the willingness of a party to be vulnerable to the actions of another party based on positive expectations regarding other's conduct and distrust in terms of confident negative expectations regarding other's conduct*.

In B1 and B2, initially the team was used to acting in a traditional and more adversarial manner in the face of a problem, especially by blaming others. Interviewees of B2 said that the team had to be constantly reminded that they were working for a single team. The client often reinforced the fact that it is important to take the first step and trust others instead of waiting for them to trust you. But, as and when the concept of the one integrated team became more and more clear to them, they started realizing that by blaming others, they were automatically blaming themselves.

Addressing people's expectations is the key here. Wong (2007) defines a successful project as one which meets people's expectations. He explains that this happens only when their values are respected and they feel that working together as a team will bring success. Studies have also shown the correlation between team engagement and trust. Buvik and Tvedt (2017) found that cross-functional teams depend on trust between them to have efficient collaborative interaction. They also went on to state that trust is a key factor in contributing to project success.

In U1, it was clear from the very beginning that the philosophy of the project is to develop a strong relationship. The ECI phase was used as an opportunity to collaborate and save the client cost through refined designs, even though there was no financial gain for the contractor themselves. A possible reason for this could be that the contractor was an alliance member along with the client in a consortium of organizations known as the Midlands Highway Alliance. Even in F1, this problem was relatively less because the principles of the Alliance were made aware very well in the tender phase of the project itself and there were proper mechanisms in place to motivate the team to work in the best interest of an Alliance.

The reason why an Alliance observed this trend could possibly be due to the fact explained by Chao-Duivis (2012) that the difference between Bouwteam and Alliance is that there is real equality in an alliance because all parties are bound by a single contract lasting right until the project completion. In case of a Bouwteam, the design is developed in collaboration with the contractor who is contractually involved only until the end of the design phase (Chao-Duivis, 2012).

13. Inter-Team working

The communication between the teams in all the projects was open and transparent. If a problem was detected, it was immediately communicated to the rest of the team without trying to hide it. If encountered with a problem, instead of blaming each other efforts were taken to first identify the root cause of the problem. Project B2 had simple communication rules like not write an email before talking about it in person. In F1, a person admitting to his own mistake and showing that he/she learnt from that mistake and perhaps also had a possible solution was rewarded instead of punished. Interviewee 1 of Project U1 considered the attitude of communicating a problem as soon as identified as one of the major success factors for the project. It eliminated the element of surprise.

This was also supported by Van Wassenaer (2017) where he cited an example of how communication norms like 'not to surprise each other nastily' could be developed by having ground rules of 'never writing an email containing bad news before having first talked about it'. The problem of siloing as defined by Pinto (2006) was not observed in these projects. He observed that siloing occurs when people working in a group are unable to act in cross-

functional ways or understand alternate viewpoints. Siloing could also occur when certain departments do not wish to share information with others (Pinto, 2006).

However, not everything went smoothly. All interviewees of B1 said that role definition should have been better at the beginning of the project through more dialogue. The same problem was also noticed in B2. In U1, Interviewee 2 cited the problem that the requirements of co-location from the client were not communicated properly at the start of the project. Thus, they initially had a separate bid manager who was working remotely since he was not used to the NEC4 form of working. Later, it was made more clear that the client wanted the contractor to be co-located with the client.

In F1, the management of the main designer did not communicate the shortage of design resources in the tender phase of the project which led to delays. Interviewees 1 and 3 of B1 felt that in some cases communication was not done to the right person at the right time because of the informal nature of conversations. The same problem was stated by Interviewee 2 of U1.

Bond-Barnard et al. (2014) found that quality communication serves as a foundation for collaboration and trust to thrive in a project. Van Wassenaer (2017) also stressed on that the key to communication is to try to listen to what the other team member is trying to say because it may have the potential to bring improvements to the project.

14. Level of involvement of Client and Senior Management

In B1, the client was actively involved by being a part of the Project Management team and core team. They laid a lot of importance on collaboration because of which they hired an expert before the tender phase to help them develop their vision on collaboration. Interviewee 1 (who was a client representative) made a video blog (i.e., an embedded video with supporting text, images or other metadata) of three to four minutes every week wherein he stressed on the highlights of the previous week and pointed out the good work done by team members. He also performed trend analysis wherein past performance was compared with current performance and potential areas of improvement were discussed with the team. He personally called teams to find out if there was any issue and also would help in coordination between different teams whenever necessary. However, Interviewee 2 believed that the Client should have been more accessible. For example, he thought it was hard to get in touch with any client on Fridays even if the matter was urgent.

In Project B2, the client took a lot of efforts to develop trust within the team. Examples of how trust was developed are mentioned in Appendix 3. Then, contractor was also allowed to participate in making changes to the contract along with the client. This gave the contractor the confidence that their interests were being taken care of.

This particular practice has been validated by Allison et al. (2019) where they highlight that it is important for the integrated team to be able to describe key issues and decisions in the contract jointly by all parties.

Another example was that during the selection of the collaboration coach, despite the time shortage, both client and contractor were allowed to give their suggestions. Even though the client had another person in mind for the role, they went ahead with the contractor's decision. At first, the team was surprised with this way of working and trusting each other. They were used to being more cynical about other parties' motives. These examples made it easy for

people to adapt to the new style of working. During all workshops conducted, first the contractor would discuss the idea with the client, take inputs from them and only then go and develop the idea. There were monthly steering meetings with the senior management of both client and contractor to discuss project issues. But, sometimes the team observed a lack of commitment from the senior management in terms of delayed approvals or trust.

In Project F1, the client was easily approachable and reachable. They were welcome to new ideas and opinions. Even during the construction phase, Interviewee 1 would make an effort to remember names of workmen on the site and try to get to know them on a personal level. During design reviews in the Big Room sessions, a working principle was devised that whoever within the client's team was approving the designs, he/she would have to be present to give early comments and soft approval (or green light signal) to continue to the next stage.

In Project U1, the client insisted on co-location of the main contractor to improve collaboration. Interviewee 2 believed that because the client was so forthcoming and open to new ideas, the entire team was motivated to perform well and have cost savings for the project even if they had no personal financial gain. The senior management of the client was very supportive in most cases. If the project manager of the client was absent, there was always another person who was up to date with the progress of the project who would make important decisions. Other project sponsors who were not involved in the progress of the project were sometimes slow in giving necessary approvals, especially in land ownership and legal matters.

The importance of selecting a client's project manager has also been mentioned in literature. The client's project manager must be chosen with care such that he/she is can facilitate team performance and is mindful of team dynamics and the interests of others (Allison et al., 2019). They also went on to write that many experienced project managers usually adopt the traditional style of command-and-control instead of managing a collaborative enterprise.

For quick reference, the above analysis is summarized in a tabular form in Table 2

Sr. No.	Collaboration Tools	Netherlands (B1)	Netherlands (B2)	Finland (F1)	UK (U1)
1	Collaboration expert in the pre-tender phase	Expert appointed to challenge their thinking and make scientifically-backed decisions	No expert in this phase	Expert appointed to design workshops for the tender phase	No expert in this phase
2	Collaboration in the tender phase	Coach present to test individuals and teams based on collaborative criteria and workshops	No coach present, no workshops conducted. There were extensive dialogues	Similar to B1	No coach present, no collaboration workshops conducted because contractor was known to the client

3	Central theme of project	Collaboration was made very explicit through jointly developed plans	Same as B1	No common plans developed. Importance of collaboration was verbally conveyed. All collaborative practices were documented after design phase was completed	No common plans present, except project charter which was, that too, created at the end of the design phase. Collaboration was verbally emphasized
4	Project Start-Up (PSU)	Extensive PSU of 10 weeks to align goals and objectives of all parties	One-day online event to get to know each other personally and the project goals	No separate PSU session. All goals and objectives were communicated by the client during kick-off meeting	No PSU conducted. The only team building event was at the end of the design phase.
5	Meeting Structure	Many weekly and monthly meetings with separate groups of Bouwteam. Interviewees did not find the set-up complex	Many weekly and monthly meetings with separate groups of Bouwteam. Interviewees found the set-up complex	Weekly meetings and other workshops in a common co-located space called Big Room	Co-location of client and contractor during the design phase. Weekly ECI meetings conducted
6	Onboarding of new members	Detailed onboarding plan based on joint interviews by client and contractor	Not as detailed and explicit as B1, but similar practices followed	Not as detailed and explicit as B1, but similar practices followed	Not as detailed and explicit as B1, but similar practices followed
7	Early involvement of s/c	S/c which would be used were finalized in the early stages but their involvement in the design phase was minimal	Problem of s/c not willing to provide engineering services in design phase because of lack of understanding of Bouwteam	High involvement of s/c during design phase. They were jointly selected by alliance and were also invited to Big Room sessions to give inputs	High involvement of s/c during design phase . They were also involved in making programme of delivery work well in advance of the construction phase

8	Team Integration	No apparent boundaries between different companies. Despite corona situation, the integration was good	No apparent boundaries between different companies. Despite corona situation, the integration was good	No apparent boundaries between different companies.	No apparent boundaries between different companies.
9	Project Follow-Up sessions (PFU)	PFU meetings conducted once in a quarter facilitated by collaboration coaches. Surveys were conducted and feedback discussed after the meeting	PFU meetings conducted once in a quarter facilitated by collaboration coaches. Surveys were conducted and feedback discussed after the meeting	Reflection meetings were conducted every two months in the presence of facilitator. However Interviewee 1 feels that more measurable indices of feedback should have been there	There were no reflection meetings during the design phase. During the construction phase feedback monitors were used to collect information on team satisfaction which would be discussed in meetings later.
10	Recognition and Rewards	There was culture of appreciation of good work but interviewees felt there should have more mechanisms to reward people	There was culture of appreciation of good work but interviewees felt there should have more mechanisms to reward people	There were many effective informal reward schemes for reporting of good ideas, owning up to mistakes and/or coming up with a solution for it, etc.	In U1, recognition was given through email, verbal exchanges and special mention for good performance in the newsletter every week.
11	Early involvement of external stakeholder community	Professional associations in surrounding areas were involved (not many residents). A stakeholder engagement matrix was made.	Communication with them was mostly one-way (informing more than engagement)	Extensive involvement and participation of residents and professional associations. They attended Big Room sessions as well	Dedicated public liaison officer to take care of communications. Mendelow's matrix was used to engage with important stakeholders
12	Team reactions to culture of trust and no-blame	Team was initially used to acting in a more adversarial manner. Gradually the	Team was initially used to acting in a more adversarial manner. Gradually the	The team acted in a unified way from the beginning itself. Proper mechanisms were in place to	It was clear from the very beginning that the philosophy of the project is to develop a strong relationship. The ECI phase was used as an opportunity to

		concept of one-team sunk in	concept of one-team sunk in.	motivate them to work in best interest of the Alliance	collaborate and save the client cost through refined designs, even though there was no financial gain for the contractor themselves
13	Inter-team working	Open and transparent communication. Problem solving was done without blaming each other. Role definition should have been discussed and set-out in a better way	Open and transparent communication. They had simple communication rules like not write an email before talking about it in person. Role definition should have been discussed and set-out in a better way	Open and transparent communication. There was a rule that a person admitting to his own mistake and showing that he/she learnt from that mistake is rewarded instead of punished	Open and transparent communication. Interviewee 1 considered the attitude of communicating a problem as soon as identified as one of the major success factors for the project. It eliminated the element of surprise.
14	Level of Involvement of Client and Senior Management	High client involvement. Interviewee 2 believed client could be more accessible	High client involvement. They took a lot of efforts to develop the trust within a team	High client involvement. They were easily approachable and reachable. They were welcome new ideas and opinions	High client involvement. They were easily approachable and reachable. They were welcome new ideas and opinions

Table 2: Cross-case analysis

6.2 Interpretation of cross-case comparison

From the above analysis, it is clear that Project B1 and Project F1 performed the best in collaboration in the pre-tender and tender phases. The Client invested time and efforts in the pre-tender phase to increase their understanding and expectations of collaboration from participants. In the tender phase, detailed assessments of collaboration were made. Project B2 and Project U1 lagged behind in these aspects. B1 and B2 had one striking feature in common which F1 and U1 project did not have: joint development of collaboration plans was done before the design phase began and this laid the foundation for good collaboration for the rest of the project. F1 and U1 did not consider it necessary to document the tools in the form of such collaboration plans. B1 and B2 also succeeded in ensuring that the needs of the team were constantly being evaluated and problems tackled early on through periodic follow up meetings, something which F1 and U1 did not follow through so extensively.

However, the two Bouwteam projects did fall short on a few aspects: the meeting structure was complex, which either led to redundancy in the number of meetings or overlap of information and subsequent reduced productivity. The concept of co-location was used to great effect in F1 and U1 which rarely led to problems in the structure of meetings. There also should have been

more informal rewards and recognition schemes in B1 and B2 which could have served as an additional morale booster. B1 and B2 should also have integrated and availed the services of critical subcontractors in the development of design to add extra value. F1 and U1 performed quite well in both these aspects. There were some aspects in which all the four projects performed well, such as Team Integration, early involvement of the external stakeholder community, inter-team working and high involvement of client in developing trust within the team.

*From the above arguments, it is evident that the **Bouwteam** projects performed better than the **NEC4** and **Alliance** projects in discussing and agreeing upon collaboration tools in the early phases of the project itself, while at the same time, established a functioning system (in the form of project follow-ups) to periodically inspect if these collaboration tools were useful in achieving desired team member satisfaction or not. The **Alliance** and **NEC4** projects, on the other hand, relied heavily on co-location, honest communication of problems and tacit agreements to sustain the collaboration within the team. This environment of co-location enabled the integration of subcontractors and more informal reward schemes into the team.*

7. Recommendations

In this chapter, recommendations are given to each contract form in the form of the most important collaboration tools which will enhance collaboration.

In the previous chapters, the four projects were analyzed individually and then compared with each other to highlight the collaboration tools which were used in each project and the aspects in which they performed well and not so well in terms of collaboration. Based on the scope for improvement in each project, a set of recommendations in the form of the most important collaboration tools will be proposed in this chapter. The purpose of these recommendations is to enhance the collaboration in the respective contract forms as a whole. The author believes that if these tools are implemented by practitioners in the suggested manner, it will stimulate collaboration in the project.

7.1 Bouwteam contract form

1. **Co-location in Big Room throughout the project**

Co-location occurs when different team members work together in one physical space over an extended period of time. The idea of a Big Room is to have co-located expertise of all parties at all times on important design decisions. The team no longer needs to make phone calls or send emails because all key persons are located in that one room. It should be noted that a Big Room is just a common space. There can also be partitions inside this common space where meeting rooms can be separated from work spaces so that those who are not required to attend the meetings can continue their design work or other works in the separate spaces.

The Bouwteam should make use of this facility to avail the aforementioned benefits. This also helps in maintaining a **simpler meeting structure**. At the same time, it must be ensured that meetings are not overcrowded to the point that it becomes unproductive.

In a Bouwteam environment, the **designers** must not only be a part of the team for their scope of work but should also be explained clearly what the project goals and objectives are, i.e., look at the project from a broader perspective.

2. **Increased involvement of subcontractors in the design phase**

It is important that subcontractors are involved in the design phase. For their selection, **joint interviews** should be conducted by the Client and Main Contractor(s). It is possible that the subcontractors are reluctant to participate in the design phase because of lack of awareness of the benefits of a Bouwteam contract form. In order to maximize collaboration, a **trust-based environment**, where all parties believe their expectations will be met, would need to be created. To develop this trust, it is recommended to make the **subcontractors understand all project goals** and objectives clearly while simultaneously ensuring they understand the integrated contract principles by honestly discussing the incurred costs for their engineering services. Subcontractors should also be **invited to** participate in the **Big Room** sessions where they give their inputs which could help optimize the design, thus integrating them further into the team.

Based on project scope, risks and opportunities, a **subcontractor engagement strategy** should be devised, preferably in the PSU phase to decide the most important parties who should be made a part of the Bouwteam.

3. **Clear definition of roles and responsibilities**

During the early stages of the project, **preferably Project Start-Up (PSU)** phase, it is essential to **discuss and define** clearly what each member of the integrated team is going to do in the project. This becomes especially important in projects where there are **more than one main contractors**, which in turn means having two project managers (or any role for that matter) representing the two parties. A clear distinction needs to be made between two similar roles of different parties. This should also extend to the **other key external stakeholders** of the project.

The recommendations to a Bouwteam contract form are presented in the form of Figure 3 for quick reference.

