NEC4 ECC CONTRACTING FOR DUTCH INNER-CITY INFRASTRUCTURE PROJECTS

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PROJECT DETAILS

Master's thesis subject:	Research to investigate how to move away from the current adversarial practices in the Dutch infrastructure sector by means of the NEC4 ECC.

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PREFACE

This thesis is my graduation thesis for the MSc Construction Management & Engineering of the faculty of Civil Engineering at the Delft University of Technology. In this thesis, the collaboration between the client and contractor on Dutch inner-city infrastructural projects is studied. By means of contractual clauses in the NEC4 ECC, I have tried to find a way to stimulate the collaborative relationship between the client and contractor. In my opinion, the contract is only one of the many factors that effects the relationship between parties. What the research shows is that the contractual clauses are able to have an effect on the behaviour of parties connected to the contract, which is taken into consideration when providing a strategy for implementation. Collaboration in this research is seen as a means to increase project performance in the end and not as a purpose in itself.

During the process of graduating and writing this thesis I have received a lot of help and support of many people. At first, I want to express my firm gratitude to my graduation committee from the TU Delft, Hans Bakker, Louis Lousberg and Mark de Bruijne for helping me through the process. During the meetings you provided useful feedback to increase the level of my thesis and to raise awareness to myself to be more critical on my own works. Secondly, I want to thank the graduation company, Aratis, for all the opportunities and the ability to develop a network of people around the subject of my thesis. Special thanks to Menno Wouda as a member of my committee and mentor at the company for guiding me through the process of writing my thesis and regular brainstorm sessions.

I am very grateful for the opportunities I have gotten to educate myself and meet new people during the last three years I spend in Delft. I want to thank my family, especially my parents and sister, for continuously supporting me in my ambitions. Last but not least, I want to thank my friends in Terneuzen and in Delft for the support and all the fun times we have had and will continue to have. I am looking forward to start working, which commences a new exciting period. I hope you enjoy reading this thesis.

Kind regards,

Niek Lauret
November 3, 2020

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MANAGEMENT SUMMARY

This thesis includes the research performed to investigate how to move away from the current adversarial practices in the Dutch infrastructure sector found in the current way of contracting. Adversarial practices are defined as each party pursuing their own concerns at the other party's expense. As a result of this, the industry is not performing to its maximum.
The objective of this research is therefore to stimulate client-contractor collaboration in Dutch inner-city infrastructure projects in order to move away from the adversarial practices. In the way the current UAV-GC is applied in projects, dysfunctional conflicts arise between the client and contractor. This research aims to find opportunities for improvement in the UAV-GC by means of clauses from the NEC4 ECC contract. The NEC4 ECC contract is a relational way of contracting, which is relatively new for the infrastructure sector.
The conventional way of contracting (UAV-GC) shows that each party often concerns its own interests rather than the interest of the projects as a whole. Not all available knowledge is used, risks are not distributed accordingly, with as a result that project underperform. Relational contracting provides a method to stimulate collaboration by focussing on the relation and behaviour of concerned parties. A way of relational contracting is project partnering, which is a method of transforming contractual relationships into a cohesive, project team with a single set of goals. Project partnering can be seen as more of a philosophy, to which the NEC4 ECC contract provides a contractual environment. On basis of the problem definition and the objective of this research, the following research question is set out:

Which clauses from the NEC4 ECC are able to stimulate client-contractor collaboration in Dutch inner-city infrastructure projects?

The projects included in the scope of this research are Dutch inner-city infrastructure projects with a budget of €10-50 million based on an UAV-GC contract. Inner-city infrastructure projects have a certain level of complexity (detailed and dynamic), because of the interaction with the surrounding works and ongoing transportation. The UAV-GC is applied when knowledge from the contractor is needed to provide a solution to challenges in the project during the design phase, which is of interest for this research. The budget of €10-50 million is chosen because parties have a certain level of interest in establishing a collaborative relation to achieve maximum performance, but are not too large, which can introduce other financial mechanisms and increased interests.

The research methods that are used to provide an answer to the research question are firstly a literature study to provide a basis for the rest of the research, followed by a (multiple) case study to analyse practical experiences.

The literature study goes further into detail on the problem definition and via a logical line of reasoning works towards a possible solution to the problem. Two products result from the literature study. At first, the problem definition is clarified with a result that opportunities for improvement within projects using the UAV-GC are listed. These opportunities result from research that shows what situations lead to the client and contractor not collaborating. These opportunities for improvement are:

- Allocating responsibilities
- Establishing a cooperative environment
- General applicability of the contract
- Financial matters
- Delivering Information

The second product from the literature study is the NEC4 ECC clauses that show potential to stimulate collaboration according to the collaborative elements found in the literature. The NEC4 ECC clauses that can potentially stimulate collaboration according to the literature study are:

- Clause 15: Early warning mechanism
- Clause 25: Working with the client and others
- Clause 30: The programme
- Clause 32: Revising the programme
- Clause 50: Payment
- Clause 54: The contractor's share
- Clause 60: Compensation events
- Clause 90: Termination
- Dispute resolution option W1 & W3
- X5: Sectional completion
- X6: Bonus for early completion
- X7: Delay damages
- X20: Key performance indicators
- X22: Early contractor involvement

The conclusion of the literature study is the starting point of the case study, which is a multiple-case study, followed by a cross-case analysis and concluded by a validation. Opportunities for improvement for collaboration in relation to the UAV-GC are studied. Out of the five opportunities for improvement found in the literature study, two are found in the cases included in the case study: allocating responsibilities and establishing a cooperative environment.

The NEC4 ECC clauses that show potential to stimulate collaboration are reflected to experiences in the cases with likewise clauses present in the UAV-GC. As a result of this, the potential of the NEC4 ECC clauses is displayed as a contribution for the opportunities for improvement in the UAV-GC.
The cross-case analysis thereafter combines all the results from the individual cases. The main result from the cross-case analysis are the NEC4 ECC clauses that show potential to stimulate collaboration linked with the opportunities for improvement in the UAV-GC. The results are captured in the following figure.

Opportunity UAV-GC	**NEC4 ECC clausules**	
Allocate responsibilities	**General conditions** Early warning Pain/gain sharing Open book economy	**Secondary option clause** Early contractor involvement
Cooperative environment	**General conditions** Cooperation agreement Key dates Set up (and revise) the programme Early warning Pain/gain sharing Open book economy	**Dispute resolution option** Dispute avoidance board **Secondary option clause** Early contractor involvement Partial completion

The results from the case study need to be validated in order to be representable for project within the scope. This is done by means of an expert panel, consisting of people with different backgrounds (lawyers, contract managers, project managers and policy makers). The experts validated that both the opportunities for improvement for the UAV-GC often come across in projects included in the scope. Furthermore, the expert panel validated that the NEC4 ECC clauses, as displayed in the table above, indeed show potential as input for the opportunities for improvement as included in the figure before.

In order to finish up the research, the main research question is answered in the following sentence:

The clauses from the NEC4 ECC that are able to stimulate client-contractor collaboration in Dutch inner-city infrastructure projects are: early contractor involvement, collaboration agreement, target cost contract with open book economy, early warning, dispute avoidance board, partial completion and key dates, and developing and reviewing the programme.

Added to the validation in this report, the conclusion shows how the above NEC4 ECC clauses are able to stimulate collaboration and how these clauses can be implemented in Dutch inner-city infrastructural projects. All of the clauses can be divided into three themes: General collaboration, Time and Payment. The clauses on general collaboration and time are also found in the cases applying the UAV-GC, therefore these clauses prove to be able to stimulate collaboration according to the interviewees and experts. The clauses on payment are not displayed in the cases and are therefore of added value when adding them to the UAV-GC contract according to the interviewees and experts.