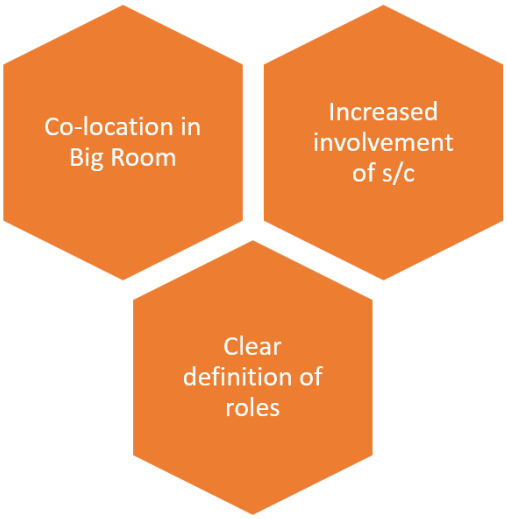

Figure 3: Recommendations to Bouwteam contract form

7.2 Alliance contract form

1. **Trust-building by Clients**

Although Alliance contracts have been implemented for quite some time now, it still might be a new project for a lot of team members. To guide these individuals into getting accustomed to this highly collaborative environment, the **Client is predominantly responsible for establishing an environment of trust** among team members. The Client has to make themselves open and vulnerable to the team to gain their trust. Other parties need to be shown that their opinion matters and that they have the freedom to speak up whenever they deem necessary. It also helps if, during the PSU phase, **parties get to know each other on a personal level**. It is also the responsibility of the senior management of a party to state clearly in these early stages any problems of **staffing or inadequate resources** that may occur in the future. This will help formulate contingency plans to prevent any surprises going ahead.

2. **Making collaboration very explicit through co-developed collaboration plans at the beginning of the design phase**

Based on the tender documents from the Client and the plans submitted by the other parties in the tender phase, **common collaborative plans** should be made together by all the parties. The aim of these plans is to **lay down all the collaborative tools** that will be used for the rest of

the project. These could be in the form of visions of collaboration of each individual party (at least Client and Main Contractors – this can also extend to describing the expected attitude and behavior of team members), the description of the role of one or more collaboration coaches, meeting structure, celebrating successes, etc. For developing these common plans, it is essential to **conduct an extensive PSU phase** before the design phase begins.

3. Use of Questionnaires and Surveys to measure team satisfaction

Conducting periodic reflection meetings is a good practice but it is equally important to be able to **collect sufficient and wholesome data** from the meetings in order to tackle problems related to **team satisfaction**. To enable this data collection, questionnaires and surveys should be developed where every team member would have to rate a statement on a scale from 1 to 5 to indicate their level of satisfaction with the collaboration in the project. The statements can be on lines of the following:

- We are open and honest with each other
- We are working as one team
- I am currently enjoying the project
- We take joint responsibility for the project as a whole
- It is clear what everyone's role and task within the team is

In addition to rating statements, questions like the below ones could also be asked:

- What is going good in the project?
- What can be done better?
- Are the joint project goals clear?
- Do you feel heard?

The recommendations to an Alliance contract form are presented in the form of Figure 4 for quick reference.

Figure 4: Recommendations to Alliance contract form

7.3 NEC4 contract form

1. **Use of a relational contracting expert in the pre-tender phase**

Before inviting bids for the tender phase, it is important that the **Client be very clear** about what exactly they expect from a contractor (or designer) in terms of the collaborative way of working. In order to guide the client in the right direction, **a relational contracting expert should be appointed**. His/her role would be to help the client obtain more clarity on their expectations and requirements of collaboration from the participating organizations. There must be **clear descriptions of all the collaborative behaviors** that are expected of the participating companies. This expert could also help the client design the workshops and other exercises that will be used to assess participants in the tender phase.

2. **Assessing collaboration in the tender phase**

During the tender phase, the participants should be tested for their collaborative skills as part of satisfying the quality criteria. This is essential because it helps in identifying a team that can work collaboratively with other teams in the project. The assessment could be divided into two parts; **Part 1** where the participants should submit documents explaining their vision, core values, important lessons learnt, reflection on collaboration, etc., **Part 2** should have criteria defined to assess the extent to which the behavior and mechanisms of the participant's team that will form a part of the integrated team match the competencies required by the Client. The goal of this part is also to test if the skills mentioned in Part 1 are demonstrable or not through workshops.

3. **Appointing an external collaboration coach for the project**

A collaboration coach not only helps the client in making informed decisions in the tender phase based on the collaborative skills of the participant but also helps in conducting/facilitating regular **'health checks'** in the project in the form of reflection meetings where team members can honestly speak about how they feel about the project.

The recommendations to an Alliance contract form are presented in the form of Figure 5 for quick reference.

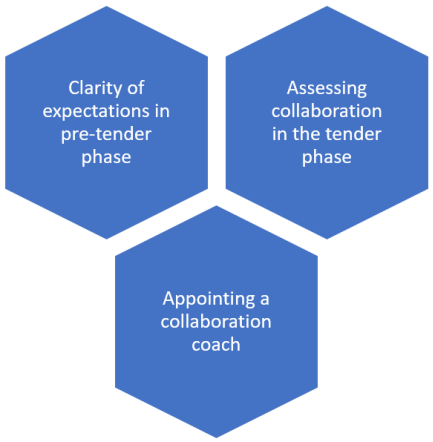

Figure 5: Recommendations to NEC4 contract form

7.4 Summary of the Recommendations

In this section, the set of tools recommended for each contract form, as explained above, have been listed. Against each tool, the color of the legend signifies the contract form from which that particular tool was inspired.

Legend

Bouwteam (Netherlands)

Alliance (Finland)

NEC4 (UK)

Bouwteam

➔ Co-location in Big Room throughout the project

➔ Increased involvement of subcontractors in the design phase

➔ Clear definition of roles and responsibilities

Alliance

➔ Trust-building by Clients

➔ Making collaboration very explicit through co-developed collaboration plans

➔ Use of Questionnaires and Surveys to measure team satisfaction during PFUs

NEC4

➔ Use of a relational contracting expert in the pre-tender phase

➔ Assessing collaboration in the tender phase

➔ Appointing an external collaboration coach for the project

8. Expert Validation

This chapter discusses the comments and suggestions given by experts, specifically on the cross-case analysis and the proposed recommendations.

The goal of these validation interviews was to understand the practicality of the cross-case analysis results and the workability of the proposed recommendations from the perspective of experienced practitioners. Interviews were conducted with three experts, the details of whom can be found in Appendix 7. Expert 1 has been working as an advisor, facilitator and project coach in the Netherlands for 20 years. Expert 2 is an NEC4 accredited Project Manager with more than 20 years of work experience in the UK. Expert 3 is a Contract Manager with more than 15 years of work experience in the Netherlands. Prior to the interviews, a small introduction of the thesis was given to them. After this, a report was sent to them which consisted of Chapter 6 and Chapter 7 of this thesis in addition to the research objective, research questions and a few details of case studies to give context. The interviews lasted around 40-45 minutes each.

8.1 Discussion on cross-case analysis

Expert 1 liked the cross-case analysis overall. She agreed with all the fourteen categories mentioned in it. She pointed out that the cultural aspect of the three countries is missing in the thesis. The author explained that after careful investigation and discussion with committee members, it was concluded that the introduction of culture would deviate from the main goal, i.e., to compare the collaboration tools in different contract forms. It was further added that there is no concrete definition of the term 'collaboration culture' in existing literature and that comparing Hofstede's dimensions for the three countries was not suitable because they revolved around national cultures and not project cultures.

Expert 2 stated that, in his experience as an NEC project manager, the categories 1, 3 and 4 of the cross-case analysis in Chapter 6, i.e., *appointing a collaboration expert in the pre-tender phase, central theme of the project in terms of collaboration* and *project start-up phase* were not indispensable. He believed that if there is an experienced and strong leader in the form of a project manager and clarity of roles and responsibilities among every team member, the above three tools are not required. Having said that, he also clarified that these tools may be useful if the Client leader/Project Manager is not competent enough. About the *early involvement of subcontractors*, he said it depended on the size and complexity of the project. In a big project, the main contractor sometimes starts involving the subcontractors in the ECI phase but in most cases, from his past experience, the main contractor does not know which subcontractors they are going to use until the construction phase. In Project U1, however, this was not the observed practice even though it was termed a small and less complex project by Expert 2. Subcontractors not only gave their design inputs, but also participated in work scheduling for the construction phase in the ECI phase itself. About *Project Follow Up sessions*, he believes that only if something goes wrong, reflection meetings should be conducted, i.e., on an as-needed basis. On the other hand, Project U1 used collaboration monitors in the construction phase to gather data on team satisfaction at regular intervals.

When asked about his comments on the complex meeting structure in Bouwteam projects, Expert 3 stated that it has both advantages and disadvantages. The advantage is that it allows persons from different roles bringing different expertise to be situated in each meeting while the disadvantage is that if a right balance is not found between the number of people to be

invited for the meeting and number of people to be left out, it will lead to problems of information redundancy and reduced productivity. About the *early involvement of subcontractors,* he said that not every subcontractor needs to be involved from the beginning. The team should jointly decide the scope of works that are of the highest importance and then make those particular subcontractors a part of the Bouwteam. He also echoed the significance of having *more informal rewards and recognition schemes* and *increased involvement of external stakeholder community* in Bouwteam projects.

8.2 Discussion on proposed recommendations

Expert 1 found the recommendations given to each contract form sufficiently detailed for practitioners to apply in their projects. She cited c*o-location in a Big Room*, *use of Questionnaires and Surveys to measure team satisfaction* and *assessing collaboration in the tender phase* as examples in which a reader can understand exactly how the tools should be implemented. She suggested to make the definition of a *Big Room* a bit clearer as she thought that it was only one room where meetings were conducted. But, it was explained by the author that it is not one single room but instead denotes a common space in which meeting rooms and work spaces co-exist. The author took this suggestion and refined the explanation of this recommendation to avoid confusion. Expert 3, while agreeing with all the recommendations given, was also particularly fascinated by the concept of a Big Room and thought it was very useful since it really improves the integration between parties.

In response to the recommendations given to the NEC4 contract form by the author, Expert 2 reiterated his stance that if the entire team is made aware and clear about the roles and responsibilities of one another at the beginning of the project, and if the project manager is competent enough to administer the contract, these recommendations may not be necessary. What he has observed over the years is that NEC projects which are run by managers who come from an engineering background encounter problems more often than a project run by someone from a contractual background. He went on to claim that if the team strictly follows the contract, there is no need to talk about collaboration. However, Project U1, which was run by a Project Manager from an engineering background (i.e., Interviewee 1), showed the importance of collaboration in an NEC project. They adopted many collaborative tools such as *honest and immediate communication of problems, open plan system, increased involvement of subcontractors in the design phase,* etc. which were not necessarily a part of the contract but were nevertheless followed because they were found to be beneficial to collaboration. Hence, going by this observation, the author believes that there is scope to implement the recommendations proposed in section 7.3 for an NEC4 contract form, as they have the potential to further improve collaboration. Furthermore, Expert 2 also admitted that his feedback is a result of his personal experience and may differ from the opinion of other practitioners.

8.3 Summary of the chapter

In general, Experts 1 and 3 identified with the tools mentioned in the cross-case analysis and agreed with most of the recommendations given to each contract form. They stated that these recommendations address many of the problems that are currently observed in projects using such integrated contract forms. Expert 2 was of the opinion that in NEC projects, the use of a collaboration coach and other methods of making collaboration more explicit depended on the contract management competence of the Client. At the same time, though, he mentioned that

the recommendations given to an NEC4 contract form may be useful to practitioners who have seen the benefits of these tools in stimulating collaboration. In view of this, and the interviews conducted in Project U1, the author believes that the recommended tools will have a positive effect on collaboration for projects using the NEC4 contract form.

9. Discussion & Conclusion

This chapter first starts with discussions on the process of the research highlighting key elements of it followed by the limitations of this research. Then, a conclusion is drawn by answering the main and sub-research questions. Finally, recommendations for future research are mentioned, and the thesis is brought to a closure by presenting a personal reflection for the readers.

9.1 Key highlights of research & Recommendations for practice

In Chapter 1, the concept of collaboration tools was introduced as a demonstrated solution to the problems faced in complex construction projects with high levels of uncertainty. Analyzing the collaboration tools used in the three contract forms (Bouwteam, Alliance and NEC4) and their uses in their respective countries (Netherlands, Finland and United Kingdom) is the foundation of this thesis. It is based on the concept that merely introducing collaboration and trust in a contract is not sufficient to guarantee effective collaboration between parties. Literature has shown that can only be fulfilled by a good project team and the environment that facilitates collaboration.

The research objective and questions were formulated to reflect the tools which can be used to improve the collaboration in the three contract forms. To establish this, a case study approach was used in which a total of four projects were taken (two Bouwteam, one Finland and one UK). Initially the plan was to study a total of six projects, i.e., two projects for each country. But, due to time constraints it had to be reduced to four.

While performing the cross-case analysis, it was observed that literature supports the findings of this research to a great extent. For example, it advocates the use of a collaboration coach to help sustain the collaboration between different parties, the importance of setting up functional agreements like PSU's, PFU's, etc. at the beginning of the project, onboarding strategy for new members, early involvement of subcontractors, recognition and rewards to encourage collaboration, the necessity for the client to be actively involved in developing team culture and a few others. It was found that in order to improve the collaboration within the team, the Bouwteam projects believed that documenting the tools to be followed for the rest of the project in the early phases itself served as the medium to realize their goal of improving collaboration. The Alliance and NEC4 counted more heavily on the interpersonal skills of the team through co-location and tacit agreements to realize the same goal.

The results of the cross-case analysis showed that there were certain areas of improvement for each contract form in terms of collaboration. The recommendations proposed in Chapter 7 were aimed to target these drawbacks in respective contract forms. However, taking this concept one step ahead and keeping it in line with the ideology of this thesis, a practitioner should examine all the recommended tools before deciding which contract form to adopt in a particular project, i.e., before getting occupied with the legal and structural aspects of a contract form. For the sake of convenience, below is a compilation of the 9 tools which a practitioner should study to decide on the required nature of collaboration, the desired style of team members working together and environment to be created for thriving of collaboration prior to selecting the contract form:

- ➔ Co-location in Big Room throughout the project
- ➔ Increased involvement of subcontractors in the design phase
- ➔ Clear definition of roles and responsibilities

- ➔ Trust-building by Clients
- ➔ Joint creation of co-developed plans
- ➔ Use of questionnaires and surveys to measure team satisfaction
- ➔ Use of a relational contracting expert in the pre-tender phase
- ➔ Assessing collaboration in the tender phase
- ➔ Appointing an external collaboration coach

While it is evident that the tools mentioned above are the same ones which have been recommended to individual contract forms in Chapter 7, it is also worth mentioning that the boundaries between the three contract forms disappear in the above list. This is to stress on the fact that irrespective of the contract form, the above tools can be used by practitioners in any integrated contract form to enhance collaboration. This list also holds value when viewed through the lens of other projects using these contract forms that may not adopt the same collaboration tools as used in the case studies for this thesis.

9.2 Limitations of research

This section discusses the limitations of this research that need to be taken into account while interpreting its findings:

- Most of the recommendations given in Chapter 7 are either only applicable or more effective when applied in ordinary circumstances, i.e., not the current work environment in times of the pandemic. For example, colocation in Big Room, assessing collaboration in the tender phase, etc. cannot be applied while working remotely. Also, recognition and reward schemes, developing common collaboration plans, efforts by client to build an environment of trust, etc. can be applied while working remotely but will not be as effective as normal scenarios.
- This research does not focus on collaboration in the construction phase.
- Due to time constraints, only one project was studied from Finland and UK. The recommendations given to the respective contract forms may have changed slightly based on a pattern observed between two projects.
- Some of the recommendations mentioned in Chapter 7 such as increased involvement of subcontractors in the design phase, efforts by client to build trust, etc. can only be applied if there is a change in the mindset of the parties like Client, Main Contractor and subcontractors. Since these are very subjective phenomena, the implementation of these recommendations may either be immediate or may take longer.

9.3 Conclusion

In this section, a conclusion is presented in the form of answers to sub-research questions and finally the main research question.

SQ1: ***What are the tools which positively influence collaboration?***

Collaboration in construction projects is known to have a positive effect on success by addressing concerns raised by size of projects, number of parties involved and high levels of uncertainty. Therefore, it is important to study in what way collaboration can be improved. In this thesis, the focus was on the tools which are used to positively influence collaboration. The following categories of tools were discussed as findings from literature:

- *Shared Ambition and Joint Objectives*: Having joint objectives serves as a compass for all the participating members. It also helps in overcoming differences in culture and attitude of working.
- *Interests and Mutual Gains*: When a project team is formed, in most cases members are not motivated enough to speak openly about their interests because they do not know each other properly. For this reason, in the initial stages of the project, there should be extensive dialogue between the parties to understand everyone's interests.
- *Relationship Dynamics*: This category relates to the factors which come into play when people work together in teams. Interpersonal skills affect the quality of collaboration. However, the most important aspect of ensuring success of collaboration is building an environment of trust.
- *Process Management*: Working in teams as one unit will only be beneficial as long as there is clarity of what comes next in terms of progress. In addition to this, the advantages of creating a mechanism which incorporates feedback of team members to assess their satisfaction have also been documented.
- *Conflict Resolution*: If a problem cannot be resolved at a level, it has to be escalated to a level where it can be resolved. For this, the use of issue resolution ladders have been suggested.
- *Support from higher management*: Managing the relational attitudes between the senior management of all parties is not only necessary to manage the collaboration within the project but is also important to establish long-term relationships between the parties.

SQ2: *What are the collaboration tools used in the Bouwteam contract form in the Netherlands?*

Two Bouwteam projects were studied in this thesis: Project B1 (Oranje Loper) and Project B2 (Michiel de Ruijtertunnel). Below were the collaboration tools used in these two projects:

- Use of a coach to guide the team on collaboration – B1 and B2
- Use of a relational contracting expert in the pre-tender phase – B1
- Co-creation of collaboration plans in the early phases of the project – B1 and B2
- Periodic Project Follow-Ups (PFU's) with the use of questionnaires and surveys to assess team satisfaction – B1 and B2
- Trust building by Clients – B1 and B2
- Detailed assessment of collaboration in the tender phase – B1
- Use of an engagement diagram for external stakeholders – B1
- Detailed onboarding plan – B1 and B2
- Open and honest communication – B1 and B2

SQ3: *What are the collaboration tools used in Alliance contract form in Finland and NEC contract form in United Kingdom?*

One project each was studied from Finland and UK: Project F1 (Tampere Rantatunneli) and Project U1 (A46 and Anstey Lane improvement). Below were the collaboration tools used in the two projects:

Finland (Alliance)

- Co-location in Big Room to facilitate transparency and fast flow of information
- Use of a relational contracting expert in the pre-tender phase
- Use of a coach to guide the team on collaboration
- Periodic reflection meetings conducted
- Clear Meeting structure
- High involvement of subcontractors and external stakeholders in the design phase
- Informal reward schemes to increase the reporting of good ideas
- Pro-activeness of Client in design development
- Open and honest communication

United Kingdom (NEC4)

- Honest and immediate communication of a problem within the team
- Pro-activeness of main contractor to engage with key stakeholders
- High involvement of subcontractors in the design phase
- High use of dashboards to measure progress
- Open plan system in the construction phase with mixed seating of all parties
- Periodic reflection meetings and assessments during construction phase
- Recognition given through verbal exchanges, email and special mention in newsletter

SQ4: ***What are the differences in the collaboration tools between these integrated contract forms of Netherlands, Finland and UK?***

In terms of collaboration, the four projects which represent the three contract forms are similar to each other in some ways but differ from each other in many ways. The Bouwteam projects clearly performed better when it came to making collaboration explicit in the form of jointly developed collaboration plans in the early phases of the project. These plans were used as guiding documents which dictated the interaction between its team members for the rest of the project. The Alliance and NEC4 projects, however, did not create such collaboration plans, but instead relied on co-location, honest communication of problems and tacit agreements to enhance collaboration. Periodic follow-up meetings to reflect on the collaborative behavior of all team members coupled with extensive questionnaires and surveys to analyze all the information was another hallmark of the two Bouwteam projects, something which the Alliance and NEC4 project did adopt but not in such a substantial manner.

The drawbacks observed in the two Bouwteam projects studied were the complex meeting structure, which sometimes caused information redundancy, dearth of informal reward mechanisms and less integration of subcontractors in the design phase. The Alliance and NEC4 projects performed better in all these aspects. The aspects in which all the projects performed well were involvement of external stakeholders, inter-team working and efforts by client to develop trust within the team.

Main Research Question: ***"Are there any collaboration tools followed in the integrated contract forms of Netherlands, Finland and UK which can be adapted to each other to improve the collaboration?"***

Yes, there are collaboration tools which can be adapted to the integrated contract forms studied in this thesis to improve the collaboration. These recommended tools arise out of the drawbacks which have been observed in the case studies. The three most important collaboration tools which have the potential to enhance collaboration in the respective contract forms are:

A. Bouwteam

- Co-location in Big Room throughout the project
- Increased involvement of subcontractors in the design phase
- Clear definition of roles and responsibilities

B. Alliance

- Trust-building by clients
- Joint creation of collaboration plans
- Use of questionnaires and surveys to measure team satisfaction

C. NEC4

- Use of a relational contracting expert in the pre-tender phase
- Assessing collaboration in the tender phase
- Appointing an external collaboration coach for the project

Despite having categorized the recommendations into the respective contract forms, the author believes that a practitioner should examine the consolidated list of the above 9 collaboration tools while conceptualizing a project of any integrated contract form, before getting into the nitty gritty of the legal aspects of the contract. This examination enables the practitioner to decide in advance the nature of collaboration and the type of environment to be created for enhancing collaboration.

9.4 Recommendations for further research

Due to the broad spectrum of topics covered under collaboration and the fact that there are more types of contract forms used in different ways in other countries, the recommendations for further research are as follows:

- As mentioned in section 9.2, this thesis is restricted to the study of collaboration till the end of the design phase. However, it is recommended to delve into the construction phase as well to measure the extent to which the collaboration tools developed in the design phase remain effective and applicable. In addition, new collaboration tools used specifically in the construction phase could be identified, which when integrated with the findings of this research could serve as a set of tools to guide project managers throughout the life cycle of the project.
- There are other countries such as Australia and Hong Kong where Alliance and NEC contract forms have been used extensively over the past few years. It is recommended to study the collaboration even in these countries which could lead to more improvements to the contract forms as a whole.
- When selecting the interviewees for a case study, it is recommended to not only select Project Managers and individuals in other senior positions, but instead also seek the opinion of Assistant Project Managers and Senior Engineers, for example. Given the

exploratory nature of these interviews, it is necessary to get a broader and more comprehensive perspective on the subject of collaboration.

- The goal of this thesis is to recommend collaboration tools which can improve the contract forms. It could also be interesting to compare the cultural differences between the three countries and to check if these recommendations can actually be implemented in the suggested way or there would be any modifications to suit the culture.

9.5 Personal Reflection

Before coming to TU Delft I worked for around three and a half years on a hotel construction project in Muscat. Even though my main responsibility was that of a scheduler, I took active participation in Contracts Management. I developed a skill for drafting contractual letters, interpreting various clauses and taking into account the interests of many parties at the same time. But, I wasn't fully satisfied with the adversarial nature of interaction between the involved parties. This was one of the main reasons I decided to pursue a masters: to research methods in which collaboration could be improved.

I consider myself extremely fortunate that the perfect opportunity to work on collaboration in international contracts came my way, thanks to my first supervisor, Leon Hombergen and my company supervisor, Joost Merema. From the beginning, the intention was to finish my thesis by May 2021. Given the average time of six to seven months required for a thesis, I planned the completion of my internship prior to that accordingly. What I enjoyed the most in this journey is having insightful conversations with Project Managers and other practitioners from the three countries. It was fascinating to study the ways in which people interact with each other in these different contract forms. I also connected with the author of the RECAP tool, Suprapto, to have a deeper understanding of his motivations behind developing the tool, which in turn would help me apply it in a more efficient manner. I believe my work experience as a Planner enabled me to work in a more systematic way by trying not to deviate from the schedule as much as possible. I also observed that my communication skills had gradually started improving. More than anything else, though, this thesis corroborated my desire to continue working in the field of collaboration within integrated contracts.

However, not everything went smoothly. Like almost every person's work in the world, even my thesis was affected by the pandemic. The response time to emails was very high in some cases, which caused delays in conducting interviews and as a result would occasionally make me apprehensive about meeting deadlines. The convenience of virtual meetings notwithstanding, it would have been an additional enriching experience to attend team meetings in person and get a firsthand perspective on collaboration, at least for the two Bouwteam projects I studied. Also, I would have been more satisfied had I studied one more project each from Finland and UK, but due to time constraints that did not materialize. However, the biggest challenge I faced was during data collection and analysis phases of my thesis. Since I was dealing with volumes of subjective data, there was a constant tension in my head caused by the uncertainty about the soundness of the results I was arriving at and the fear of having to redo weeks of hard work in case it was not accepted.

This, in fact, is my biggest learning. Going forward in my professional career, I would strive to be more assured about the work I do without repeatedly getting worked up about the

outcome. Afterall, I am a strong advocate of the principle that any endeavor in life is not as much about the end result as it is about the process of reaching there.

References

Aaltonen, K., 2011. Project stakeholder analysis as an environmental interpretation process. Int. J. Proj. Manag. 29, 165–183.

Allison, M., Ashcraft, H., Cheng, R., Klawans, S., and Pease, J. (2019). INTEGRATED PROJECT DELIVERY: An Action Guide for Leaders. In IPD Advisory Council workshop. Washington.

Bayliss, R., Cheung, S., Suen, H. and Wong, S.-P. (2004) Effective Partnering Tools in Construction: A Case Study on MTRC TKE Contract in Hong Kong. International Journal of Project Management, 22 (3), 253-263.

Bell, J., Kaats, E., and Opheij, W. (2013). Bridging disciplines in alliances and networks: in search for solutions for the managerial relevance gap. International Journal Of Strategic Business Alliances, 3(1), 50. doi: 10.1504/ijsba.2013.058297.

Boes, H., and Dorée, A. (2013). Public Procurement At Local Level in the Netherlands: Towards a Better Client- Contractor Collaboration in a Competitive Environment. In Proceedings of the 29th Annual ARCOM Conference (pp. 717–727).

Bond-Barnard, T.J., Steyn, H. and Fletcher, L. (2014), "The specification of a structural equation (SEM) model for project communication, trust, collaboration and success", 28th IPMA World Congress, Elsevier International of Rotterdam, pp. 1-15.

Bond-Barnard, T., Fletcher, L., and Steyn, H. (2018). Linking trust and collaboration in project teams to project management success. International Journal Of Managing Projects In Business, 11(2), 432-457. doi: 10.1108/ijmpb-06-2017-0068.

Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. Qualitative research in psychology, 3(2), 77-101.

Bruggeman, E. M., Chao-Duivis, M. A. B., and Koning, A. (2010). A Practical Guide to Dutch Building Contracts. Den Haag: Instituut voor bouwrecht. Den Haag: Instituut voor Bouwrecht. – difference between Alliance and Bouwteam

Buvik, M. and Tvedt, S.D. (2017), "The influence of project commitment and team commitment on the relationship between trust and knowledge sharing in project teams", Project Management Journal, Vol. 48 No. 2, pp. 5-21.

Chao-Duivis, M. (2012). Het bouwteam model. Den Haag: IBR, Stichting Instituut voor Bouwrecht.

Cheung, Y.K.F. and Rowlingson, S. (2005) Success factors in an alliancing contract : a case study in Australia. The Queensland University of Technology (QUT) Research Week International Conference, July, Queensland, Australia.

Cuppen, E., Bosch-Rekveldt, M., Pikaar, E., and Mehos, D. (2016). Stakeholder engagement in large-scale energy infrastructure projects: Revealing perspectives using Q methodology. International Journal Of Project Management, 34(7), 1347-1359. doi: 10.1016/j.ijproman.2016.01.003.

Das, T.K. and Teng, B. (2001) Trust, Control, and Risk in Strategic Alliances: An Integrated Framework. Organization Studies, 22(2), 251-283.

Department of Infrastructure and Regional Development, Australian Government (2015) – National Alliance Contracting Guidelines: Guidance Note 6, Early Contractor Involvement and other Collaborative Procurement Models.

Dietrich, P., Economics, B., Eskerod, P., Dalcher, D. and Sandhawalia, B. (2010), "The role of project collaboration quality and knowledge integration capability in multipartner projects", PMI Research and Education Conference, PA, pp. 1-38.

Division of Construction, California Department of Transportation (2015) - Field Guide to Partnering on Caltrans Construction Projects.

Douma, M.U., Bilderbeek, J., Idenburg, P.J. and Looise, J.K. (2000) 'Strategic alliances – managing the dynamics of fit', Long Range Planning, Vol. 33, No. 4, pp.579–598.

Eadie, R., and Graham, M. (2014). Analysing the advantages of early contractor involvement. International Journal Of Procurement Management, 7(6), 661. doi: 10.1504/ijpm.2014.064971.

Eadie, R., Millar, P., McKeown, C. and Ferguson, M. (2012b) 'The feasibility and rationale for using early contractor involvement ECI in Northern Ireland', Proceedings of 7th International Conference on Innovation in Architecture, Engineering and Construction (AEC), Sao Paulo, Brazil, Escola Politecnica, University of Sao Paulo Brazil.

Edwards, R. (2008) Early Contractor Involvement (ECI) Contracts in the South Australia Transport Infrastructure Construction Industry.

Eggleston, B. (2019). The NEC4 Engineering and Construction Contract: A Commentary (3rd ed.). John Wiley and Sons Ltd.

Eriksson, P. E. (2008) Procurement Effects on Coopetition in Client-Contractor Relationships. Journal of Construction Engineering and Management, 134 (2), 103-111.

Eriksson, P.E., Leentje, V., Anna, K., Sofia, L., Johan, L. and Lilly, R., (2019), "Collaborative procurement strategies for infrastructure projects: a multiple-case study", Proceedings of the Institution of Civil Engineers - Management, Procurement and Law, Vol. 172 No. 5, pp. 197-205.

Faems, D., Janssens, M., Madhok,, A. and Van Looy, B. (2008) Toward an Integrative Perspective on Alliance Governance: Connecting Contract Design, Trust Dynamics, and Contract Application. Academy of Management Journal, 51(6), 1053-1078.

Faris, H., Gaterell, M., and Hutchinson, D. (2019). Investigating underlying factors of collaboration for construction projects in emerging economies using exploratory factor analysis. International Journal Of Construction Management, 1-13. doi: 10.1080/15623599.2019.1635758.

Ganta, V. (2014). Motivation in the workplace to improve employer performance. International Journal Of Engineering Technology, Management And Applied Sciences, 2(6).

Gardner, I. (2015). *Achieving successful construction projects*. Routledge.

Greenwood, D., and Wu, S. (2012). Establishing the association between collaborative working and construction project performance based on client and contractor perceptions. Construction Management And Economics, 30(4), 299-308. doi: 10.1080/01446193.2012.666801.

Hartmann, A., Caerteling, J., 2010. Subcontractor procurement in construction: the interplay of price and trust. Supply Chain Manag. Int. J. 15, 354–362.

Hayford, O. (2018). Collaborative Contracting. Pricewaterhousecoopers.

Heravi, A., Coffey, V., Trigunarsyah, B., 2015. Evaluating the level of stakeholder involvement during the project planning processes of building projects. Int. J. Proj. Manag. 33, 985–997.

Hoeve, G. ten (2018) . Improving collaboration between client and contractor in integrated contracts in the Dutch construction sector (MSc.). Delft University of Technology.

Hoog, J. de (2020). Client-contractor collaboration in bouwteams: A contractor's perspective (MSc.). Delft University of Technology.

Houlihan, M., and Click, A. (2012). Teaching Literacy: Methods for Studying and Improving Library Instruction. *Evidence Based Library And Information Practice*, *7*(4).

Jefferies, M., Brewer, G. and Gajendran, T. (2014) Using a case study approach to identify critical success factors for alliance contracting. Engineering Construction and Architectural Management, 21(5), 465-480.

Kahane, A. (2010) Power and Love: A Theory and Practice of Social Change, Berret-Koehler, San Francisco, CA.

Kamminga, P. (2015). Rethinking contract design: Why incorporating non-legal drivers of contractual behavior in contracts may lead to better results in complex defense systems procurement. Journal Of Public Procurement, 15(2), 208-235. doi: 10.1108/jopp-15-02-2015-b004.

Koppenjan, J., Veeneman, W., Van der Voort, H., Ten Heuvelhof, E., Leijten, M., 2011. Competing management approaches in large engineering projects: the Dutch RandstadRail project. Int. J. Proj. Manag. 29, 740–750.

Kumaraswamy, M., Anvuur, A., Smyth, H., 2010. Pursuing "relational integration" and "overall value" through "RIVANS". Facilities 28, 673–686.

Lahdenperä, P. (2007), "Innovaatioita edistämässä. Lähtökohtia ja ajatuksia rakennus- ja infra-alan hankintamallien kehittämiseen" ["Fostering innovation. Views and ideas on the development of building and infrastructure construction procurement"], VTT Working Papers 87, Technical Research Centre of Finland (VTT), Espoo. (in Finnish).

Lahdenperä, P. (2012) "Making sense of the multi-party contractual arrangements of project partnering, project alliancing and integrated project delivery", Construction Management and Economics, 30(1): 57–79. - organizational mechanisms.

Lavikka, R., Smeds, R. and Jaatinen, M. (2015) "Coordinating collaboration in contractually different complex construction projects", Supply Chain Management: An International Journal, 20(2): 205-217 – organizational mechanisms.

Lee, Y. and Cavusgil, S. T. (2006) Enhancing Alliance Performance: The Effects of Contractual-Based Versus Relational-Based Governance. Journal of Business Research, 59, 896-905.

Lencioni, P. (2002). *The five dysfunctions of a team*. San Francisco, Calif.

Lenderink, B., Halman, J., Boes, H. and Voordijk, H. (2020), "A method to encourage and assess innovations in public tenders for infrastructure and construction projects", Construction Innovation.

Leung, K. and White, S. (2006) 'Exploring dark corners: an agenda for organizational behavior research in alliance contexts', in Shenkar, O. and Reuer, J. (Eds.): Handbook of Strategic Alliances, Sage Publications, Thousand Oaks, CA.

Limbergen, K. van (2020) . Assessing collaborative behavior as partner selection mechanism (MSc.). Delft University of Technology.

Lloyd-walker, B., Mills, A., and Walker, D. (2014). Enabling construction innovation: the role of a no-blame culture as a collaboration behavioural driver in project alliances. Construction Management And Economics, 32(3), 229-245. doi: 10.1080/01446193.2014.892629.