MANAGEMENT SAMENVATTING

Deze scriptie bevat een onderzoek wat in gaat op hoe botsende relaties tussen de opdrachtgever en opdrachtnemer binnen Nederlandse infrastructurele projecten, die het gevolg zijn van de huidige manier van contracteren. Botsende relaties worden gedefinieerd als: elke partij streeft zijn/haar eigen belangen na ten koste van de andere partij. Het resultaat hiervan is dat de infrastructurele sector niet maximaal presteert.
Het doel van dit onderzoek is daarom om samenwerking tussen de opdrachtgever en opdrachtnemer te stimuleren binnen Nederlandse infrastructurele projecten, zodat er afstand gedaan wordt van de vijandige relaties. Hoe de UAV-GC op dit moment toegepast wordt, zorgt ervoor dat er dysfunctionele conflicten ontstaan tussen de opdrachtgever en opdrachtnemer. Dit onderzoek heeft dan ook als doel om kansen in de UAV-GC te vinden voor verbetering door middel van clausules en methodes vanuit het NEC4 ECC contract. Het NEC4 ECC contract is een relationele manier van contracteren, wat relatief nieuw is voor de huidige infrastructurele sector.
De conventionele manier van contracteren (UAV-GC) laat vaak zien dat partijen hun eigen belang na streven in plaats van de belangen van het gehele project. Niet alle beschikbare kennis wordt toegepast, risico's worden niet goed verdeeld en projecten zijn gedoemd om onder te presteren. Relationele contracten bieden een methode om samenwerking te stimuleren door de focus te leggen op de relatie van de betrokken partijen en het gedrag van de mensen. Een manier van relationeel contracteren is project partnering, wat een methode is om contractuele relaties te transformeren in een hecht project team met een gezamenlijk doel. Project partnering wordt echter meer als een filosofie gezien, waar de NEC4 ECC een goede contractuele omgeving voor biedt. Op basis van de probleemdefinitie en het doel van het onderzoek is de volgende onderzoeksvraag geformuleerd:

Welke clausules uit de NEC4 ECC kunnen ervoor zorgen dat samenwerking tussen de opdrachtgever en opdrachtnemer gestimuleerd wordt in Nederlandse binnenstedelijke infrastructurele projecten?

De projecten die binnen de scope bekeken worden in dit onderzoek zijn Nederlandse binnenstedelijke infrastructurele projecten met een budget van €10-50 miljoen die gebruik maken van een UAV-GC contract. Binnenstedelijke infrastructurele projecten brengen een bepaalde complexiteit (gedetailleerd en dynamisch) met zich mee, omdat er veel interactie is met de activiteiten in de directe omgeving. De UAV-GC wordt toegepast wanneer de kennis van de opdrachtnemer nodig is om bepaalde uitdagingen in het project aan te gaan tijdens de ontwerpfase, wat voor dit onderzoek interessant is. Het budget van de projecten binnen de scope is zodanig gekozen dat er een bepaald belang is voor beide partijen om een goede samenwerking te creëren. Het budget van het project mag echter niet te groot zijn, omdat er dan hele andere financiële mechanismen en belangen bij komen kijken.

De onderzoeksmethodes die zijn toegepast om antwoord te geven op de onderzoeksvraag is als eerste een literatuuronderzoek om een basis te leggen voor het onderzoek, gevolgd door een case study om een praktische analyse te kunnen maken.

Het literatuuronderzoek treedt verder in detail wat betreft de probleemdefinitie en via een logische lijn van redeneren wordt er een voorstel gedaan voor een oplossing van het probleem. Uiteindelijk resulteert het literatuuronderzoek in twee producten. Als eerste worden kritische punten ten opzichte van de UAV-GC uit verschillende onderzoeken gekoppeld in onderwerpen. Deze onderwerpen presenteren de mogelijkheden voor verbetering van de UAV-GC. De punten voor verbetering zijn:

- Toewijzen van verantwoordelijkheden
- Ontwikkelen van een coöperatieve omgeving

- Toepassen van algemene contractuele voorwaarden
- Financiële kwesties
- Aanleveren van informatie

Het tweede product van de literatuurstudie zijn de NEC4 ECC-clausules die potentie bieden om samenwerking te stimuleren volgens samenwerkingsfactoren. Deze clausules zijn:

- Clause 15: Early warning mechanism
- Clause 25: Working with the client and others
- Clause 30: The programme
- Clause 32: Revising the programme
- Clause 50: Payment
- Clause 54: The contractor's share
- Clause 60: Compensation events
- Clause 90: Termination
- Dispute resolution option W1 & W3
- X5: Sectional completion
- X6: Bonus for early completion
- X7: Delay damages
- X20: Key performance indicators
- X22: Early contractor involvement

De conclusie van de literatuurstudie is het startpunt van de case study, welke een multiple-case study is, gevolgd door een cross-case analyse die vervolgens gevalideerd wordt. In de case study zijn de mogelijkheden tot verbetering van de UAV-GC onderzocht en in de cases komen de volgende twee punten naar boven: toewijzen van verantwoordelijkheden en ontwikkelen van een coöperatieve omgeving.

De NEC4 ECC-clausules uit de literatuurstudie zijn onderzocht als eventuele toepassing op de projecten in de case study die gebruiken maken van een UAV-GC contract. In de cross-case analyse zijn vervolgens resultaten van de individuele cases tegen elkaar uitgezet. De belangrijkste uitkomst van de cross-case study is de koppeling van de NEC4 ECC clausules die potentie bieden om samenwerking te stimuleren met de mogelijkheden tot verbetering van de UAV-GC. Het figuur hieronder laat de resultaten hiervan zien.

Mogelijkheden tot verbetering UAV-GC	**NEC4 ECC clausules**	
Toewijzen van verantwoordelijkheden	**Algemene voorwaarden** Early warning Pain/gain sharing Open book economy	**Secundaire optionele clausule** Early contractor involvement
Ontwikkelen van een cooperatieve omgeving	**Algemene voorwaarden** Cooperation agreement Key dates Set up (and revise) the programme Early warning Pain/gain sharing Open book economy	**Dispuut resolutie optie** Dispute avoidance board **Secundaire optionele clausule** Early contractor involvement Partial completion

De resultaten van de cross-case analyse zijn gevalideerd om representeerbaar te kunnen zijn voor projecten binnen de scope. Dit is gedaan door middel van een expert panel, bestaande uit professionals met verschillende achtergronden (advocaten, contract managers, projectmanagers en beleidsbepalers) om verschillende visies op de resultaten te geven.
De experts hebben gevalideerd dat de mogelijkheden tot verbetering van de UAV-GC ook terug te vinden zijn in andere projecten binnen de scope. Ook de toepasbaarheid van de NEC4 ECC clausules als potentie voor het stimuleren van samenwerking en als invulling voor de mogelijkheden tot verbetering is gevalideerd.

Om vervolgens het onderzoek af te ronden, kan het antwoord op de hoofdvraag samengevat worden in de volgende zin:

De NEC4 ECC clausules die samenwerking kunnen stimuleren tussen opdrachtgever en opdrachtnemer binnen Nederlandse infrastructurele binnenstedelijke projecten zijn: early contractor involvement, collaboration agreement, target cost contract with open book economy, early warning, dispute avoidance board, partial completion and key dates, and developing and reviewing the programme.

Als aanvulling op de validatie laat de conclusie nog zien hoe de NEC4 ECC-clausules een mogelijkheid bieden om samenwerking te stimuleren en hoe deze toegepast kunnen worden in de huidige praktijk. Alle clausules kunnen verdeeld worden over drie verschillende thema's: Algemene samenwerking, Tijd en Betalingen. De clausules over algemene samenwerking en tijd zijn ook te vinden in de huidige UAV-GC, waarmee wordt aangetoond in dit onderzoek dat deze clausules inderdaad een mogelijkheid bieden om samenwerking te stimuleren. De clausules over betalingen zijn niet in de UAV-GC terug te vinden en kunnen daarom van toegevoegde waarde zijn wanneer deze toegevoegd worden aan de project specifieke UAV-GC contracten volgens de geïnterviewden en experts.

DEFINITIONS

Word	Description
CM	Contract Manager
Fast track procedure (Raad van arbitrage)	This arbitral procedure is aimed at settling disputes as fast as possible during the construction phase. At short terms a binding advise is given.
Integrated contract	Integrated contract is an umbrella term for different contractual models as: design and construct (D&C), turnkey, design build finance maintain (DBFM) etc. (Stam, 2016). These contractual models have in common that different project phases are integrated in one contractual model.
IPD	Integrated project delivery model
IPM	Integrated project management model
NEC	New Engineering Contract (NEC) is a contractual model for construction projects, which originates in the United Kingdom, but is internationally used. It is characterized by its plain language, with the aim to stimulate good management and its flexibility as a fit for purpose contract on varying projects.
NEC4 ECC	The NEC4 ECC is the fourth edition of the New Engineering contract, set up as an integrated contract where the engineering and construction responsibilities are with the contractor.
ON	Opdrachtnemer (contractor)
OG	Opdrachtgever (client)
PSU	Project start up
PFU	Project follow up
PM	Project Manager
ProRail	ProRail is the railway manager of the Netherlands.
Rijkswaterstaat	The executive agency of the ministry of infrastructure and water management in the Netherlands.
TBGN	Tijdelijke buitengebruikname (temporary decommissioning)
Transactional contract	Contracting method focussed on monetarised values, such as money and working hours.
UAV	The Uniforme Administratieve Voorwaarden (UAV) are a traditional Dutch form of contracting in the construction sector. A client applies the UAV if only the construction of the project is procured to a contractor and the rest of the activities is carried out by the client itself (Pianoo, 2020).
UAV-GC	The Uniforme Administratieve Voorwaarden on Geïntegreerde Contracten (UAV-GC) are a Dutch form of contracting in the construction sector. A client uses the UAV-GC when more responsibilities and tasks are with the contractor. It is often used when the design and construction of a project are within the responsibilities of the contractor (Pianoo, 2020).
UO	Uitvoeringsontwerp (execution design)

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PART I INTRODUCTION

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Chapter 2: Research design

1. INTRODUCTION TO RESEARCH

The aim of this chapter is to provide an introduction to the report by elaborating on the background of the problem definition and giving a direction where the solution to the problem may be found. To conclude this chapter, an overview of the whole report is given to support the reader in going through the report.

1.1 Developments in composition of Dutch infrastructure projects

The infrastructural market is expecting a growth of 3.4% between 2018 and 2023, but what is more important is the increased complexity and changing composition of projects (Rijkswaterstaat, 2019). Dutch government organizations also recognise the current changing composition of projects and have developed a market vision document to show what future ambitions there are to improve project performance. The market vision document published in 2016, signed by multiple organizations including Rijkswaterstaat, Proroil and several other big governmental companies elaborates on future ambitions. Below, the ambitions mentioned in the market vision document most relevant to this research, are summarized (Marktvisie, 2016)

- Moving from hierarchical structures to a more collaborative environment throughout the whole construction industry chain.
- Instead of working from self-interest, think, work, act and learn through the construction industry chain.
- Moving from an adversarial relationship to excel in works that have started from realistic preconditions (reële randvoorwaarden)
- Stepping away from opportunistic behaviour towards early collaboration in terms of discussing risks and dilemmas.

Apart from the changing composition and complexity what is concerning is that the current infrastructural market already faces multiple problems such as cost overruns and delays and these problems may get worse with the changing composition and increase of complexity (Matton Van den Berg & Kamminga, 2006).

In 1994, the UK government and industry commissioned a report to investigate the perceived problems in the construction industry. The author of the report: Sir Michael Latham, described the construction industry as ‘ineffective’, ‘adversarial’, ‘fragmented’ and ‘incapable of delivering for its customers’ (Latham, 1994). A second report by Sir John Egan in 1998 advised on opportunities to improve efficiency and quality of the UK construction industry (Egan, 1998). These two reports delivered a large impact on the UK construction industry, by shedding light on the occurring problems. The, by Latham (1994) described, adversarial relations, do not only occur in the UK. The US and the Netherlands have similarly reported on the importance of improving adversarial relations in a collaborative effort (Cheung, 2015; van Riggelen, 2019). A major factor contributing to adversarial relationships is the conventional way of contracting, which will be elaborated below. Further on in the report, the exact criticism is explained, and solutions are proposed.

Integrated contract (UAV-GC)
To counter the challenges in the Dutch construction industry, the UAV-GC was introduced in 2005. The aim of this type of contract is to change responsibilities between the client and contractor, whereas the contractor is responsible for the design and the construction (Bleeker, 2014). Apart from the

successes of the UAV-GC, there appeared some faltering in the implementation of this contract. Shifting responsibilities came with ambiguous situations for both parties. Due to conditions in the UAV-GC, both client and contractor were afraid to share their knowledge and expertise because in their perception that would mean that full responsibility was taken on that matter. As a result of this, not all available knowledge was used, risks were not distributed accordingly, and projects were doomed to underperform (Chao-Duivis, 2019). According to Chao-Duivis, causes of this problem are the legal nature of the contract and setting the price of the project too early (Chao-Duivis, 2019; Strang, 2017). As seen in the literature, this problem also occurs in other countries, where conventional (transactional) forms of contracting have dominated the sector. As a result, contractors and clients tend to undermine each other at every turn, creating a hostile and litigious environment. An often-mentioned solution is a move towards more collaboration through the chain applying relational contracting. These practices are already popular in other industries (manufacturing and mechanical engineering) and first implementations in the construction industry already show promising results (Bishop et al., 2009; Harper, Molenaar, & Cannon, 2016).

Relational contracting

Ghassemi and Becerik-Gerber mention that the conventional way of contracting (transactional contracts) encourages each party to concern itself with its own interests rather than the interest of the projects as a whole (Ghassemi & Becerik-Gerber, 2011).

Opposing to the conventional way of contracting, a relatively new way of contracting is seen, namely relational contracting. Relational contracting provides a method to stimulate collaboration by focussing on the relation and behaviour of concerned parties (van der Veen & Altes, 2011). With the different approach to contracting and collaborating in a project, relational contracting applies the key element that parties cooperate on an equal basis (Kamminga, 2008).

By putting the focus on relations, the relational contracting theory acknowledges that contracts are embedded in relations and introduces relational norms to accommodate them.

Further incorporating collaboration into a contract, the relational contracting theory shows that guiding principles are to specify functions of the agreement, specify goals of the agreement and to plan for flexibility. Specifying goals and functions of the agreements sets out responsibilities and a common goal for involved parties.

Forms of relational contracting are studied in this report to come up with the specific contract type that proves to be most promising in terms of stimulating collaboration and moving away from the adversarial relationships.

1.2 Report structure

The structure of the report is shown in Figure 1. The report is divided into four parts: the introduction, literature study, case study and synthesis. The first part provides an introduction to the problem definition and further explains how the way of working is structured towards a possible solution to the problem definition. Part two includes the literature study, which continues on the problem definition and step-by-step works towards the possible solution of the problem through the available literature. The case study in part three examines the possible solutions in practice and goes further in depth on the exact problems that arise. Part three finishes off with a cross case analysis, which combines all the knowledge from the case study as an input for the synthesis. Part four, the synthesis, includes an implementation strategy based on the cross-case analysis and is validated by an expert panel. To round up the report, a conclusion is given and a discussion touches on the limitations and implications of the research and recommendations for further research.