Löfgren, P. and Eriksson, P.E. (2009) Effects of collaboration in projects on construction project performance. In: Dainty, A. (Ed) Procs 25th Annual ARCOM Conference, 7-9 September 2009, Nottingham, UK, Association of Researchers in Construction Management, 595-604.

Love, P.E., Irani, Z., Cheng, E., Li, H., 2002. A model for supporting interorganizational relations in the supply chain. Eng. Constr. Archit. Manag. 9, 2–15. Love, P.E., Li, H., 2.

Love, P.E.D, Mistry, D. and Davis, P.R. (2010) Price Competitive Alliance Projects: Identification of Success Factors for Public Clients. Journal of Construction Engineering and Management, September 2010, 947-956.

Lumineau, F. (2017). How contracts influence trust and distrust. Journal of Management, 43(5), 1553–1577.

Lunnan, R., Ness, H. and Mercer Traavik, L.E. (2011) 'Alliance formation: the impact of teams and individuals in initial negotiations', International Journal of Strategic Business Alliances, Vol. 2, No. 4, pp.271–286.

Manu, E., Ankrah, N., Chinyio, E. and Proverbs, D. (2015), "Trust influencing factors in main contractor and subcontractor relationships during projects", International Journal of Project Management, Vol. 33 No. 7, pp. 1495-1508, doi: 10.1016/j.ijproman.2015.06.006.

McDonald, M. and Crawford, K. (2010) 'Rail duplication and construction: New Lynn Rail Trench', Proceedings of CORE 2010: Rail, Rejuvenation and Renaissance, pp.637–646, Engineers Australia, Wellington, N.Z.

Mills, A., and Davis, P. (2016). Identifying Cultures in Construction Project Alliances. Pacific Association Of Quantity Surveyors (PAQS).

Nader, A. (2019). Success factors to the client-contractor collaboration in the Dutch infrastructure sector (MSc.). Delft University of Technology.

Naoum, S. (2003) An Overview into the Concept of Partnering. International Journal of Project Management, 21 (1), 71-76.

Nichols, M. (2007) Review of Highways Agency's Major Roads Programme, Report to Secretary of State for Transport, The Nichols Group, London.

ku, C. (2007). The future of leadership development: The importance of identity, multi-level approaches, self-leadership, physical fitness, shared leadership, networking, creativity, emotions, spirituality and on-boarding processes. Human Resource Management Review, 17(4), 355-359. doi: 10.1016/j.hrmr.2007.08.006.

Peckett, V., Hallam, C., Worthington, C., and Fordham, R. (2017). NEC4: A closer look at the changes in the ECC. CMS Law. CMS Law.

Pinto, J. (2006). Project management: Achieving Competitive Advantage. Upper Saddle River, N.J.: Pearson Education.

Rahman, S., Endut, I., Faisol, N., and Paydar, S. (2014). The Importance of Collaboration in Construction Industry from Contractors' Perspectives. Procedia - Social And Behavioral Sciences, 129, 414-421. doi: 10.1016/j.sbspro.2014.03.695.

Rahmani, F., Khalfan, M., and Maqsood, T. (2013). The use of early contractor involvement in different countries. 38Th AUBEA Conference.

Rowlinson, M. (2015). Practical Guide to the NEC3 Engineering and Construction Contract: Wiley. – NEC3.

Riggelen, R. van (2019). Bouwteam; for more collaboration in the construction industry (MSc.). Delft University of Technology.

Saad, I. H. (2000). "The project reporter multimedia progress reporting for construction projects." American Society of Civil Engineers, Construction Congress VI, 1165–1176.

Shelbourn, M., Bouchlaghem, N., Anumba, C., and Carrillo, P. (2007). Planning and implementation of effective collaboration in construction projects. Construction Innovation, 7(4), 357-377. doi: 10.1108/14714170710780101.

Spruijt, C. J. (2016). Improving the use of traffic models in transport and infrastructure planning: Identification of problem issues and explorative research on possible improvements.

Stam, R. (2016) . Relationship Contracting Arrangementrs (MSc.). Delft University of Technology.

Suprapto, M. (2016). Collaborative contracting in projects (Ph. D). Delft University of Technology.

Tyler, T.R. (2003), "Trust within organisations", Personnel Review, Vol. 32 No. 5, pp. 556-568, doi: 10.1108/00483480310488333.

Wassenaer, A. van (2017). A Practical Guide to Successful Construction Projects. Informa Law From Routledge.

Walker D. H. T. and Lloyd-Walker B. M. Project Procurement Arrangements. Newtown Square: Project Management Institute, Inc., 2015.

Wondimu, P., Hailemichael, E., Hosseini, A., Lohne, J., Torp, O., and Lædre, O. (2016). Success Factors for Early Contractor Involvement (ECI) in Public Infrastructure Projects. Energy Procedia, 96, 845-854. doi: 10.1016/j.egypro.2016.09.146.

Wong, Z. (2007). Human factors in project management. San Francisco, Calif.: Jossey-Bass.

Wu, G., Zuo, J. and Zhao, X., 2017. "Incentive Model Based on Cooperative Relationship in Sustainable Construction Projects," Sustainability, MDPI, Open Access Journal, vol. 9(7), pages 1-20, July.

Yin, R. K. (2009). Study Research; Design and Methods.

Zuo, J. and Ma, T. (2005) Project Culture – A Move Towards Trust. The Queensland University of Technology (QUT) Research Week International Conference, 4-5 July 2005.

Appendices

Appendix 1: RECAP Tool (Relational Capability)

1a. Original RECAP Tool

A. Front-end definition and collaborative practices

This section examines the extent of how well the *front-end definition* is actually understood/ comprehended by the project teams and how well *collaborative practices* are actually being implemented in the current project. Collaborative practices are additional practices used to enhance the collaboration between parties (owner and contractor) and their project teams.

The words "**both teams**" and "**we**" refer to the owner and the contractor teams. Please mark "X" on the associated rating column, where: **1** = Very Poor, **2** = Poor, **3** = Moderate, **4** = Good, **5** = Very Good, **NA** = not applicable, **DK** = Do not know.

Sub Criteria / Indicators	1	2	3	4	5	NA	DK
1. Front-end definition							
a. The project goals, objectives, and scope are understood by the contractor team.							
b. The project goals, objectives, and scope are understood by the owner team.							
c. All functional/ high level technical requirements (*basic design*) are reviewed together by both teams.							
d. The *project execution plan* is reviewed together by both teams and adjusted accordingly if needed.							
e. There are clear *roles and responsibilities* assigned to both teams.							
2. Team integration							
f. We form an *integrated project team* (IPT) where the owner and the contractor teams are structured and integrated as a single team with no apparent boundaries.							
g. We perform *goal setting and alignment meetings* with sub-contractors and suppliers.							
h. We perform *goal setting and alignment meetings* with the owner's business and operation representatives.							
i. We exercise *inter-team building* workshops to encourage collaboration via fun and excitement.							

j. We have *recognition and rewards program* to stimulate individual and team levels collaborative behavior.							
3. Joint working processes							
k. We jointly conduct *planning*.							
l. We jointly perform *monitoring, controlling*, and *reporting*.							
m. We jointly conduct *issue management*.							
n. We jointly *define* and *monitor* the achievement of key *performance* areas.							
o. We jointly *identify and monitor risks* and formulate a necessary *mitigation plan*.							
p. We have robust *mechanisms to resolve conflicts/disputes*.							
q. We have formal *procedures for joint decision making*.							

B. Project performance and Relationship continuity

This section is concerned with the perceived current achievement of the collaboration output, the project performance. The assessment aspects include measures of efficiency, quality of output, and satisfaction, and potential continuity of the relationship in future.

Please rate the following statements reflecting the current achievement or progress of the project so far. Please mark "X" on the associated rating column, where: **1** = Very Poor, **2** = Poor, **3** = Moderate, **4** = Good, **5** = Very Good, **NA** = not applicable, **DK** = Do not know.

Sub Criteria / Indicators	1	2	3	4	5	NA	DK
4. Efficiency							
a. The project is progressing in accordance with the estimated cost so far.							
b. The project is progressing in accordance with the planned schedule so far.							
5. Quality							
c. So far, there are no significant reworks due to major defects regarding the project deliverables.							
d. So far, all project activities are performed or completed safely with no accidents causing severe injury.							
e. So far, the facility or product constructed is taken into operation reliably without major problems.							
f. So far, the facility or product constructed is functioning according to the specified capacity.							
6. Satisfaction							
g. Both owner and contractor are satisfied with the project results and outcomes so far.							
h. So far, this project will make a positive impact on the owner's business.							
i. So far, this project will be a (commercial) success to the contractor.							

Please mark "X" on the associated rating column, where: **1** = Unlikely, **2** = Slightly likely, **3** = Moderately likely, **4** = Highly likely, **5** = Completely likely, **NA** = not applicable, **DK** = Do not know.

Sub Criteria / Indicators	1	2	3	4	5	NA	DK
7. Relationship continuity							
j. Beyond this project, we will likely work with each other in future with the same partners.							
k. The relationship experience we gain so far will be useful in future project(s) even with different partners.							
l. Because of collaboration in this project, we gain benefits that enable us to compete more competitively.							
m. This collaborative relationship makes our companies' able to develop unique capabilities (truly innovative products/solutions).							

C. Relational attitudes

This section is concerned with how well the senior management of both parties (the owner and the contractor) commits to support the collaboration, taking into account the degree of trust and interactional norms to bring together the necessary resources into a project.

The words "**senior management**" refers to high level managers or executives representing a company with the authority to make a final decision about a project. Please mark "X" on the associated rating column, where: **1** = Very Poor, **2** = Poor, **3** = Moderate, **4** = Good, **5** = Very Good, **NA** = not applicable, **DK** = Do not know.

Sub Criteria / Indicators	1	2	3	4	5	NA	DK
8. Senior management commitment							
a. Senior management of the owner commits to provide necessary resources and support to the project teams.							
b. Senior management of the contractor commits to provide necessary resources and support to the project teams.							
c. Senior management of the owner shows consistent and passionate leadership.							
d. Senior management of the contractor shows consistent and passionate leadership.							
e. Senior management of both parties actively work together to resolve potential conflicts when needed.							
9. Senior management trust							
f. There is an atmosphere of mutual trust between senior management of both parties.							
g. There is a mutual enthusiasm from senior management of both parties in achieving the project goals.							
h. Senior management of both parties has confidence in each other to do what is right.							
i. Senior management of both parties keeps their promises truthfully.							

10. Established relational norms							
j. The owner intentionally adopts 'no blame culture' when problems arise.							
k. The contractor intentionally adopts 'no blame culture' when problems arise.							
l. The owner is intentionally open and honest in any interactions with no hidden agendas.							
m. The contractor is intentionally open and honest in any interactions with no hidden agendas.							
n. The owner strives for business outcomes whereby both parties either win or both parties lose.							
o. The contractor strives for business outcomes whereby both parties either win or both parties lose.							
p. Both parties agree to have an equal say in any critical decisions that matter to both parties.							

D. Inter-teamworking

This section is intended to assess how the owner's team and the contractor's team work together in a project across their company's boundaries. Inter-teamworking reflects how two collaborating teams communicate with each other effectively, achieve synergies in coordinating interdependent activities, equally contribute their specific knowledge and expertise, align their effort, help each other in achieving project goals, behave as one team, and personally trust each other. The words "**both teams**" and "**the teams**" refer to the owner's core team and the contractor's core team. Either team can be represented by at least one person (team leader or manager or representative). Imagine the interaction between these two teams when you rate the following statements.

Please mark "X" on the associated rating column, where: **1** = Very Poor, **2** = Poor, **3** = Moderate, **4** = Good, **5** = Very Good, **NA** = not applicable, **DK** = Do not know.

Sub Criteria / Indicators	1	2	3	4	5	NA	DK
11. Communication							
a. Both teams communicate directly with each other.							
b. Project-relevant information is shared openly by both teams.							
c. Whenever a problem is detected, it is immediately and honestly communicated to the other team.							
d. Both teams are satisfied with the usefulness of the information shared by other team.							
12. Coordination							
e. The work done in the teams is closely synchronized between the teams.							
f. There is a clear linkage between the teams for their interdependent tasks.							
g. There is no redundancy regarding the work done between both teams.							

13. Balanced contribution							
h. Both teams recognize the specific strengths and weaknesses of each team's competences.							
i. Both teams are contributing their knowledge/ expertise in accordance with their full potential.							
j. There is a balanced contribution of ideas between the teams.							
14. Mutual support							
k. Both teams help each other as well as they could.							
l. Whenever problems occurred, they are resolved constructively.							
m. Every critical decision is made together by both teams.							
15. Aligned effort							
n. Both teams give this project the priority it needs.							
o. Both teams put their best effort into this project.							
p. There is no conflict regarding the effort that each team put into this project.							

Sub Criteria / Indicators	**1**	**2**	**3**	**4**	**5**	**NA**	**DK**
16. Cohesion							
q. Members of both teams are personally engaged to this project.							
r. Members of both teams are integrated as one team.							
s. Members of both teams feel proud to be part of the project team.							
t. Members of both teams feel responsible for maintaining the relationships within the project team.							
17. Affective trust							
u. Both teams are comfortable being dependent on each other.							
v. Both teams keep their promises.							
w. Both teams work with high levels of integrity.							
x. Both teams are fair to each other.							
y. Both teams look out for the interests of both companies.							
z. Both teams can rely on each other for not taking advantage of the other team's weaknesses.							

Modifications made to the original RECAP tool[1]:

- **3. Joint working processes**: An indicator has been added under this sub-criterion, i.e., *We had periodic reflection meetings where we critically analyzed the decisions taken, the collaborative behavior, the satisfaction of team members, etc.* The reason this was added is that there is available literature showing the benefits of conducting periodic follow-up meetings. Van Wassenaer (2017) cited the importance of assessing team satisfaction on a periodical basis in the form of surveys, Plus/Delta method, etc. He

[1] The changes made to the RECAP tool have been discussed with the author of the tool (Suprapto) and it has been concurred that they add value without deviating from the original intended purpose.

stated that by doing so, the root cause of certain problems could be identified and necessary measures taken to resolve it. Allison et al. (2019) and Houlihan and Click (2012) also recommended conducting Plus/Delta methods, which are surveys to identify what went well and what could be improved. Thus, adding this dimension to the RECAP tool was found to be meaningful for this thesis.

- Under the criteria **"Front end definition and Collaborative Practices"**, a sub-criterion of *Involvement of external stakeholder community* has been added. The importance of this practice has been receiving increased attention over the years, especially for public infrastructure projects (Aaltonen, 2011; Heravi et al., 2015). A driver for this interest is the increasing difficulty that the industry faces in delivering these projects, primarily due to public opposition (Cuppen. et al., 2016). Rather than applying the traditional "predict-and-control" management strategy, a process management strategy of "prepare-and-commit" is advocated (Koppenjan et al., 2011). Since this research focuses only on infrastructure projects, the inclusion of this sub-criteria is considered relevant. Its aim is to understand the ways in which the external community is engaged in the Dutch as well as international integrated contract forms.

- Sub-criteria 4, 5 and 6 have been left out for the below reasons:

a. They speak about the progress of the project in terms of cost and time which is not the aim of this research.
b. They are designed to capture the practices carried out during the construction phase whereas this research is predominantly restricted to the design phase.

1b. Adapted RECAP tool

Based on the reasoning given in 1a, below is the adapted RECAP tool that has been used for this research.

		Rating							
		1	**2**	**3**	**4**	**5**	**NA**	**DK**	**Comments**
		Very Poor	**Poor**	**Moderate**	**Good**	**Very Good**	**Not Applicable**	**Don't Know**	
A	**Front end definition and Collaborative practises**								
	This section examines the extent of how well the front-end definition is actually understood/comprehended by the project teams and how well collaborative practices are actually being implemented in the current project. Collaborative practices are additional practices used to enhance the collaboration between parties (owner and contractor) and their project teams.								
1	**Front end definition (5)**								
A	The project goals, objectives, and scope are understood by the contractor team.								
B	The project goals, objectives, and scope are understood by the owner team.								
C	The project goals, objectives, and scope are understood by the design team.								
D	All functional/ high level technical requirements (basic design) are reviewed together by all teams.								
E	The *project execution plan* is reviewed together by all teams and adjusted accordingly if needed.								
F	There are clear roles and responsibilities assigned to all teams.								
2	**Team Integration (5)**								
A	We operate as an *integrated project team (IPT)* where the different parties are structured and integrated as a single team with no apparent boundaries								
b	We perform *goal setting and alignment* meetings with sub-contractors and suppliers.								

c	We perform *goal setting and alignment* meetings with the owner's business and operation representatives.								
d	We exercise *inter-team building* workshops to encourage collaboration via fun and excitement.								
e	We have recognition and rewards program to stimulate individual and team levels collaborative behavior.								
3	**Joint Working Processes (7)**								
a	We jointly conduct *planning*								
b	We jointly perform *monitoring, controlling, and reporting.*								
c	We jointly conduct *issue management*.								
d	We jointly *define* and *monitor* the achievement of key performance areas.								
e	We jointly *identify* and *monitor* risks and formulate a necessary *mitigation plan*.								
f	We have robust mechanisms to resolve/escalate conflicts/disputes.								
g	We have formal procedures for joint decision making.								
h	We had periodic reflection meetings where we critically analyzed the decisions taken, the collaborative behavior, the satisfaction of team members, etc.								
4	**Involvement of external stakeholder community (4)**								
A	Efforts were made to involve the external stakeholders in the development of the design								
B	They were constantly kept in the loop regarding changes proposed to the design by the design team								
C	Their inputs had a positive effect on progress								
D	Their inpust added a lot of value to the design								
B	**Relationship Continuity**								
	This section is concerned with the perceived current achievement of the collaboration output. The assessment aspects includes potential continuity of the relationship in future.								
5	**Relationship continuity (4)**								
A	Beyond this project, we will likely work with each other in future with the same partners.								
B	The relationship experience we gain so far will be useful in future project(s) even with different partners.								