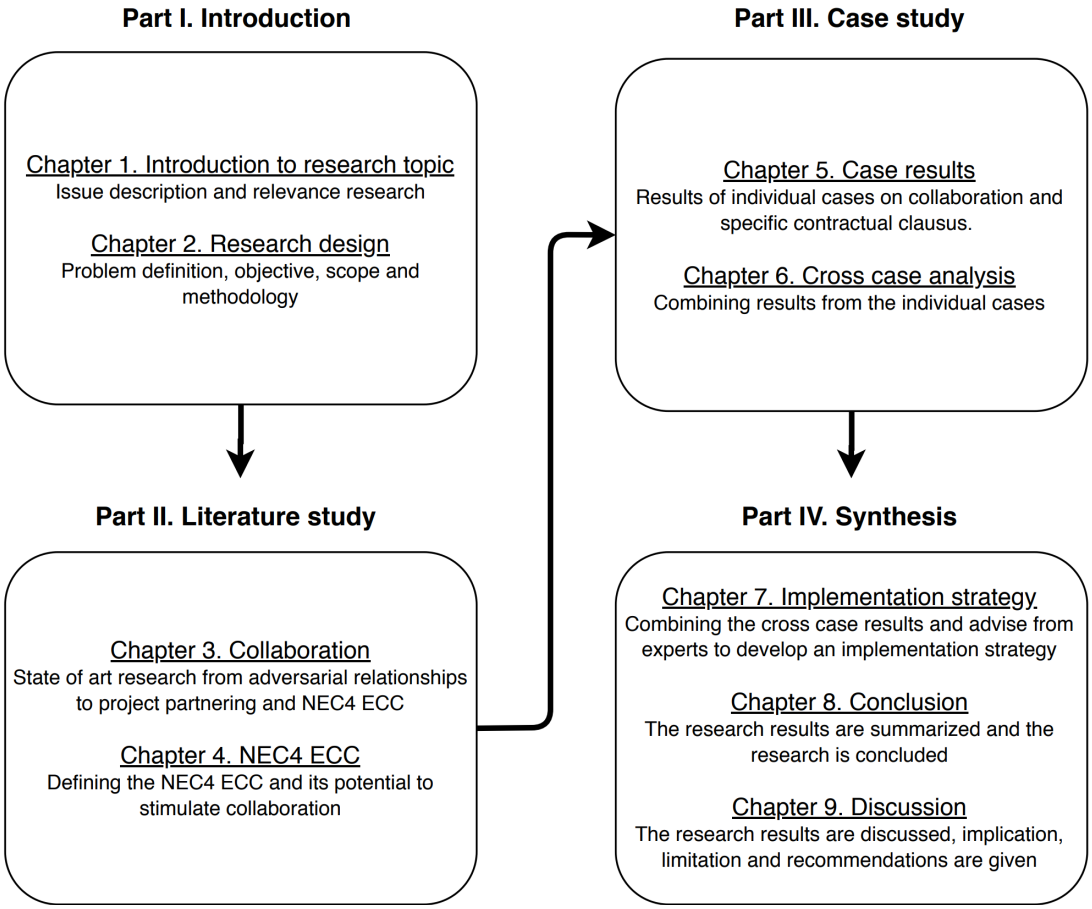

Figure 1 Report structure

2. RESEARCH DESIGN

2.1 Problem definition

The main problem at the basis of this research is the current adversarial practices that are found in the Dutch infrastructure sector found in the current contracting methods. As a result of this, the industry is not performing to its maximum, because only by means of collaboration, synergy can be achieved.

2.2 Research objective

The main objective of the research is to find the potential of the NEC4 ECC to stimulate collaboration in Dutch inner-city infrastructural projects in order to move away from adversarial relations.
The means to avoid adversarial relations is to stimulate collaboration within projects. Firstly, the current collaborative practices in projects need to be analysed. Thereafter, relational contracting model are studied to see how this type of contract is able to stimulate collaboration. Section 2.4 assists in setting out a roadmap to achieve the research objective by formulating a research question. The following sections help to focus on the heart of the problem.

2.3 Scope

The scope takes into account an inner-city infrastructural project with a budget of 10-50 million euros where an UAV-GC contract is used (Figure 2), because:

High complexity
Inner-city projects are perceived as projects with a high detailed and high dynamic complexity. Projects can be recognized as detail complex when they consist of many components and those components have a high degree of interrelatedness (Hertogh & Westerveld, 2010). Inner-city projects include a lot of components as for example a big variety of stakeholders, interaction with daily ongoing activities (public transport, cyclists, pedestrians) and possible other ongoing neighbouring inner-city construction/infrastructure projects.
Dynamic complexity in a project is defined by Hertogh and Westerveld as “the potential to evolve over time and having a limited understanding and predictability” (Hertogh & Westerveld, 2010, p. 187). Due to the dynamic environment in which inner-city construction projects are executed, they are defined as having a high dynamic complexity.

High interests
Taking projects into account with a budget above 10 million euros, means that there is a certain level of interests by involved parties to establish a collaborative relationship. In smaller projects, the effort to establish an effective working relationship is too big compared to the amount of work to be done. Due to the high level of interest, parties try to avoid disputes and divide risks as effective as possible (Akintoye, McIntosh, & Fitzgerald, 2000). Therefore, the client and contractor might consider setting up a contract which aims at solving adversarial problems.

Brownfield project
Characteristic about an inner-city project is the environment in which the construction works are executed. Most often, inner-city projects are executed in an already existing dynamic environment. This means that during the execution, a lot more attention has to be paid to the surrounding

environment compared to for example large infrastructure projects by Rijkswaterstaat who develop for example a new road connection between two cities as a “greenfield” project.

Not excessively large
A choice is made to only look at projects that have a budget under 50 million euros. If a project gets more expensive than 50 million euros, the interests increase significantly as well as the profit margin, timeframe and research opportunities for the specific project. Also, with such a large project, a financing component is often introduced in the contract, which increases the interest for more organizations to get involved in the investment of the project (Hayford, 2020).

Integrated contract
When technical and practical knowledge from the contractor is needed to provide solutions to a problem in a project known beforehand, an integrated contract can be facilitated (UAV-GC). A solution to the problem definition is to be sought in a form of relational contracting called NEC4 ECC. However, the NEC4 ECC has not been applied on projects included in the scope in the Netherlands. Therefore, the UAV-GC will be used as a basis. A comparison of the UAV-GC and NEC4 ECC is elaborated upon later on in this report.

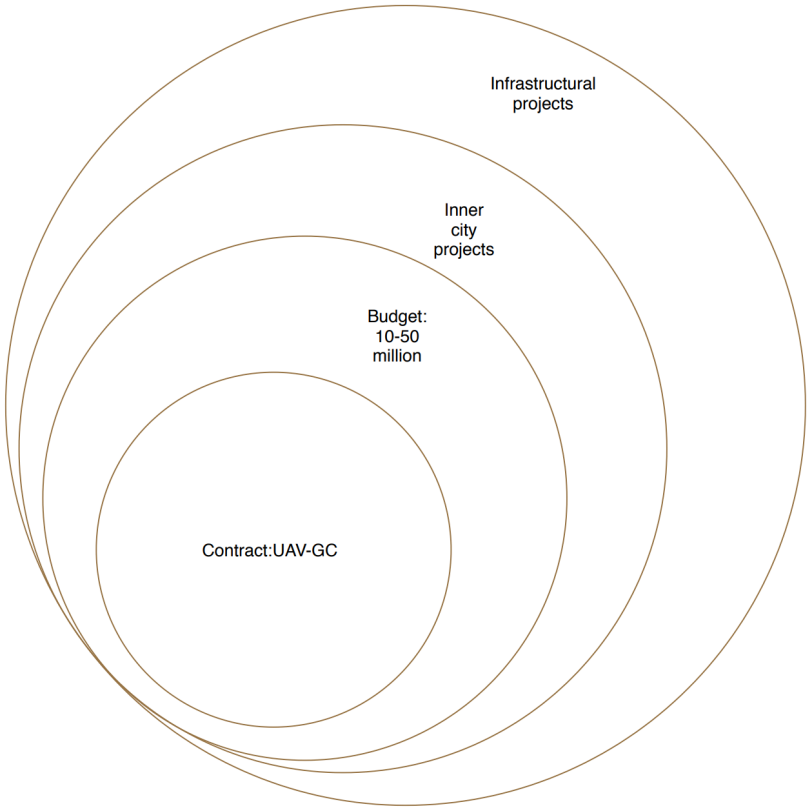

Figure 2 Scope

2.3.1 NEC ECC

The relational contracting method that will be analysed is the NEC4 ECC, because of multiple reasons. The NEC4 ECC is a contractual environment where project partnering can be practised as a way of

relational contracting. The NEC4 ECC focusses on collaboration in projects in the infrastructure sector (ten Hoeve, 2018).
The potential of the NEC4 ECC as a way to stimulate collaboration within the projects as defined in the scope is shown in multiple studies.
Gerrard (2005) mentions that the NEC contracts have been used on more than 45000 projects in over 20 counties (mostly in the UK, Hong Kong and South Africa), reflecting on the international applicability.
A study by Siu, Leung and Chan (2018) points out the benefits of the NEC contracts. Interviewees in this study mention that the NEC stimulates proactive risk management by means of the early warning mechanism built in the contract. Risk management plays a large role in stimulating collaboration (Siu, Leung, & Chan, 2018).
Similar projects that used the NEC contracting form, which match the scope are the following:

- Development of Area 54, Tuen Mun, Hong Kong
- Building connectivity infrastructure between Kai Tak North and San Po Kong- Choi Hung areas, Hong Kong
- Retrofitting noise barriers on Tuen Mun Road, Hong Kong

Advantages of the NEC in these projects were among the following:

- The NEC early warning process enables risk mitigation to keep the project on track
- NEC fosters the client-contractor relationship to minimize the potential impact of risks on price and completion date
- The NEC pain/gain sharing mechanism introduces an incentive for the contractor to reduce the actual costs, leading to a gain situation for the project
- NEC's collaborative ethos ensured all parties worked together to ensure innovation within the projects was a success.
- Technical matters can be resolved earlier under established NEC mechanisms to minimise disruption to the works programme
- Common goals among all parties can be achieved through continuous communication (NEC, 2020).