C	Because of collaboration in this project, we gain benefits that enable us to compete more competitively.								
D	This collaborative relationship makes our companies' able to develop unique capabilities (truly innovative products/solutions).								
C	**Relational Attitudes**								
	This section is concerned with how well the senior management of both parties (the owner and the contractor) commits to support the collaboration, taking into account the degree of trust and interactional norms to bring together the necessary resources into a project.								
6	**Senior management commitment (5)**								
A	Senior management of the owner commits to provide necessary resources and support to the project teams.								
B	Senior management of the contractor commits to provide necessary resources and support to the project teams.								
C	Senior management of the designer commits to provide necessary resources and support to the project teams.								
D	Senior management of the owner shows consistent and passionate leadership.								
E	Senior management of the contractor shows consistent and passionate leadership.								
F	Senior management of the designer shows consistent and passionate leadership.								
G	Senior management of all parties actively work together to resolve potential conflicts when needed.								
7	**Senior management trust (4)**								
A	There is an atmosphere of mutual trust between senior management of all parties.								
B	There is a mutual enthusiasm from senior management of all parties in achieving the project goals.								
C	Senior management of all parties has confidence in each other to do what is right.								
D	Senior management of all parties keeps their promises truthfully.								
8	**Established relational norms (7)**								
A	The owner intentionally adopts 'no blame culture' when problems arise.								
B	The contractor intentionally adopts 'no blame culture' when problems arise.								

C	The designer intentionally adopts 'no blame culture' when problems arise.								
D	The owner is intentionally open and honest in any interactions with no hidden agendas.								
E	The contractor is intentionally open and honest in any interactions with no hidden agendas.								
F	The designer is intentionally open and honest in any interactions with no hidden agendas.								
G	The owner strives for business outcomes whereby both parties either win or both parties lose.								
H	The contractor strives for business outcomes whereby both parties either win or both parties lose.								
I	The designer strives for business outcomes whereby both parties either win or both parties lose.								
J	All parties agree to have an equal say in any critical decisions that matter to both parties.								
D	**Inter-team working**								
	This section is intended to assess how the owner's team and the contractor's team work together in a project across their company's boundaries. Inter-teamworking reflects how two collaborating teams communicate with each other effectively, achieve synergies in coordinating interdependent activities, equally contribute their specific knowledge and expertise, align their effort, help each other in achieving project goals, behave as one team, and personally trust each other.								
9	**Communication (4)**								
A	All teams communicate directly with each other.								
B	Project-relevant information is shared openly by all teams.								
C	Whenever a problem is detected, it is immediately and honestly communicated to the other teams.								
D	All teams are satisfied with the usefulness of the information shared by other teams.								
10	**Coordination (3)**								
a	The work done in the teams is closely synchronized between the teams.								
b	There is a clear linkage between the teams for their interdependent tasks.								

c	There is no redundancy regarding the work done between the teams.								
11	**Balanced Contribution (3)**								
A	The teams recognize the specific strengths and weaknesses of each team's competences.								
B	The teams are contributing their knowledge/expertise in accordance with their full potential.								
12	**Mutual Support (3)**								
A	The teams help each other as well as they could.								
B	Whenever problems occurred, they are resolved constructively.								
C	Every critical decision is made together by the teams.								
13	**Aligned effort (3)**								
A	All teams give this project the priority it needs.								
B	All teams put their best effort into this project.								
C	There is no conflict regarding the effort that each team put into this project.								
14	**Cohesion (4)**								
A	Members of all teams are personally engaged to this project.								
B	Members of all teams are integrated as one team.								
C	Members of all teams feel proud to be part of the project team.								
D	Members of all teams feel responsible for maintaining the relationships within the project team.								
15	**Affective trust (6)**								
A	All teams are comfortable being dependent on each other.								
B	All teams keep their promises.								
C	All teams work with high levels of integrity.								
D	All teams are fair to each other.								
E	All teams look out for the interests of both companies.								
F	All teams can rely on each other for not taking advantage of the other team's weaknesses.								

1c. Definition of criteria

Criteria	Sub-Criteria	Explanation
Front end definition and collaborative practices	Front end definition	The ability to comprehend the project scope, basic design, execution plan, and roles and responsibilities.
	Team Integration	The extent to which the owner and the contractor teams are structured and integrated as a single team with no apparent boundaries.
	Joint Working Processes	The extent to which the owner and the contractor teams perform joint working processes.
	Involvement of External Stakeholder Community	The extent to which external stakeholders were allowed to participate in the design development
	Relationship Continuity	The perceived intention to continue the relationship in future.
Relationship Continuity	Senior management commitment	The extent to which the senior management of the organization was committed to the project and enthusiastic about working with others
Relational Attitudes	Senior management trust	The extent to which the senior management of the organization was committed to the project and enthusiastic about working with others
	Established relational norms	Norms of no-blame culture, win-win and communication openness.
	Communication	The extent to which teams are able to inform and share ideas openly and effectively with others
Inter-team working	Coordination	The extent to which project activities were synchronized and aligned
	Balanced Contribution	The extent to which the teams contribute their specific knowledge and expertise.
	Mutual Support	The extent to which the teams help each other in achieving project goals.
	Aligned Effort	The extent to which the teams align their effort.
	Cohesion	The extent to which the teams behave as one team.
	Affective trust	The extent to which the teams' members personally trust each other

Table 3: RECAP criteria and sub-criteria used in this study

Appendix 2: Project B1 (Detailed)

Pre-Tender phase

A relational contracting expert, who is also an Associate Professor at VU Amsterdam and Affiliate Faculty Program on Negotiation Harvard Law School), was hired by the Client before the tendering phase to help shape the Client's vision. While they already had come up with a broad theme themselves, the idea was to seek the advice of an expert who could challenge their way of thinking and help them make scientifically backed decisions instead of assumptions. According to the Interviewee 1 below are some of the key highlights of the sessions with the expert:

a. It is a general conception that if the team is composed of people who are the best in their field of specialization, for example the best planner or best project manager, then collaboration will automatically be high. But, that is not the case always. There is not enough literature which suggests that collaboration comes naturally to people because people are difficult to motivate. There has to be an environment which facilitates collaboration.
b. Bonuses and penalties do not influence the way people collaborate with each other. It can, in fact, sometimes be counterproductive to collaboration. A similar argument was made by (Victoria (Australia) Guidance note on ECI, p. 8, 2015) that contractor behavior is not influenced by incentives and bonuses. It is incorporated in contracts to give Clients the impression that they can influence the delivery.

Tender Phase

A significant feature of the tender phase was that there were three **collaboration coaches/psychologists** present (who also continue to be a part of the design phase) to do individual as well as team assessments of the participating organizations. Their role is to help the Clients decide which participating team comes closest to meeting all the criteria as explained below. Here, the coaches are not only used during the design phase to carry out periodic collaborative 'health check-ups' during the project but also used during the tendering phase to guide the Client team is assessing the collaborative nature of the participating companies.

There was no price criteria for the assessment of tenderers. Instead, there were three quality criteria present to *Plan of Action Collaboration (30%)*, *Risk and Opportunity Plan (45%) and Assessment Collaboration (25%)*.

Plan of Action Collaboration

This set of criteria mainly assessed the candidate's vision of collaboration, their core values, the decisive success factors for collaboration, lessons learnt from previous collaborations, methods used for decision making, basic attitude of team members, etc.

Assessment Collaboration

These criteria were used to assess the extent to which the behavior and mechanisms of the Candidate's team that will form a part of the Bouwteam match the competencies required by the Client. Competencies like *adaptive power*, *dealing with interests*, *taking joint responsibility*, *focus on quality and collaboration* were assessed.

An interview was conducted with one of the collaboration coaches who was present during the tendering stage to understand how the inherent subjectivity of all the criteria was dealt with during the assessment. He used the term "objectified subjectivity" which meant that they had clear definitions and descriptions of what they meant for each category. For example: for 'adaptive power' which is one of the judging competency under the third quality criteria, it was clearly stated as to what the definition of adaptive power was and what kind of behavior was attributed to it. They would also specify what the exact opposite behavior entailed. After the assessment exercises were finished, the three collaboration coaches sat down with the Client team and engaged in four to five hours of extensive dialogue to arrive at the final selection of contractors. Out of seven participating companies, two Main contractors were selected to form a part of the Bouwteam along with the Client organization.

Project Start-Up (PSU) Phase

This was done by organizing many sessions where parties shared their visions, ambitions and expectations of collaboration. Things like what they find important, which elements would be used for collaboration, what collaborative instruments they would co-develop were at the center of focus. All members present in these sessions were allowed to contribute ideas based on their expertise. The task was to come up with common amalgamated cultural plans - that contained the core values of the Bouwteam, the collaborative instruments to be used, onboarding strategies for new members, etc. – and structural plans - that contained the organization structure, frequency of meeting of all the teams, conflict escalation procedure, etc. The main challenge which was faced during this phase was that all the sessions were conducted online due to ongoing pandemic.

Both the contractors were given a period of three months to come up with their versions of cultural and structural plans. Interviewee 2 felt that these three months were very useful in thinking about their understanding of collaboration. The process of arriving at these common plans, as discussed with one of the coaches, was as follows: First, the parties would present their version of the collaboration plans in what they called a "Pitch to Partners". After listening to everyone's pitches, each party was asked to reflect on the other party's plan by stating which aspects they liked and which they didn't and finally give a ranking to each of the collaborative instruments thought of by each party. All differences were sorted out by engaging in a dialogue and finally it would be agreed upon as to which aspects from each plan will make it to the final common plan. This way it was ensured that the common plan has inputs from all parties based on their skills and expertise.

During this phase, efforts were also made to co-develop and communicate the project objectives to every member of the Bouwteam. The four primary objectives were Quality, Time, Environment and Budget. The way in which first hundred days of the project would play out were discussed in this phase, major milestones were agreed upon and this entire process helped in getting to know each other in a better way. However, Interviewee 1 feels that the assignment of roles and responsibilities to all team members could have been made more explicit and clear at the beginning of the project. This was supported even by Interviewee 3 who claimed that there should have been more discussions in the beginning of the project as to who is doing exactly what. For example, there were 3 project managers in the Bouwteam. It was not clear as to which project manager is going to do which task. There were some other practical issues faced such as the project manager of one of the main contractors was re-located to another

project in the middle of the phase and the entire exercise of re-aligning vision and ambitions with the senior management of that Contractor was time-consuming and redundant.

Interviewee 2 found the practice of requirements being identified in the design stage a little strange. His observed practice is that usually requirements are ready before parties start tendering for a project. While he acknowledges the advantage that requirements are being co-developed by all parties, he is skeptical of the fact that an extra requirement may come up once the design is finalized.

Organization Structure

Figure 6: **Bouwteam structure with Core Team and their associated disciplines**

The main decision-making team with respect to progress of the project was known as the "**Core Team"**. It consisted of around 10 members including all the three main organizations. There were different fields of discipline within the core team like Technical Management – Design and Performance, Project Management, Project Control, Environmental Management, Contract Management and each discipline had their own team (also consisting members from all three organizations) who were performing the day to day activities for their particular discipline. The core team along with its sub-teams together formed a part of the Bouwteam. The core team was responsible for maintaining a link between the various disciplines. The usual way of working is that members of these sub-teams would discuss issues related to their discipline with their core team in-charge and this core team member would bring up this topic (in addition to the project progress) in the weekly meeting with other core team members. The core team was formed during the PSU phase itself.

But, work was not confined to silos. If there is an issue within the Design Team which needs to be cleared by the Environmental Management team, there was direct communication between the two. The people within a team would connect with other Bouwteam members when required and not just work with their core team area in-charge. There is no fixed hierarchy existent.

Then there is the *Benen op Tafel (BOT)* meeting is a kind of top view of the Bouwteam to check whether collaboration within the Bouwteam is going as per plan or not. It consists of the Project Managers of the three organizations who met once a month.

In addition to the weekly meeting of core team members, there were other meetings as well. The *Directie Overleg* consisted of the Board of Directors from the three organizations. This meeting was around twice or thrice a year. They are the advisory board at the highest level and they check alignment of different parties and their long term commitment.

If there is an issue which cannot be resolved by the Core team, it is escalated to the BOT team. If not resolved on the BOT level as well, it goes to the board of directors level.

Team Integration and Joint Working Processes

Even though the role assignment of the project managers and some technical managers was an issue initially, there was a clear system in place to select Bouwteam members before beginning the onboarding strategy. The **onboarding strategy** was put in place wherein the procedure for assessing and inducting new members to the Bouwteam was charted. The profile for candidates based on attitude, behavioral and competency matrices (where all the desired characteristics such as open, active, initiative, decisive were clearly defined). Two rounds of joint interviews are conducted (by key representatives of the Client and the two Main Contractors), the first one by two key members of the Bouwteam, with a focus on basic attitude, and the second round was with a project manager or department head more focused on technical knowledge. Every new member added to a team gets a mentor (buddy) assigned to make a smooth start. The mentor helps quickly acquainting the new member with the shared vision, core values, rules of work, etc. In case this process of onboarding does not go smoothly, the collaboration coaches can step in and remove the obstacles. The Bouwteam initially consisted of fifteen members but gradually increased to sixty. As mentioned by the collaboration coach who was interviewed, this was sometimes a challenge because when they built a culture of working with a certain set of people, each time a new person was added the entire process had to be repeated.

Both the main contractors decided during the tender phase itself about the subcontractors they would be using in the construction phase. But, the use of the s/c during the tender phase was limited. The client did not specify in the contract about the use of subcontractors' expertise in the design phase. It was the responsibility of the contractors to do so.

The culture of **equality** is evident in the fact that in the meeting sessions conducted as explained in the Organization structure, all partners (including subcontractors) were given an equal place for consultations. There was no observed hierarchy wherein a member would have to go through the main contractor to speak to the Client or discuss some issue with him. People are happy that their ideas and opinions are being heard and given importance to. They could directly approach any representative of the Client without any hesitation. Both the main contractors had sister companies who were going to execute different scopes of work. The knowledge of these companies was also used in the design stage.

Various **collaborative instruments** are designed to facilitate collaboration. These are categorized into 'must haves and 'nice to haves'. Some of them are *celebrating success* (an example of this is if a milestone has been achieved, the good news is shared across all platforms such that all achievements are given recognition which eventually boosts the morale of the team members), *collaboration coaches, buddy system, Keep-Start-Stop Reflection Moments* (will be explained later), etc. It's not the case that all instruments are used all the time. A dynamic approach has been adopted to activate the instruments when required.

About recognition and rewards, given that a lot of work is going on remotely, it is not easily achieved. There are no monetary rewards of any kind but they are more of rewards in terms of appreciation. There were no "Employee of the Month" kind of awards which was in line with the principle that everyone worked as a single team. The atmosphere in the workplace was also conducive to admitting to a mistake without the fear of being punished. But, Interviewee 3 feels that there should have been more informal reward schemes for good performance.

Interviewee 2 would have preferred a more graphic way of monitoring and discussing progress. He suggested the use of a dashboard wherein every Monday morning when the core team met, everything is displayed in front of everyone in terms of activities performed in the previous week, areas of improvement, etc.

Decision-making is based on the consent of all team members. There is an effort taken to actively resolve all **conflicts** within individual teams and avoid escalation as far as possible, while maintaining full transparency with the senior management. There are no formal mechanisms as such to resolve disputes. At the moment, the participants do not feel the need for it because most of the work is going smoothly without many conflicts.

Conducting **reflection meetings** was a key aspect of this project. There were **Keep-Start-Stop meetings** (or Project Follow-Up meetings) conducted once in every two months. The collaboration coaches would supervise the meeting with the agenda of **'health check-up**' of the collaboration between the teams and satisfaction of team members. The coaches prepare a questionnaire which has collaborative indicators that people have to rate on a scale of one to five. Some of the indicators are: "We are open and honest with each other", " Atmosphere in the team is good", "We are working as one team", "I am currently enjoying the project", "We take joint responsibility for the project as a whole", "We are on the right track in collaboration". These two-hour meetings are for everyone to express their feelings, what they feel is going

right and wrong, what the team should **keep** doing, what they should **stop** doing and what they should **start** doing.