2.3.2 Client-contractor relationship

Various factors influence performance of infrastructure projects; the two main players are the client and contractor. The scope of this research is focussed on the relationship between the client and contractor due to multiple reasons. The client and contractor are eventually responsible for the construction process and the project performance. Their behaviour influences the process of construction of projects and their success (Kamminga, 2008). Furthermore, the UAV-GC and NEC4 ECC contracts are bilateral contracts (agreements between two parties), which mostly focus on client-contractor relationships. Lastly, Aratis (graduation company) has experience with client-contractor relationships. Because of this, more relevant cases can be found to conduct the cross-case analysis.

2.4 Research question

On basis of the scope, the research objective and with the use of (Verschuren, Doorewaard, & Mellion, 2010) the main research question is formulated.

Main question:

Which clauses from the NEC4 ECC are able to stimulate client-contractor collaboration in Dutch inner-city infrastructure projects?

Sub questions:

Sub question 1: How can client-contractor collaboration on infrastructure projects be stimulated?

Sub question 2: How can the NEC4 ECC stimulate a collaborative relationship?

Sub question 3: Which clauses from the NEC4 ECC could have stimulate a collaborative relationship in the case studies?

2.5 Methodology

Two research methods are applied to find an answer to the main research question and sub questions. The first method to establish a basis for the research is a literature study on the state of art literature. The second method is a cross-case study to find practical implications of implementing certain contractual clauses and develop a strategy to be implemented in Dutch inner-city infrastructure projects.
This section elaborates on how the methods assist in finding the answer to the main research question and sub questions. Figure 3 displays the methodology of the whole research in one single flowchart. A distinction is made between the different research methods and the deliverables per step, which are elaborated further on in this section.

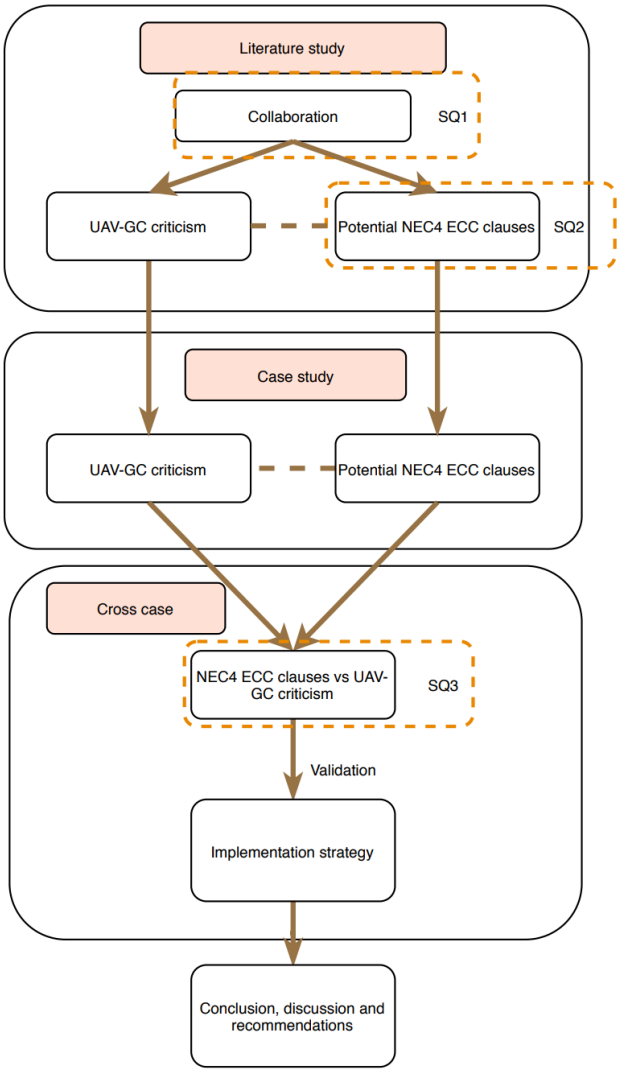

Figure 3 Methodology

2.5.1 Literature study

In the literature study, the problem definition is further touched upon to provide the reader with more background knowledge on the reason why this research is conducted. From the problem definition, the literature study works towards the possible solution to the problem definition as defined in the literature. Figure 4 displays how the literature study in a structured way works toward the solution to the problem definition.
As can be seen in Figure 3, the literature study gives an answer to sub research questions one and two. Two deliverables result from the literature study:

- Opportunities for improvement to the current way of contracting (UAV-GC)
- Clauses from the NEC4 ECC that can potentially improve the current way of contracting and stimulate collaboration.

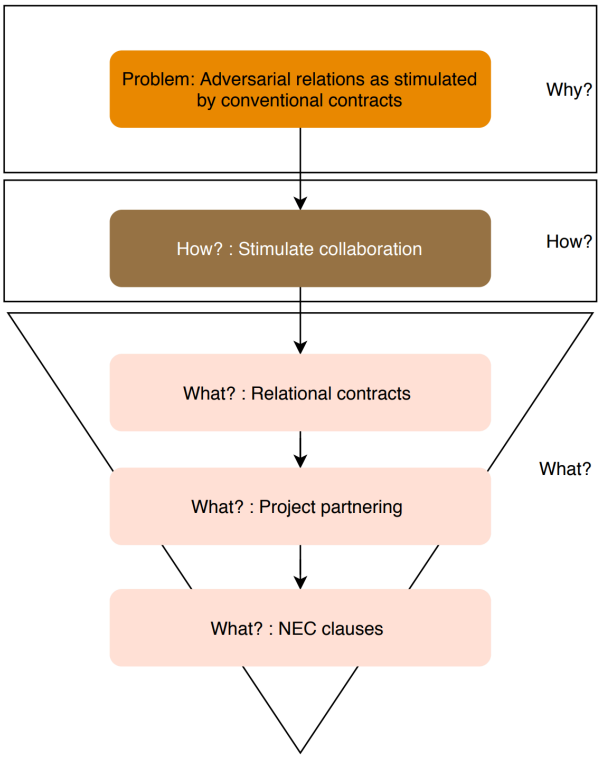

Figure 4 Methodology literature study

2.5.2 Case study

The two deliverables from the literature study provide the input for the case study. The main goal of the case study is to provide an answer to sub question 3 by elaborating on how the NEC4 ECC clauses could be able to stimulate collaboration in the cases presented in the case study and eventually for cases as included in the scope.
Firstly, the list of opportunities for improvement for the UAV-GC resulting from the literature study is analysed in the case study to see which opportunities are seen in the cases. Secondly, the list of clauses from the NEC 4 ECC that can potentially stimulate collaboration is analysed during the case study to show the potential as an application to the cases. The methodology of conducting the case study is

derived from the book: Case study Research and Applications by Yin (2018) and is further elaborated below.

Case study
On basis of the scope as mentioned before and with the help of the network established by the graduation company: Aratis, the cases are selected. In the case study, it is aimed to find contradicting cases or overlapping cases to either find differences or similarities. This can only be done by selected a minimum of two cases. Including more than two cases in the case study adds to the validity of the results. Taking the time and the validity of the research into account, a total of three cases are selected. After the cases are selected, a data collection protocol is designed. By means of semi-structured interviews with the client and contractor of each project, the collaborative relation is analysed. Semi-structured interviews are used in this case, because it lets the interviewees elaborate freely on their experiences. The interview protocol is included in Appendix C. As a result of the interviews, the details on the collaborative relationship can be retrieved. In each interview, the project manager or contract manager from the client and contractor are interviewed, because these people are actively involved in the daily processes but also maintain a helicopter view on the progress. The details on the relationship between the client and contractor are not captures in documents and therefore by means of interviews, the details on the relationship are presented in this report.
The interviews itself are designed to retrieve two components, which are presented in Figure 3 as well: the effect of the UAV-GC contract on the client-contractor relationship and the potential of each NEC4 ECC clause to stimulate collaboration.

Cross-case analysis
After the analysis of each individual case, a cross-case analysis is conducted to combine the gained knowledge from each case to provide an answer to the third sub research question.
The opportunities for improvement to the UAV-GC to, in the end, stimulate collaboration from each case are analysed and mutual opportunities are combined in the cross-case analysis. Furthermore, the opinions and experiences of the interviewees from each case on the NEC4 ECC clauses are combined in the cross-case analysis to provide an overall opinion on the potential of each clause to stimulate collaboration.
Finally, the result of the cross-case analysis is a list of NEC4 ECC clauses that can potentially provide a solution to the opportunities for improvement for the UAV-GC.

Strategy development
The results from the cross-case analysis only display a possible solution to the opportunities for improvement for the UAV-GC in the presented cases. The presented cases are a selection of projects that are part of the scope as elaborated before. The cases are selected in such a way that the results from the case study could be applied to all cases that are included in the scope. To validate the results from the case study as an application to the whole scope, experts are interviewed. During these interviews, the opportunities for improvement for the UAV-GC are validated as well as the applicability of the NEC4 ECC clauses to the scope. Experts with different background are interviewed to gain a broad view on the applicability of the NEC4 ECC clauses as a way of stimulating collaboration. As a result of this, the answer to the main question is formulated.

2.6 Societal and scientific relevance

As elaborated before, the main goal of this research is to move away from the current adversarial relationships by means of stimulating collaboration. The NEC4 ECC shows a lot of potential to facilitate in stimulating collaboration. However, no infrastructural project in the Netherlands have been executed with the use of the NEC4 ECC. To set out a benchmark of the current way of collaborating, projects using the UAV-GC contract are analysed. Not a lot of research towards the current ways of

collaborating with the use of the UAV-GC have been conducted. This research tries to add to the available knowledge on collaborating in project using the UAV-GC.
Furthermore, because no projects have been executed using the NEC4 ECC and not a lot of research has been conducted on the implementation of the NEC4 ECC in Dutch infrastructural projects, this research aims to give a first insight into the implementation of the NEC4 ECC the Dutch infrastructure sector.

This also introduces the societal relevance and the link to the graduation company (Aratis) who supports in the development of this thesis. Aratis is a company specialised in procurement-and contract management and is in continuous search of improving their services. In the current infrastructural sector, Aratis recognises opportunities in the UAV-GC contract to stimulate collaboration between the client and contractor. Through the development of a strategy based on the NEC4 ECC, this research tries to contribute to the societal relevance.

PART II LITERATURE STUDY

Chapter 3: Collaboration
Chapter 4: NEC4 ECC

3. COLLABORATION

This chapter elaborates on the relationship between the client and contractor. The aim of the chapter is to clarify the current adversarial relationship and to explain how this relationship can evolve from adversarial to project partnering through collaboration. At first, the current adversarial practices are further elaborated and a link with the UAV-GC is made. This provides a better view on the problem definition. Following the elaboration on the problem definition in the first section, in a structured way, potential solutions are proposed. Different forms of relational contracts are compared and the contract that shows the most potential is further researched.

3.1 Adversarial relations

As mentioned in chapter 1, adversarial relations are a cause for bad project performance. This section further elaborates on the problem definition and goes into further detail concerning the definition of adversarial relationships and what the result of adversarial relationships can be. The following sections work their way towards a solution.

Definition
Adversarial relationships are common in literature, but the exact definition differs. The definition most often used in literature, by Drexler and Larson, is defined as follows:

> "Participants perceive themselves as adversaries with each party pursuing their own concerns at the other party's expense. Major conflicts are deferred to superiors and resolved on a win/lose basis under the spectre of formal litigation. Considerable time and energy is devoted to legal protection" (Drexler Jr & Larson, 2000, p. 294).

This definition includes the negative effects of an adversarial relation by mentioning that major conflicts can happen, which are resolved on a win/lose basis. This shows that either way, one party will lose and one will win, which is not an ideal situation to establish a relationship to carry out a project. Larson adds to this that in the end this will result in a lose/lose relationship between the client and contractor, pointing out the main problem as the basis to this research (Larson, 1995). Kamminga (2008) adds to this, that the current adversarial relations between the client and contractor affect the potential to achieve successful collaboration and thus affect the performance in infrastructure projects (Kamminga, 2008).

3.1.1 Dysfunctional conflicts

Adversarial relationships can express themselves as dysfunctional conflicts. A conflict between a client and contractor is distinguished as a task related or emotional conflict. A task related conflict can lead to improvement of team performance, but emotional conflicts can lead to claims and disputes as shown in Figure 5 (Lousberg, 2012). The literature often lacks clarity defining the terms conflict and dispute, therefore Figure 5 is added to clarify the definitions.
This research tries to come with a solution that avoids dysfunctional conflicts and thus claims and disputes, because once these escalate they cause project delays, require litigation proceedings for resolution and ultimately destroy business relationships (Acharya, Dai Lee, & Kim, 2006).

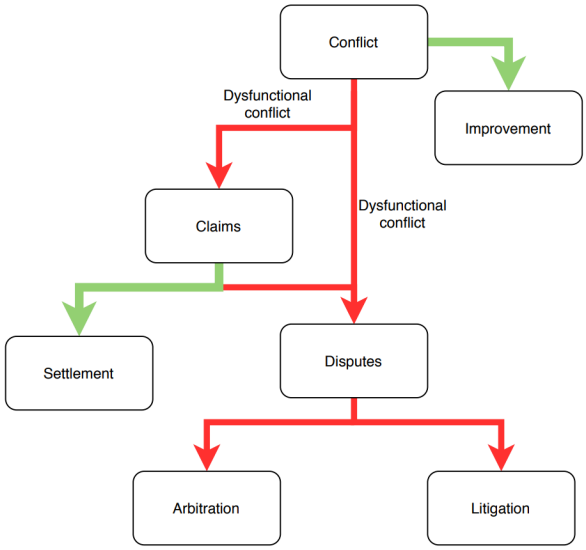

Figure 5 Conflict development, adapted from (Acharya, Dai Lee, & Im, 2006; Heaphy & Birch, 2018; Kumaraswamy, 1997; Lousberg, 2012)

3.1.2 UAV-GC

This section goes in on the UAV-GC contract itself, the philosophy behind it and situations that have led to dysfunctional conflicts as seen in practice which are used as opportunities for improving the contract.

Philosophy

More and more interest came for a contractual model in which the contractor is responsible for the design and construction of the project. By transferring tasks to contractors, it is expected that departments deliver a facility quicker and at lower cost because of the incentivized opportunity for them to act innovatively (Marijn Van den Berg, 2015). Major construction companies in the Netherlands thereafter combined powers to set up the integrated contract form based on turn-key agreements, which later was named the design and construct agreement. After some iterations, after the first model of 1998, the UAV-GC 2005 was published (Bleeker, 2014).

Compared to the traditional contract (UAV 2012) in the Dutch construction sector, the UAV-GC puts more responsibilities at the contractor and removes a lot of liability from the client. The philosophy behind this idea was to develop a model that facilitates the integration of design and construction activities (CROW, 2013). The UAV-GC claims to be the innovative contract that overcomes fragmentation within the teams and processes over different lifecycle stages (Marijn Van den Berg, 2015).

Criticism

After years of applying this contracting method, some criticism has arisen on the applicability of the contract on certain projects. Multiple researchers have elaborated on the UAV-GC and situations that have led to disputes, which is elaborated below.