Involvement of external stakeholder committee

The professional associations in the areas surrounding the project were actively involved while developing the design. They were not only informed about the progress of the project and inconvenience which will be caused due to construction activities, they were also allowed to participate in it. For example, competitions are arranged for painting the outer side of the bridges. The representatives vote and decide which design is shortlisted. However, the representative of the main contractor noted that since the bridge is monumental and has historic significance, the external community doesn't have as much of a say in how the final design will eventually look. A stakeholder engagement diagram was developed to determine the degree of influence a particular stakeholder would have on the project. As can be seen in Figure 7 the numbers mentioned in bubbles are the various stakeholders which were taken into consideration.

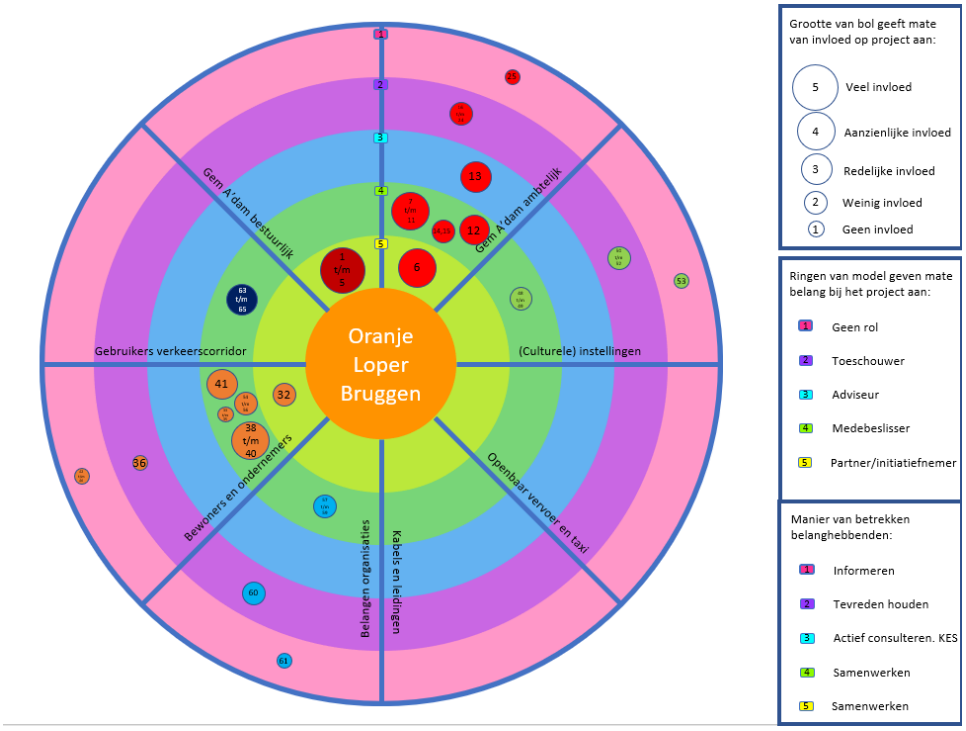

Figure 7: Stakeholder Engagement Diagram in Project B1

Relationship Continuity

It is truly believed that the relationship experience gained in this project will be useful in their future endeavors and also enable them to compete more competitively with innovative solutions. Especially for the contractors, the risk profile is low in such projects, hence they are satisfied with the relational way of working. Also, all the interviewees were of the opinion that people working in a Bouwteam project develop sensibilities that are different from those working in traditional projects. Learning to work in close engagement with other parties gives them the upper hand. There is a procedure in place wherein all team members can submit motivated proposals for innovations. At the Bouwteam table it would then be decided if those

innovations would be worked out in more detail or a budget set out for them. However, as per Interviewee 1, the tasks given to the team members are focused on improving the way people work with each other which does not necessarily encourage innovation as they tend to get lazy about the outcome. Although there is a logical combination of low risk and low profit for the contractors, this does not always result in creativity. The other two interviewees did not agree with this statement. At the same time, it is also acknowledged that since the project is that of bridge renovation where the main aim is to keep stakeholders happy, there is not much inherent scope for innovation. In more technically challenging projects, he is of the opinion that introducing self-imposed constraints (like reducing the duration of the project) can stimulate creativity. There is also a **'lessons learnt' register** which records the details of all the knowledge gained during the specific field-related discussions and core team discussions that is considered important for reference in the future.

Inter-team working

The communication between all teams is transparent. Relatics, a web-based platform for sharing information, is used to communicate important information of the project like BIM models, decisions taken by core team, etc. This system was open to all the team members who can view the latest information about the project. If a problem is detected, it is communicated to the entire team without trying to hide it. Even the Project Managers directly call teams working in their field of discipline and check on the status of any work that required coordination between fields of other disciplines. As mentioned earlier in the Organization structure, teams working in their discipline need not only report to their core team member in-charge, they can also directly communicate with team members of other disciplines in case there is some coordination required between the two or some issue needed to be resolved. However, Interviewee 1 and 3 felt that sometimes information communication was not transparent. There were cases where information was withheld. Also, sometimes people used to add additional buffers while communicating planning details which, in a way, reduces the usefulness of the information shared. Due to the pandemic, coordinating activities between different disciplines is a major challenge faced.

A common logo was developed for the Bouwteam which helped in aiding the collaboration.

About **Mutual Support**, it was observed that people work hard to arrive at a solution to a problem. The Bouwteam structure gives a chance to everyone to speak out what their strengths and weaknesses are. People do not shy away from asking for help because they are lacking in that aspect. It's much better than people thinking they can do the work themselves and hesitate before asking for help. But, sometimes it was observed that people gave their hundred percent only when the work or related problem was within their scope, but the support marginally reduces when other players start getting involved.

There was mostly no conflict with regards to the Aligned Effort except for the fact that, on certain occasions, the Interviewee 1 felt that the Client was putting in less effort than the others. For example if they wanted to reach out to someone from the Client's office on a Friday afternoon, they would not be available. The cohesive nature of the team was very strong as people felt responsible for upholding the integrity of the Bouwteam. In order to challenge the team if their design generated value for money, they got the final design reviewed by other members outside the Bouwteam within the respective organizations.

Appendix 3: Project B2 (Detailed)

Front end definition

During the tender phase, the companies were shortlisted based on past experience on similar projects, technical capabilities, etc. but not really based on collaboration. The participating companies were asked to submit their plan of action with a chapter mentioned on collaboration specifying how they wanted to achieve it. Other than this, there were no workshops or exercises given to check if the parties could actually demonstrate what they have written. Most of the understanding developed through extensive dialogue between the teams. This is one area of improvement which Interviewee 1 feels is necessary in future projects. The reason stated for the above by all interviewees was that the complexity and scope of the project was not very high and hence the client did not invest resources in that. During the dialogue, the implementation plan developed by the Clients prior to the tender phase was given to the participants to enable them to understand what is expected of them in term of collaboration by drawing their attention to important aspects of the plan. It was a very open and transparent process which worked well because this was the first time the potential Bouwteam members were interacting each other face to face.

The Project Start-Up was a one day online event (due to the corona measures). The event was used to get to know each other on a personal level. An external sketch artist was hired to make drawings based on all the discussions made during the day. These pictures were then put up in the meeting room for everyone to see to give an impression of the day and to be constantly reminded of. People were divided into groups to have conversations about what they thought of the project goals, what their likes and dislikes were, etc. They discussed things like what people think is a good way of collaboration and not project related stuff like design issues, risks, etc. Collaboration rules were jointly established by both teams like having short communication lines (always call before sending an email), no hidden agendas, etc. The below images were made by the sketch artist during the PSU.

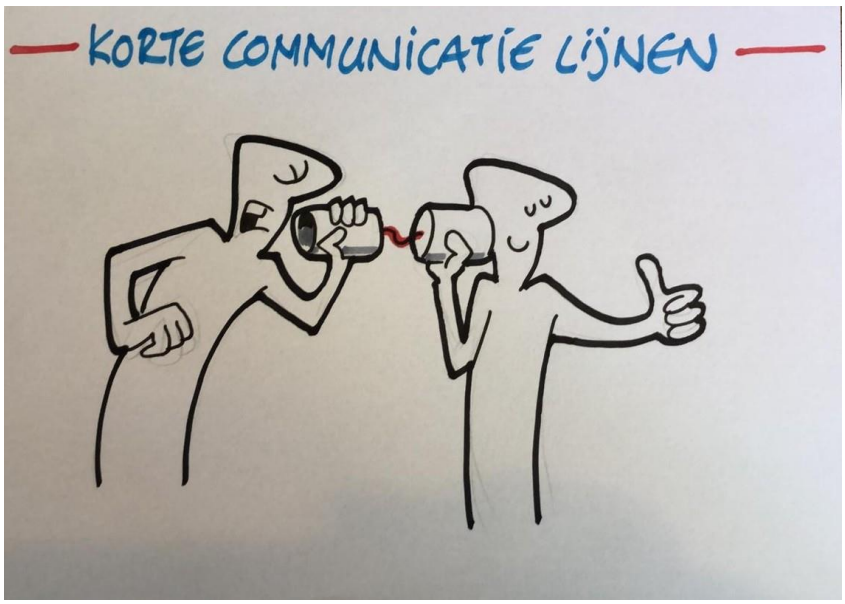

Figure 8: Sketches made during PSU of B2

Input for the Bouwteam Plan was received and collected during this session by asking questions to the groups about what they feel should be a part of the Bouwteam plan. Elements from the implementation plan and the plan of action developed by Engie were combined into the Bouwteam plan. The entire session was facilitated by the collaboration coach, who also continued in the rest of the Bouwteam phase to resolve any conflicts which may have occurred while collaborating. Interviewee 3 felt the need to integrate the design team in a better way with the rest of the team. Their strength was low and they did not have the same understanding of the Bouwteam.

A detailed design was already available when Engie was brought on board. During the Bouwteam phase, not only was the design finalized but also extensive work plans of the construction phase were created ranging from scheduling to risk management. The Bouwteam phase consisted of around 20 members.

Since most of the team was used to working in traditional type of contracts, they had to be constantly reminded by the client to have trust in each other and also told that they could not wait for others to trust you, it's important to take the first step. Because this was done so early on in the project, strong relations were built from the beginning itself. Interviewee 2 felt that since many of them were working on a Bouwteam project for the first time, definition and distribution of roles and responsibilities was challenging. Interviewee 3 commented that stakeholders like tunnel management organization and maintenance contractor should have had better role definitions at the beginning.

Meeting consultation structure

Figure 9 shows the collaboration diagram used in the project. The Project Management consisted of one project manager and one deputy project manager from both Client and Contractor. The Management Team consisted of one representative from the various organizations like client, contractor, tunnel management organization, maintenance contractor, design team, etc. The Kern Team or core team consisted of the entire Bouwteam.

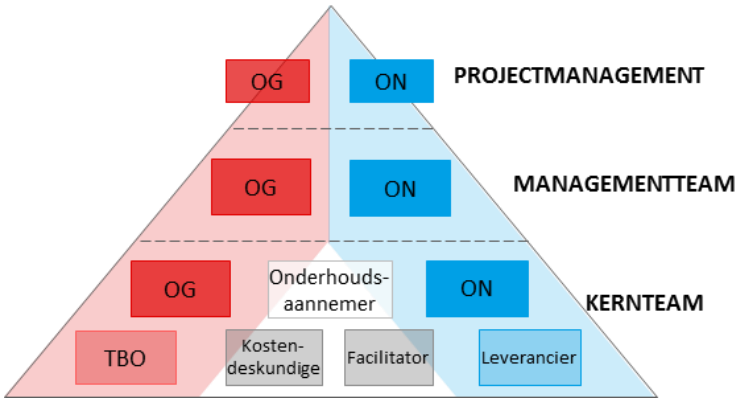

Figure 9: Organization structure

There were many periodic meetings conducted throughout the Bouwteam phase: *Bouwteam meeting* to discuss an overview of the project once a month. This was attended by the entire Bouwteam. *Benen op Tafel (BOT)* meetings were also conducted once a week only with the Project Management Team. There was no specific agenda for this meeting as they could discuss any aspect of the project. The idea was to just be open and honest with each other. These meetings helped to get to know the other team better which was then used during the other meetings. *Stand Up* meetings were conducted once a week where the Management Team would participate. Things like progress, planned actions, interdependency of tasks, etc. was discussed but not in a very detailed manner. Two *Work Track meetings* (one for design and work preparation and the other for contract and pricing) happened simultaneously bi-weekly. All the main decisions of the project were taken in these meetings. Design issues, work planning, resolution of conflicts, etc. were the key agendas in these meetings. All the interviewees feel that this particular meeting structure was too complex. There was an overlap of information and agendas and this led to some unproductive meetings. In the end, they ended up having lesser meetings than planned. Despite the corona situation, the team met one day a week in the client's office.

Joint Working Processes

One of the main subcontractors (for camera installation) did not participate in the Bouwteam phase because of the traditional mindset. They were not used to the Bouwteam concept of giving engineering services during this phase and then not having the guarantee of being selected for execution. The contractor could also not convince them on this matter. Interviewee 1 feels that the client should have communicated this requirement better during the tender phase such that suitable arrangements to involve the subcontractor could be made early on.

As mentioned before, a detailed execution plan was made during the Bouwteam phase in the form of a draaiboek. Workshops were conducted for every chapter in the document like logistics, scheduling, traffic management, risk management, etc. The contractor would come up with certain ideas or concepts for the design which would first be pitched to the clients in an early stage, inputs were received from the entire team and then would be further developed by Engie. The client was not present merely for approval. They were a part of reviewing the design from early on. Most of the workshops conducted during the Bouwteam phase were technical.

A Project Follow-Up (PFU) was conducted once a quarter. These sessions were to assess how the collaboration was going in the project. They were facilitated by the collaboration coach. Team members were asked to mention what they were happy and sad about. Each one had to write compliments about another member. The importance of giving praise was stressed on by the coach. But, Interviewee 3 felt that there should have been more such informal practices.

The coach also discussed theories during these sessions like defensive strategies used which helped people relate to and apply in their work.

A Project Barometer was used to assess the satisfaction of the entire team. It was an excel sheet which consisted of columns for team members to fill about what they felt was good, what could have been done better, questions about whether they felt their opinion was heard, whether the collaboration was working and similar personal satisfaction related questions. A screenshot of a project barometer is mentioned in Figure 10.

Begintijd	Tijd van voltooien	E-mai	Na	Wat vind jij van de sfeer in het bouwteam?	Wat gaat er goed?	Wat kan er beter?	Is het gezamenlijk projectdoel duidelijk?	Wordt er voldoende gecommunicee rd?	Voel je je gehoord?
6/9/20 14:56:25	6/9/20 14:58:41	anonymous		8					
6/10/20 12:46:19	6/10/20 12:51:45	anonymous		8					
6/8/20 11:44:20	6/8/20 12:10:27	anonymous		8					
6/11/20 16:46:47	6/11/20 16:55:52	anonymous		8					
6/11/20 13:26:04	6/11/20 13:28:35	anonymous		7					
6/11/20 19:23:13	6/11/20 19:37:45	anonymous		8					
6/11/20 9:22:54	6/11/20 9:26:06	anonymous		9					
6/8/20 9:34:00	6/8/20 9:35:37	anonymous		6					
6/8/20 16:27:11	6/8/20 16:31:16	anonymous		8					
6/8/20 10:36:12	6/8/20 10:50:07	anonymous		7					
6/10/20 13:49:44	6/10/20 13:53:07	anonymous		8					
6/8/20 16:26:45	6/8/20 16:32:22	anonymous		8					
6/8/20 9:30:45	6/8/20 9:38:28	anonymous		7					
6/8/20 16:19:32	6/8/20 16:24:22	anonymous		7					
				gemiddeld =7.6					

Figure 10: Project Barometer in B2

These responses would be discussed in separate feedback sessions to decide on how to tackle the problems mentioned by the team.

External Stakeholder Community Involvement

The residents or communities around the tunnel were not consulted during the Bouwteam phase. Professional parties like railway stations, metro and other companies were consulted and explained what the project was. But, most of the communication was one-way. Many letters were sent to people living around the tunnel, newspaper advertisements and movies were made to show the people what the project planned to achieve.

Inter-Team Working

Trello was used to record actions during all the meetings. Miro was used for serious gaming. A dedicated person would make a game around one topic (for example risk management). Two teams would play against each other. The goal was to think about a situation simulated in a game. This served as a team building and trust building exercise and platform for shared knowledge. The team had confidence in one another because during the game they would explain their thought process while solving a problem.

There was an open and honest atmosphere in all the discussions and meetings. There were no major issues of aligned effort since the contractor committed to ensuring key persons were always available in the project. If any new member joined the team, the entire Bouwteam would decide if the person was a right fit for the project or not. Even the senior management of both teams were extremely supportive of the entire project. A steering committee was in place which met once a month to discuss how the project was going.

There was a lot of trust within the teams. Interviewees 1 and 2 believed that as client they had to take the initiative to make themselves open and vulnerable to the team to be trusted. Examples of how the client showed they want to inculcate a culture of trust are: In the weekly meetings, the client would instruct his team on how to act in the right manner instead of pointing fingers at the other party. This way the entire team had more confidence in the fact that they would be trusted. Another example is that the client let the contractor be open and flexible in the submission of the first invoice. They did not question the calculations given as back up and paid the amount very quickly. It was a small sign but effective in emphasizing the importance of building trust.

Interviewees 1 and 2 felt that both the contractor and client would think along with each other about the problems. But, Interviewee 3 was of a different opinion because he believed there were certain boundaries created in the project due to the fixed amount payment to the contractor during the Bouwteam phase. This sometimes caused different parties to have different motivations within the project. He believes if there was a shared budget with a bonus system, the collaboration would have been better.

Appendix 4: Project F1 (Detailed)

Organization Structure

The Alliance consisted of an **Alliance Executive Team (AET)**, which is the highest decision-maker of the Alliance and is responsible for Alliance Management. Below this is the **Alliance Project Team (APT)** whose task is to manage and coordinate the daily activities of the Alliance. The APT is resourced with the necessary skills and expertise and is capable of quick and flexible decision making. The working philosophy of the team is based on openness, mutual trust and respect. The various technical disciplines of Roads and Streets, Bridges, Tunnel and Technical Systems function under the APT.

The APT is headed by the Project Manager (PM) and the Deputy Project Manager (DPM), who were responsible for all the technical disciplines as well as other departments like Safety, Risk Management, Planning, Communications, etc. The PM and DPM are allowed to attend the meetings of AET and inform the APT about the decisions taken by the AET on a need to know basis. In addition, everyone in the Alliance will be informed of the major decisions by the APT through a weekly newsletter.

Tender Phase

The tender phase evaluation criteria had a weightage of 75% for collaborative quality criteria like leadership and alliance capabilities, ability to learn from mistakes. The remaining 25% was for the fee offer.

During the first phase, the number of tenderers was reduced to five on the basis of participant applications and company references. These five tenderers were first required to submit twenty-page documents which contained information like the organizational structure, preliminary plans to find sub-designers, etc. The Client had appointed an external **alliance facilitator**, who also served as an alliance expert, who coached the owners' personnel and participated in the preparation of events related to the procurement. He helped develop the Client's vision of collaboration by benchmarking based on Australian alliance model. He planned all workshops that were conducted during the tender phase, designed their content, and was present during the workshops to help the client give scores to participating companies. Additionally, there was a **neutral observer** whose role was to ensure the fairness of the procurement phase. When the results of the selection process were announced to the public, even the comments of the neutral observer was attached to show that the procedure was conducted in a fair manner. The alliance facilitator was also present during the development phase where he would plan and design team-building workshops, checking if promises are kept, if all parties are given equal chances and giving comments on if teams are improving in collaboration as compared to their performance in the tender phase or not. Continual Improvement was an important principle used in the project.

One to one workshops were held with all the tenderers to assess all the evaluation criteria mentioned above. The expert monitored the proceedings of these workshops, they would give their feedback on how a particular company and their key personnel was cooperating with the Client and then the Client would give a scoring based on their feedback. These experts were very careful to not let their presence be felt in a meeting which would otherwise make some parties conscious. Their duty was to only assess the way of working naturally and free of pretense. Criteria like assessing 'self-reflection' were assessed in the following way; at the end

of the workshop, parties were asked to write on walls what they thought of their performance on a personal level, small group level and in relation to how it was like working with others. 'Learning from mistakes' was assessed in the following way; parties had to write down their biggest mistakes ever committed. Interviewee 2 said it was a fun exercise because people had to dig deep into the mistakes committed in the past and the lessons they learnt from that. The contractor representative interviewed also mentioned that he was very happy with the fact that the tasks given to the Contractor during these workshops were related to the same project and not made-up, fictitious scenarios which he was used to prior to this. This exercise helped in already coming up with some unique solutions for the problems pertaining to the project. After these workshops and respective teams' scoring, the best two tenderers were selected. Development workshops and other financial negotiations were done and finally the development phase agreement was signed.

During the tendering phase, the companies were asked to name all the key persons or decision-makers whom they would be bringing into the Alliance organization. The priority was the find the best team at all times. They had to prove that those individuals were capable of making important decisions related to the project. An example of how they were assessed by the Client is that they were asked to name the mistakes they made in the past, how they rectified it and what they learnt from it. This way it was ensured that all alliance member organizations did not have to refer to any senior management official outside the Alliance because all of those decision makers were present in the AET. This meant that the contractor would have to name those persons who would be one hundred percent available for the project. Even the Client promised that they would devote 80% of their time to this project and hence, declared all the resources upfront which they would be using for this project.

Team Integration and Joint Working Processes

Before the process of tendering itself, the road plan and administrative design was ready and accepted. That was a starting point to bring all the members of the Alliance on board in the development phase. The alliance members together developed the project plan which detailed the entire scope of works and other collaborative practices to be followed by the team. All weekly meetings took place in one common room known as the **Big Room**. The Client demanded that at least key persons of companies within the alliance be present in these big room sessions to have consolidated and collocated expertise of all parties for taking important decisions, discussing issues and other progress related matters. In these sessions, the main contractor was always available to sit with the designer and discuss feasibility and constructability of the design. There was no requirement of making phone calls or sending emails to anyone because they all were present in one room. Although, most of the subcontractors and suppliers for this project came from the same company as the main contractor, a few subcontractors were also involved in these big room sessions to discuss identified critical elements in the design. Similarly, to order many long lead items, the expertise of suppliers was used in this phase. Rules to select suppliers and subcontractors were developed jointly by the Alliance. The objectives of Big Room were fast information flow, transparency and openness of operations, and stimulating conditions for innovative operations. For practical reasons, however, the Big Room was divided between Tampere and Helsinki and provided with video conference equipment for smooth communications. Around thirty to forty people at a time would be working in the Big Room. Only those who were needed to discuss the topic of that particular day's session was required to attend it. The workshops ensured that they weren't

overcrowded as it would then be rendered unproductive. For example, only the critical designers (i.e., those with one hundred percent workload) were situated in the Big Room at a time. The alliance facilitator was tasked with assisting the project team and its members in coaching new employees for the alliance, evaluating the alliance's operations and making proposals for development measures to the AET and APT.

There was an painshare/gainshare monetary incentive system in place (like in most Alliance contracts) which mainly rewarded contractors for breakthrough or exceptional performance during the implementation phase. However, the environment in the Big Room sessions during the development phase was such that it was a big facilitator of innovations. An example of an informal mechanism in place was that if anyone came up with an innovative idea, they would definitely not have to execute it. This cancelled out any kind of hesitation or psychological barrier or the burden of seeing the idea through which a team member would have before coming up with an idea. This increased the reporting of good ideas. Such actions were also rewarded with non-monetary but morale boosting incentives like a film ticket or taken out for lunch or some other recreational activities. This reward exercise was done every week where some team member or the other would make an observation about a safety problem (especially during the execution phase) or any kind of innovation, irrespective of whether their idea is eventually implemented or not.

Decisions were made together and unanimously in the alliance. However, the Client is entitled to make a unilateral decision on moving from the design phase to the implementation phase after the AET has approved the target cost and other documents. There was no system of voting to come up with decisions. Instead, decisions were arrived at through extensive dialogue and consensus.

The 'Last Planner Wall' system was used in Big Room sessions to help everyone know what the other team is planning, what their milestones are, etc. For example, if the contractor planned to start concreting for abutments on a particular date, he would mention it on the wall. So, the design team is aware that they have to keep the design ready by that date. If something was not possible, it would be discussed during the Big Room sessions. It helped others plan their activities ahead. This was mainly done during the construction phase.

Involvement of external stakeholder community

There was a high and active involvement of the residents around the tunnel location in the design phase. The philosophy was that it is very important to take their opinion while developing the design because for many of them the tunnel would be the first object visible when they look out of their window every morning, the construction activities (like blasting) would cause nuisance to them, and this was a good way to prevent any resistance or opposition to any of the tunnel works which could potentially hamper the progress of the project. Hence, it was vital to consider their inputs. For example, there were a few noise barriers and ventilation pipes in the tunnel that were not very aesthetically pleasing. So, the representatives of people living around the tunnel were given a chance to influence the way in which they are concealed. Art competitions were conducted by the Tampere Art Museum during in which many local Finnish artists participated and then the museum selected the winner (i.e., the one who is able to make the most visually appealing design) based on a voting system involving the representatives of people living in the tunnel area. Also, people from daycare schools were invited to paint the temporary fences around the construction works.

Also, since public image was one of the key result areas, a detailed project communications plan was made in the development phase. The doors of the Big Room were open to anyone living in the city of Tampere at all times from Monday to Friday. They were invited to these sessions through social media platforms and other media events. They were constantly kept in loop about what the previous and current progress was. Monthly meetings were held to listen to and address any concerns or queries they had regarding the project and how it would affect them. Around 50 to 100 people would attend the meeting every month. Based on these concerns, work schedules were modified to suit everyone. It was believed that their involvement never caused a delay in the project but instead resulted in some good innovative ideas.

Relationship Continuity

About working with the same partners in the future, Interviewee 1 said that the public procurement procedures in Finland guide the selection of alliance members. Having said that, he would like to work with the same partners in other projects if they perform well in the bidding process. The collaborative tools used in this project have been incorporated in the many other projects by the Client, even in those having different contractual models like Design and Build, Design-Bid-Build. The same goes for the contractor. So, the experience from this project has enabled all parties to compete more competitively.

Inter-team working

There were no major issues concerning the communication protocols within the Alliance. There was the culture of transparency while sharing information. When the team comes across a mistake, the first priority is to communicate it to everyone involved and then address the issue without to put the blame on any specific person or group. After addressing the issue, steps are taken to do a root cause analysis to identify ways in which it could be avoided in the future. The reason why the communication of mistakes or errors was so efficient was because there was a system in place which facilitated this behavior. A person admitting to his own mistake and showing that he/she learnt from that mistake and perhaps also has a possible solution is rewarded instead of punished. If there was a culture which ridiculed mistakes and created a hostile environment, then people would start hiding them. However, the Interviewee 1 felt that communication of progress, targets, daily information should have been more graphic and involving more visuals. It could have been used to do a quick check on where things stood and what the areas of improvement were.

Sometimes the communication between the different technical disciplines of bridges, tunnels, etc. was slow but that didn't have a huge impact on the progress. About Balanced Contribution, instead of looking for faults, parties focused on how well they could complement each other in strengths and weaknesses. If it was ever felt that the Alliance required more competence, it was mutually decided how to acquire it. Since it was in the best interest of the project and the Alliance in specific to achieve desired outcomes together, everyone involved contributed with their full potential and helped each other out wherever required. Of course, one of the main problems faced was that the main designer could not commit resources to the project all the time since they were simultaneously working on various projects. As a result, there were occasional delays caused also because, as stated Interviewee 3, some of the persons working in the design team were less competent than the others. He also felt that this aspect of working on many projects at once was not communicated honestly in the Alliance at the beginning by

the design team. However, efforts were taken later to improve the coordination and come up with solutions causing the least inconvenience to all projects.

Appendix 5: Project U1 (Detailed)

Front End Development

There were 10 quality criteria mentioned in tender documents which weighed 60% of the assessment while the remaining 40% was price related. However, since the contractor was already known to the client there were no real workshops to assess the collaborative behavior. The understanding was based on the relationship built over the years. Familiarity played a big role. The only team-building event conducted at the end of the ECI phase was an Escape Room game session where team members were locked inside a room and given clues to solve to escape out of it. This helped team members get to know everyone who was going to be a part of the construction phase since they already started working collaboratively.

Initially there was a separate bid manager appointed by the contractor for tendering the project and coming up with the final price. This bid manager was not collocated with the client team since he was used to working in a traditional way (this was the first NEC4 project done by the contractor). The client wasn't happy with this way of working since they wanted to have more collaboration and engagement with the contractor in the ECI phase such that they clearly understand the goals and objectives of the project. Later, the bid manager was removed and the contractor started working more collaboratively with the Client. The benefits of collocation were the linkage between the various stakeholders and ease of discussing construction plans. Every team member could physically go and discuss with any client member aspects of the design instead of merely working on it separately and just sending it to the Client. Interviewee 2 feels that the Client had a clear understanding of their goals and objectives but should have made their requirement of collocation and intense collaboration more explicit through contract documents or any other communication form.

There was no separate Project Start-Up phase before the beginning of the ECI phase. All joint activities like creating the project charter, workshops to discuss goals and objectives were done towards the end of the ECI phase to set the tone for the construction phase. The process of creating the project charter was as follows: each party would put up their ideas on color-coded chits (one color for each party) on a big board in the meeting room. Ideas were categorized, common ones were combined and finalized which would make it to the final document. A screenshot of the project charter is given below:

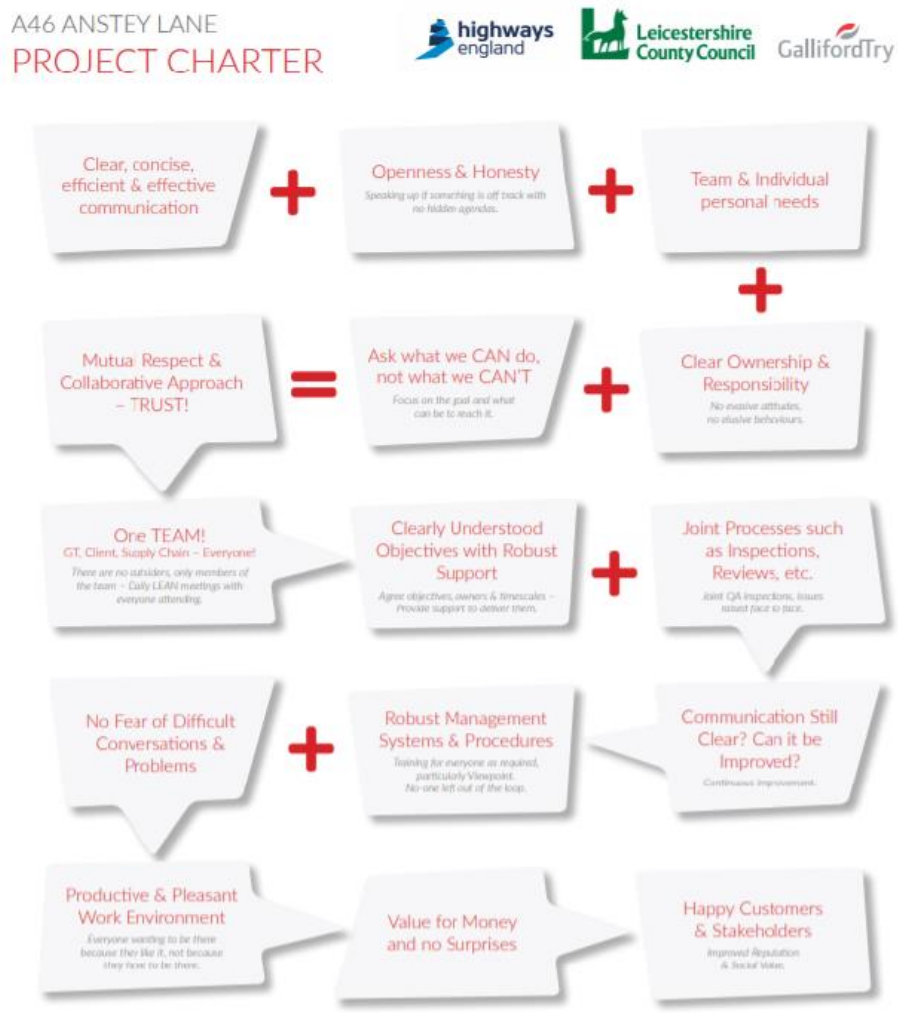

Figure 11: Project Charter at U1

The project charter was not a dynamic document. It was put up on the big board with everyone's signatures to serve as a reminder of the agreed core values.

During the team-building event discussions happened even on a personal level where people could even state preferences like 'leaving early on a Thursday due to prior commitments', what their likes and dislikes are, etc. such that everything was made clear to the entire team at an early stage. As part of the contract, the contractor had to name the persons who would be forming a part of the team. If any of them needed to be changed, an approval system was in place by the Client.

Team Integration

The entire team was integrated as a single unit. Contractually, there was a structure that the Client issues an instruction to the contractor and they in turn give it to the subcontractor. But, while working, there was an atmosphere of openness and absence of a communication hierarchy since the subcontractor was free to talk directly to the Client about issues faced or anything else as they wished. Even the selection of the subcontractors was a result of joint interviews by both the client and contractor. A collaborative way of working opens up more avenues for innovation because people are not focusing on issues and blaming others but instead on solving the problem.

Recognition was given to team members who performed well. For example, the liaison officer who distributed the newsletter every week included a write-up on a particular team member highlighting the achievement in the last week. This served as a tool for motivation. Verbal appreciation and emails were also predominant. Good work was also rewarded with a box of chocolates sometimes. Because of the open plan system (as explained below), everyone was aware of the good work done by a co-employee. There was also joint ownership and input for submissions made for Awards and other case studies such that credit was taken jointly by the team as a whole.

Joint Working

During the ECI phase, the team was collocated at the Client's office building. There was a separate room assigned to the contractor to work during this phase. There was a separate Project Board which consisted of Client (and other major stakeholders like HE and LCC) who discuss the high level requirements of the project. Interviewee 1 was the focal point within the ECI team to convey important decisions to the contractor's team.