Van Dijk gathered situations which have let to disputes and categorized them. By doing so, it becomes clear what kind of conflicts lead to disputes. The categories of conflicts that have let to disputes are the following:

1. Applicability of general conditions

2. Providing information, documents and information duty
3. Risk distribution
4. Duty to warn
5. Final settlement
6. Permits
7. Penalties (van Dijk, 2013)

Geertsma (2016) and van Loo (2012) also conducted research into the application of the UAV-GC and displayed the following points of criticism towards the UAV-GC:

1. The UAV-GC is not flexible and needs to be modified strongly for each project (Geertsma, 2016)
2. The UAV-GC is seen as vaguer and less focused on cooperation
3. Parties within the UAV-GC are not open to each other in terms of risks (Geertsma, 2016)
4. Risks are wrongly distributed in the UAV-GC (Van Loo, 2012)

Lastly, Hayford (2020) displays often heard criticism toward conventional ways of contracting of which is UAV-GC an example. The five critical notes towards conventional contracting are the following:

1. Allocating responsibilities leads to the 'blame game', not problem solving
2. Fixed prices motivate minimum compliance
3. No incentive on other participants to contain the cost of changes
4. Obligations to co-operate do not really work
5. Fast tracking and early contractor involvement is difficult

For applicability of the criticism in this report, all the above-mentioned critical notes on the UAV-GC are summarized in topics (Table 1)

Table 1 Topics of criticism UAV-GC

Topic	Critical notes
Allocating responsibilities	Risk distribution (van Dijk, 2013) (Van Loo, 2012)
	Allocation of responsibilities (Hayford, 2020)
Cooperative environment	Vague and less focused on cooperation (Geertsma, 2016)
	Parties are not open in terms of risks (Geertsma, 2016)
	Minimum compliance because of fixed price (Hayford, 2020)
	Obligations to co-operate do not really work (Hayford, 2020)
General applicability of contract	Applicability of general conditions (van Dijk, 2013)
	Not a flexible contract (Geertsma, 2016)
	Duty to warn (van Dijk, 2013)
	Fast tracking and early contractor involvement is difficult (Hayford, 2020)
Financial matters	Penalties (van Dijk, 2013)
	No incentive to contain cost of changes (Hayford, 2020)
	Final settlement (van Dijk, 2013)
Delivering information	Providing information, documentation and information duty (van Dijk, 2013)
	Permits (van Dijk, 2013)

It can be concluded that successes have been achieved with the use of the UAV-GC, but there is room for improvement on certain kind of aspects. From here on, the research report works it way toward potential solution to the points of criticism.

3.2 Client-contractor collaboration

To increase project performance by resolving the adversarial relationships, collaboration between the client and contractor needs to be stimulated. This section uses the existing literature to elaborate on definitions regarding collaboration, key attributes to facilitate collaboration and challenges that occur when attempting to collaborate.

Definition
A big contribution to the concept of collaboration in the construction industry is made by M. Suprapto. In his dissertation he describes client-contractor collaboration as follows:

> "Collaboration is the behavioural interaction between client and contractor working together for the purpose of achieving specific project and business objectives by effective utilization of each party's specific resources and capabilities based on shared values and norms" (Suprapto, 2016, p. 77).

As Kamminga explains in his dissertation, a characteristic of collaboration is parties working towards a *common goal.* Within a project, parties generally have a mix of converging and diverging goals, but at least some of the goals they both are committed to obtain. Common goals in this instance are defined by goals they would be incapable of accomplishing when working alone (Kamminga, 2008). Both Kamminga and Suprapto include the interaction between two parties and how in the end a collaborative relationship can be established. This acts as a basis for the definition of collaboration in this research.

Challenges
Until now, the positive sides of collaboration have been highlighted, however challenges appear when a collaborative way of working is pursued, which need to be kept in mind.

<u>Organisational</u>
Especially when moving from a traditional relationship in a project to a collaborative relationship, intra- and interorganizational ways of working need to be alternated. For example, role ambiguities within an organization can arise as responsibilities and ways of working are revised (Suprapto, 2016). Other challenges that appear with intraorganizational changes towards collaborative working, is the lack of adequate skills, the tendency not to escalate disputes and the misunderstanding of ways to collaborate (partnering and alliancing). Interorganizational challenges that appear are tension between different contract principles, difficulties with evaluating behaviour, remaining cooperative attitude after implementation, willingness to provide money to implement a collaborative working relationship and the pressure on contractors (Kamminga, 2008).

<u>Legal</u>
From a legal aspect, some notions and intentions can collide when a contract with collaborative incentives is applied. When setting up a partnering or alliancing relationship, certain goals are pronounced, as elaborated later on in this chapter. These goals can collide with the contract, which will thereafter result in ambiguity. With ambiguity, parties tend to take a flight to an adversarial dispute resolution mechanism, which diverges the intent of the collaborative relationship. On the other side, with upfront agreements, parties can act opportunistic in a situation where it is not suitable

(Kamminga, 2008). As a result of this, conflicts arise because parties made wrong estimations in terms of the total risk profile and expectations clash later on in the project.

Procurement

A last set of challenges arise when you have a look at the traditional procurement compared to the collaborative procurement strategies. When applying (new) collaborative procurement strategies, parties still have the tendency to go back to the traditional competitive ways of tendering because new ways of working need a large shift in mindset. This results eventually in triggering conflicts and claim behaviour. Furthermore, each organization has certain standardised procedures focussed on traditional procurement and what can often be seen is the fact that organizations lack the competence to adjust these standardised procedures (Kamminga, 2008).

The challenges to client-contractor collaboration are taken into account when developing the strategy for implementation purposes.

3.3 Relational contracting

Since the beginning of the 1990s, investigation committees have tried to come up with proposals to improve collaboration in projects during realisation stage. One of their main results was to introduce relational contracting as a way to facilitate project partnering, project alliancing and integrated project delivery (Kamminga, 2008). Relational contracting offers contractual flexibility, facilitates team building, eases ongoing contractual relationships and enables the client and contractor to achieve a common goal (Gil, 2009; Rahman & Kumaraswamy, 2004). Furthermore, lawyers say that contracts drive behaviours instead of deliver projects (Gil, 2009). This adds to the aim of the research, by applying relational contracting to steer parties away from their current adversarial behaviour.
These principles are seen as underpinnings of collaborative arrangements. This section elaborates on the idea of relational contracting by providing a definition, key principles of relational contracting and the key elements in a contract to stimulate collaboration.

Definition

Relational contracting is a high level concept of contracting with a different approach than traditional contracts (Stam, 2016). The relationship between client and contractor is regarded as less hierarchical, more open, and less managerial. The key element of relational contracting is the intention of parties to cooperate on an equal basis (Kamminga, 2008).
The exact definition of relational contracting is not easy to give, as numerous definitions are provided in literature. The first definition, and the one most seen in other relevant literature, was given by Macaulay as: “the working relationship amongst parties who do not often follow the legal mechanism offered by the written contracts, and the parties themselves govern the transactions within mutually acceptable social guidelines” (Macaulay, 1963, p. 55).

Practices

Mutual benefits and win-win scenarios are the basis for entering into a relational contract (Yeung, Chan, & Chan, 2012). If relational contract principles are translated into practice, all potential project patterns will be forced to fit into the new culture in order to obtain new work. This sets up the basis for a relational contracting culture and help to expand this culture on a broader scale as a standard way of doing business. As a result of this, the next generation of the construction industry can be horizontally and vertically integrated in relational contracting oriented organizations to provide efficient and effective services for clients (Rahman & Kumaraswamy, 2004).

3.3.1 Relational contracting principles

Setting up a relational contract, guiding principles need to be followed to get the most out of the contracting strategy. Van der Veen and Korthals Altes (2011) have developed an overview of five guiding principles which an urban development agreement must contain to provide the right conditions for a successful project. These principles are the following, and need to be taken into account when applying a relational contracting method:

1. Focus on relations: Projects often extend over a long period of time, where the relation between the client and contractor becomes more complex. Discussing mutual objectives, nature of their relation and developing procedures that promote the values of trust and the harmonization of conflicts from the start, will result in a clear vision on the relationship. The common contract norms are able to stimulate the focus on the relations (van der Veen & Altes, 2011).

2. Focus on the interest of the project: Moving from the specification of the relations within the project, the interests of the actual project itself need to be discussed. The most ideal situation is to balance the relations/roles of each party with the interest of the project. Role integrity, contractual solidarity and propriety of means can provide a focus on the interest of the project (van der Veen & Altes, 2011).

3. Specify functions of the agreements: Four different functions of the agreement are specified: exchange, planning, statutory and instrumental function. *The exchange function* defines the core function of a contract: money and goods are exchanged. *The planning function* clarifies the planning of activities to deliver the project. *The statutory function* consists of the duties, obligations and procedures committed to by the parties. *The instrumental function* is used to clarify the goal by the governmental organisation (the client in this case) (van der Veen & Altes, 2011).