ECI meetings were held weekly to discuss progress, alignment of programme of works, issues to be resolved, risk register, decision of the types of workshops to held, etc. Workshops were also conducted on key issues like traffic management, carbon efficiency, utilities, etc. to understand how critical items in the design would eventually turn out in construction. Since there was a complex relationship of the project between the main stakeholders like HE and LCC where each party had their own interest, these special workshops were arranged to get their approval at an early stage in the project. For example, knowing that traffic management was a crucial topic for LCC, a very successful workshop was conducted to decide on the dates of road closure and traffic blocking. This set the foundation for a relation of trust between the parties to work jointly towards the success of the project. A similar workshop was organized by the contractor with HE owing to previous experience of difficulties in handing over of the project. Eight department heads of HE attended these workshops to clearly state their requirements. The process of conducting such an extensive workshop was new for everyone associated with the project, but it was extremely beneficial in ensuring smooth progress of the project and relational building between parties. Interviewee 2 stated that the contractor was very pro-active in these sessions of engaging with key stakeholders. Workshops were also conducted on programme delivery with subcontractors such that the construction phase was planned well in advance to avoid any surprises at a later stage.

There were also bi-weekly commercial meetings to review the expected costs of compensation event notices (cost of change requests) to ensure that the budget on the owners' side covers the expected change costs. This meant that there was openness in terms of client budget and allocation for risks.

When the contractor was brought on board in the project, the preliminary design had already been completed. The contractor gave inputs from a constructability point of view like joining of kerbs, usage of different material and others. Only once all the parties gave their inputs to this design and they were approved would the drawings go into the next phase of design. Each drawing was labelled depending on the phase it belonged to. Only the final drawings were given to the contractor to arrive at the target price for the construction phase. The strength of the ECI team was around 10 people. The design team was divided into several components like signals, street lighting, civil, drainage, etc. The civil and drainage team was collocated with the

rest of the team and hence communication with them was not an issue. But, the signals and street lighting teams were not collocated. Unfortunately, the biggest issue in the project was in the street lighting because the quality control of the design was not very good.

The joint meetings conducted used a collaboration board with Post-It notes such that progress was visual and easily manageable (Figure 12). Actions were recorded in the form of color coded notes for different parties similar to the process of arriving at the project charter.

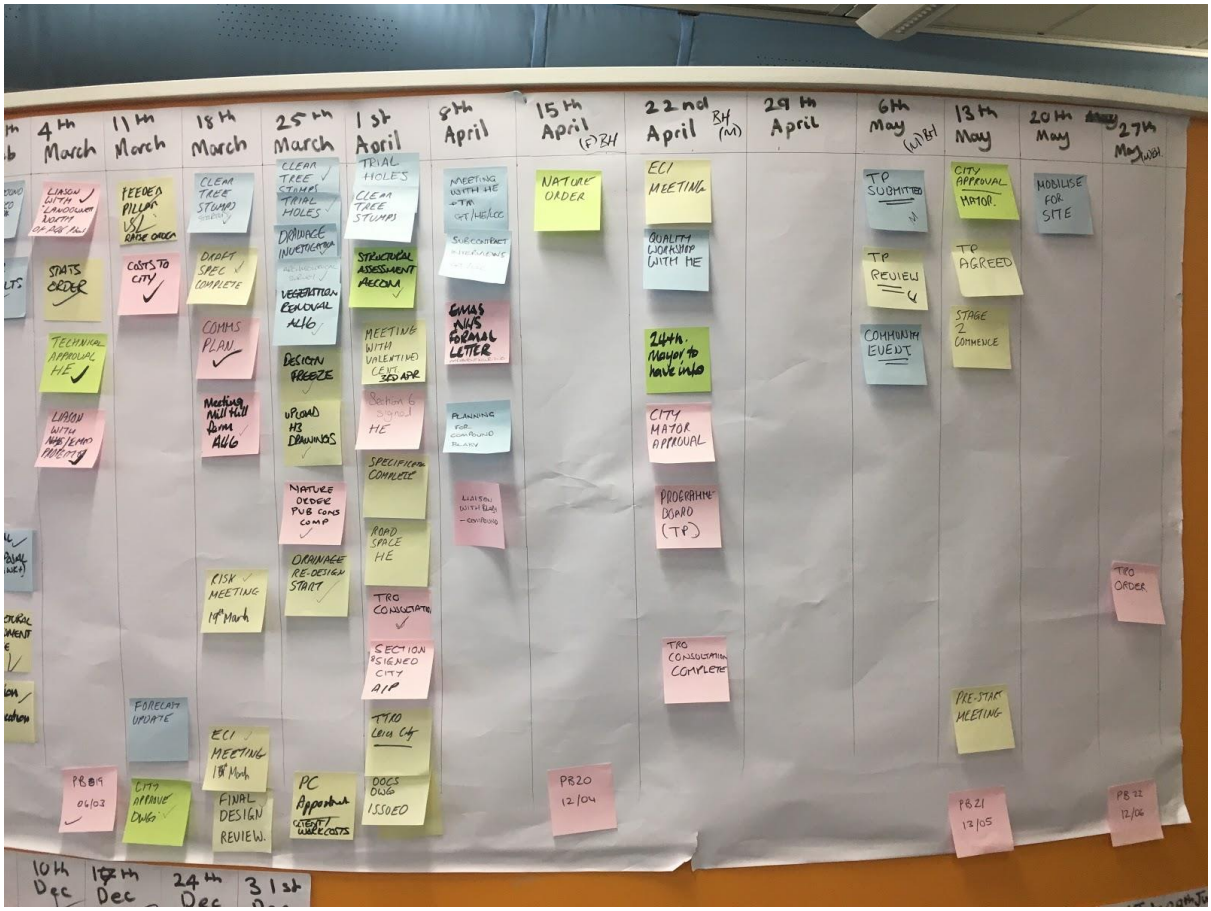

Figure 12: Collaborative Boards at U1

Engagement of External Stakeholder Community

The contractor engaged a public liaison officer who took care of all communications with the external stakeholders in the form of weekly newsletters with updates on progress, look-ahead programs and project photos. Joint community events were conducted at a local shopping center where the proposed drawings were set out and the residents in the neighborhood were free to ask questions related to the project. There were concerns about disruptions to the commute but the long-term benefits of the project were explained to them. The inputs from these users also helped in adding value to the design. For example, it enabled the project team to understand pedestrian movement and create safer routes to the centers, whereas, previously, users used a vehicular access road used by emergency vehicles and no footpaths. Mendelow's Matrix was used to categorize the stakeholders to decide their engagement strategy.

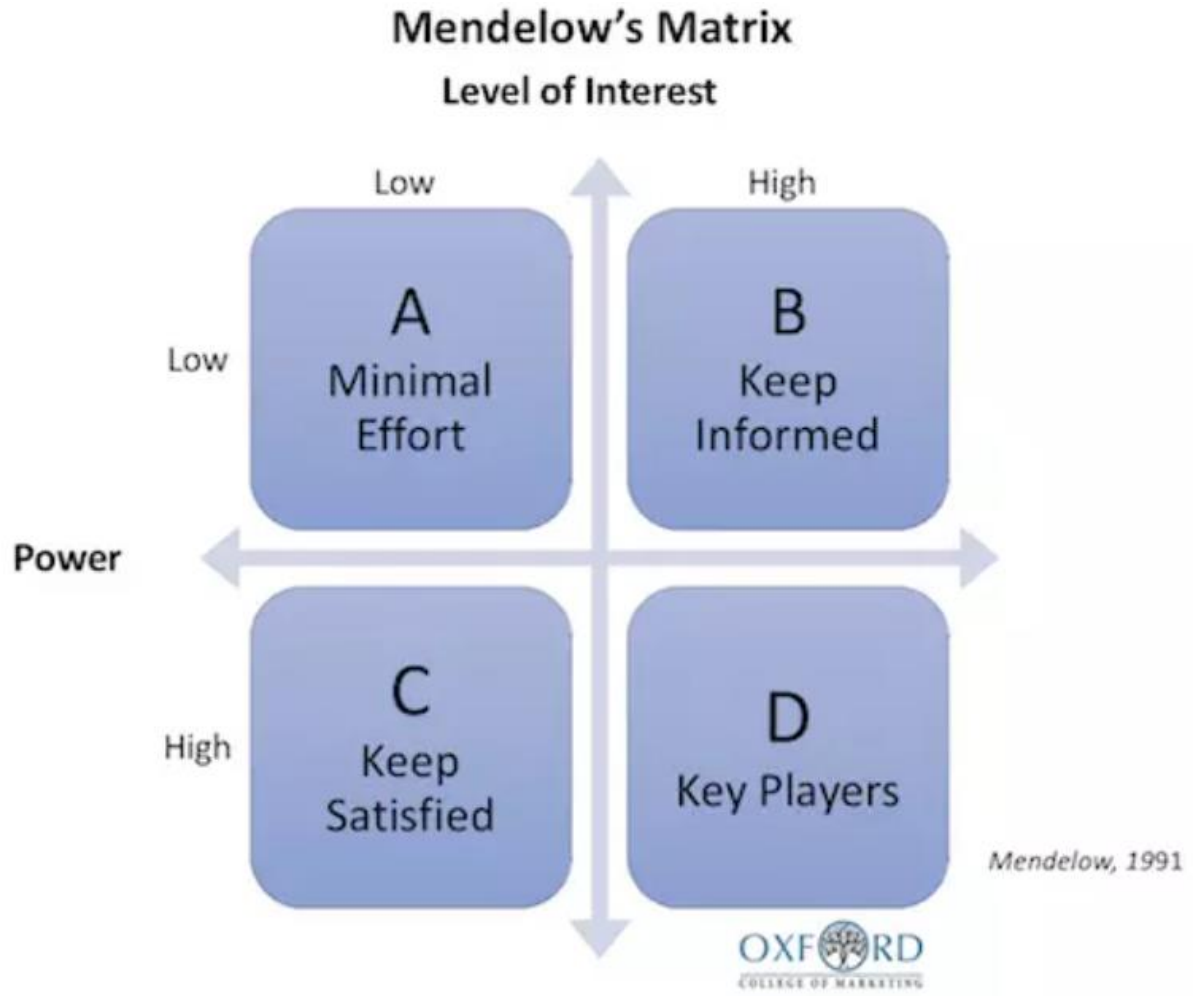

Figure 13: Mendelow's Matrix used at U1

An adjacent hospital was found to be the most important stakeholder because access was a critical issue for the hospital. Meetings were held with them where they were consulted over the design and other temporary measures put in place to maintain effective access during the scheme.

Inter-Team Working

Viewpoint was used as a shared folder containing all the updated documents and information useful for the project. Even contractual documents like early warnings, client instructions, compensation, etc. Interviewee 1 feels that immediately and honestly communicating problems to everyone in the team was a major success factor in the project. There was no element of surprise. If there was a potential problem on site, there would already be a solution ready because it was discussed in advance. There was also an environment of trust where a change request by the client was immediately executed by the contractor without waiting for an official instruction because they knew the instruction would follow soon. Interviewee 2 cited one issue which he observed. Since the atmosphere of collaboration was so collaborative and informal, decisions taken between some people were not always communicated to the entire team. There was a gradual understanding of each others' strengths and weaknesses by both teams and efforts were taken to improve them. Interviewee 1 cited an example of a team member from the contractor who was initially shy to speak in front of others but eventually molded him to

become more confident to deliver speeches to a huge crowd. There was also no conflict regarding the effort put in by each team since their entire effort was on the project.

Construction Phase

The most striking feature of the construction phase was the presence of an open plan system. It was a dedicated single-storey common space/office area for the entire team including the Client, Contractor, Main subcontractor and other key stakeholders. There were no separate offices for project managers or other personnel of any team, but instead open spaces (with no divisions) where everyone within the was free to walk in and talk to a member of another team. The contractor proposed to have mixed seating where Client and contractor representatives were not seated separately but instead combined with no apparent boundaries. This helped in strong communication both on a technical level as well as personal level and also in the induction of new members to the team. There was also a recreation room for playing table tennis where project related informal discussions could also happen. When asked about the idea of using this open plan system even during the design phase, both interviewees agreed that it could have been used but would not have been financially viable.

Daily Lean meetings were conducted by the contractor during this phase to keep everyone up to date with the proceedings of the project and discuss the plan in the coming days. Even the Client participated in these meetings. In addition to this, collaborative planning meetings and joint weekly meetings were conducted. The planning meetings were mainly to do collective planning with subcontractors to align them so that every party understands others' schedules as well. Joint Meetings were mainly to discuss project issues and other commercial issues openly with the Client.

Informal team-building events were conducted during this phase like a table tennis tournament, occasional meetups at restaurants, etc. Not many feedbacks or surveys were taken during the ECI phase to assess the satisfaction of the employees. In the construction phase, there was a feedback monitor (a touch screen) in place where people would just have to tap how happy they were on a scale of 1 to 5 and answer other simple questions to gauge the satisfaction. After a few days, the types of questions asked would change to reflect other topics. These responses were not only discussed internally but also during the Project Board meetings with the client senior management and other sponsors in addition to the progress, risks, financial status, etc. Project Reporting not only included project progress but also team satisfaction data, innovative ideas that came up during meetings, etc. The contractor prepared an interactive presentation highlighting the innovative collaborative practices being used in the project which could inspire the senior management to implement similar practices in other projects.

There was also a healthcare system in place to assess the general well-being of the team. A doctor visited the site once in six months to raise awareness on health issues, talking through difficulties and ways in which stress can be relieved. For example, since night workers were more exposed to fatigue, this practice was useful for them. This was a practice initiated by the contractor.

Appendix 6: Interview Protocol

This appendix includes the interview questions for the interviews with the eleven interviewees. The interviews are semi-structured, which means that the interviewee has the freedom to elaborate on personal experiences and knowledge on the topic.

First Interview

After establishing first contact with the interviewee via email, project documents which give information on the collaboration in the project are requested (This is only done with the first interviewee of a project). These can be tender documents, project plans, contract agreements, value for money reports, results of surveys conducted during project follow-ups, etc. During the first interview, basic information like function/role, years of experience in similar contracts and the stage of the project from which they were involved was collected. This meeting lasted around ten to fifteen minutes.

After this first interview, the RECAP assessment form is sent to them. Once the filled-in form is returned, the detailed interview is conducted based on a questionnaire developed from their RECAP form responses, literature and preliminary interviews with collaboration experts.

Detailed Interview

Based on the comments of the interviewee in the RECAP assessment form, the project documents and the type of contract form being studied, some of the questions below have either been skipped or more questions have been added. On an average, the interview lasted around one and a half to two hours.

Front-end definition

1. Can you give insight into the tender phase? More specifically, how are the quality criteria assessed?
2. How extensive was the project start-up/kick-off phase in the project?
3. Were there collaboration advisors present during the tender and design/development phase of the project?

Team Integration

1. Were different parties structured as an integrated team with no apparent boundaries?
2. How involved were the subcontractors and other operators in the design phase?
3. What kind of inter-team building workshops were conducted during the design phase?
4. What were the informal rewards and recognition mechanisms used to encourage collaborative behavior?

Joint Working Processes

1. What was the meeting structure and frequency in the design phase?
2. What were the procedures used for conflict resolution and decision-making?
3. Were there reflection meetings conducted during the design phase to gauge satisfaction of team members? If yes, what was the process of conducting these meetings, collecting and processing the feedback?

Involvement of external stakeholder community

1. How involved was the external stakeholder community in the design phase?

Involvement of Senior Management

1. Was the senior management committed to provide resources and support to their project teams?
2. How was the mutual engagement between the senior management of all parties?

Inter-Team Working

1. How efficient was the communication and coordination between parties?
2. What were the tools used to communicate within teams?
3. Was there any conflict regarding the effort that each team put into this project?
4. Were all the team members personally engaged to the project?
5. What were the efforts taken to develop a culture of trust?

General

1. Which of the above categories/indicators/practises do you consider to be the most important in making the project a success? And why?
2. What are the lessons learnt from this project and how would you like to approach it in the future?

Appendix 7: List of Interviewees

7.1 Case Studies' Interviewees

Project Code	Name of Interviewee	Organization	Remarks
B1	Joost Merema	PRO6 managers	Interviewee 1
	Willem Wagenaars	Wagenaars Management B.V.	Interviewee 2
	Monica Melis	Dura Vermeer Infra B.V.	Interviewee 3
B2	Ninke Hanenberg	AT Osborne	Interviewee 1
	Daan Seesing	Seesing Project Management & Advies	Interviewee 2
	Ruben Bosveld	Engie Services Nederland NV	Interviewee 3
F1	Mauri Mäkiaho	Finnish Transport Infrastructure Agency	Interviewee 1
	Matti Aitomaa	YIT Finland	Interviewee 2
	Kari Niemi	A-Insinöörit	Interviewee 3
U1	Teresa Hylton	Waterman Aspen	Interviewee 1
	Shaun Beales	Galliford Try	Interviewee 2

7.2 Validation Experts

Sr. No.	Name of Expert	Organization	Remarks
1	Cécile Claessen	Cohezy	Expert 1
2	Simon Cardwell	Pulse Consultant	Expert 2
3	Mark Siewers	PRO6 managers	Expert 3