4. Specify goals of the agreement: Goals by the contracting parties, goal of the project and the goal of the specific agreement are part of guiding principle 4. The effectuation of consent is a common contract norm that is able to specify these goals in the contract (van der Veen & Altes, 2011).

5. Plan for flexibility: As mentioned earlier on in this report, conflicts arise with changing circumstances due to the lack of flexibility. Guiding principle 5 includes the planning for flexibility to provide adequate change management for the project in the contract (van der Veen & Altes, 2011)

3.3.2 Relational contract models

Different relational contracting models are available as mentioned in the current literature. Below, the types of relational contracting models are depicted including their characteristics and the ability to contribute to this research (Bresnen & Marshall, 2000a, 2000b; Drexler Jr & Larson, 2000; Hosseini, Windimu, Klakegg, Andersen, & Laedre, 2018).

- Alliance
  - Pure project alliance
  - Hybrid alliance
  - Project design alliance
  - Mini alliance / risk alliance
- Integrated project delivery
- Project partnering

Alliance

A collaborative working agreement is the Alliance contract, which is an agreement in which partners agree to collectively share risks and benefits and at the end of the project, parties share the profits and/or losses. Alliancing in projects has been identified as a management strategy that can be applied to reduce risks and promote movement away from current adversarial approaches to a more collaborative culture (Jefferies, Brewer, & Gajendran, 2014). When applying a pure-alliance, a legally binding contract is established so that a new organizational body is created (Matton Van den Berg & Kamminga, 2006). A variation on the pure-alliance is the Dutch Project Design Alliance, which is an alliance solely responsible for the design and the contractor is responsible for the construction. The contractor has an incentive to blame errors during the construction phase on the design, of which he then only bears half the costs. Another variation on the alliance principle is the risk-alliance, which concerns the implementation of the pain/gain-sharing principle for only parts of the project. This is a method of bearing unknown (high) risks (Stam, 2016). These variations prove that a lot of different alliance compositions are possible.

A characteristic of an alliance is the fact that it is preferred that interests of all involved parties are the same (Prorail, 2016). Setting up an alliance most often comes with a lot of extra legal costs, is very complex and is never standard (Koenen, 2015). As Hayford (2020) mentions in his research, the scale of a project that is suitable for an alliance contract has to have a minimum value of $50 million (€40 million) to justify the additional procurement and contract establishment costs associated with the model (Hayford, 2020). Due to the additional procurement and contract establishment costs, the costs of such a contract are too big to fit the scope. Therefore, this model will not be further studied in this research.

Integrated project delivery

Integrated project delivery (IPD) is a project delivery method distinguished by a contractual agreement between the client, contractor and designer where at the end of the project, risk and reward are shared and stakeholder success is dependent on project success (Cohen, 2010). Early involvement of experts and integration of multiple organizations is the core of this model (Lahdenperä, 2012) .

The model is relatively new, it was first introduced in 2003 when a group of companies bound themselves jointly to the fulfilment of the contract to the owner. IPD is a contractual model which fits best for projects with high technical complexity, as knowledge of parties is combined in the beginning to come up with the best design.

The scope of this research focusses on the collaboration between the client and contractor. As IPD is known for its multi-party contract where maximum potential is achieved through the input of all the parties involved including their specific expertise, it is difficult to extract only the client and contractor relationship from the whole network. Figure 6 displays the complex structure of the multiple parties incorporated in the IPD contract. Therefore, this model does not comply with the scope of the research. Furthermore, IPD is often used for projects that are especially technical complex and projects that can be modelled in an early stage (Ghassemi & Becerik-Gerber, 2011). As the projects in the scope are overall complex in terms of the dynamic environment and internal dynamics over the course of the project, this model does not fit within the scope of the research.

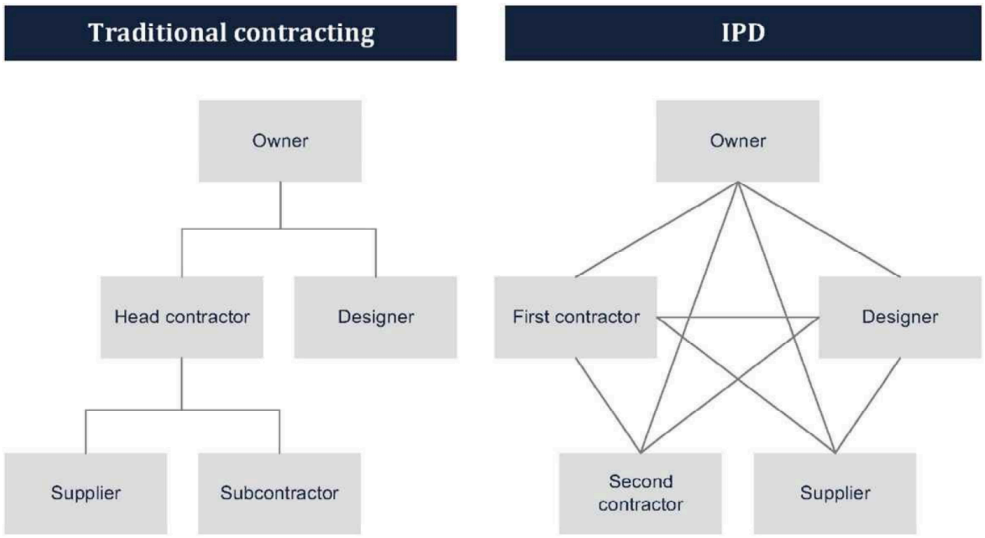

Figure 6 Traditional contract and IPD contract (Hayford, 2020)

Project partnering

Partnering distinguishes itself for being more of a philosophy, whereas alliancing and integrated project delivery are typically more incorporated into the contractual structure, and thus can be seen as independent contractual models (Hosseini et al., 2018). The process of partnering, attempts to create an environment where trust and teamwork prevents disputes, foster a cooperative bond to everyone's benefit and facilitate the completion of a successful project (Hellard, 1995). The client and contractor develop an explicit strategy of commitment and communication which are documented in a partnering charter (Walker, Hampson, & Peters, 2002). Along with the charter, a legally binding contractual arrangement is present, which is not standardized within the principles of project partnering (Walker et al., 2002). Further on in this chapter, a solution for the legally binding contractual arrangement is presented.

With the increase of projects become more complex and critical than before and construction projects being associated with low efficiency due to the focus on transactions, focussing more on relationships rather than transactions, a change can happen. Partnering facilitates to accomplish this change, avoid conflicts and eliminate adversarial relationships (Hosseini et al., 2018). This model shows a lot of potential in terms of finding a solution to the current problem, which is elaborated in the following section.

Conclusion

After comparing the three relational contracting models, project partnering is perceived as having the most potential to provide a solution to the problem definition and fits best in the scope. From here on, only project partnering is studied to find an application of project partnering to constructively work towards a solution to the problem definition.

3.4 Project partnering

The following paragraph will go into further detail on how project partnering is able to avoid dysfunctional conflicts and eliminate adversarial relationships by stimulating collaboration.

Definition

Partnering is a concept that has gained a lot of attention in the USA, UK and Australia, since the releases of the Latham and Egan reports as elaborated before. However, partnering in The Netherlands is not

often practiced in construction projects. Some of the most cited and influential studies are analysed to get a clear view of what partnering entails, how it can stimulate collaboration and what difficulties can arise. Appendix A gives a representation of the studies that are used as a theoretical background for developing theories concerning partnering.

To get a clear overview of what partnering entails, the definition should be clarified. One of the most read definitions is by the Construction Industry Institute mentioned by multiple studies shown in Appendix A, which is the following:

> Partnering
> Partnering is a long-term commitment by two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources (Ballard, Kim, Azari, & Cho, 2011).

Two different ways of partnering can be identified: strategic and project partnering. Considering the scope of this research, only project partnering will be taken into account, as strategic partnering is a voluntary form of partnering that is long term in nature (Hughes, Williams, & Ren, 2012). Project partnering focuses more on project performance and short term benefits (Cheng & Li, 2002). A definition for project partnering as provided in the research paper by Larson:

> Project Partnering
> Project partnering is a method of transforming contractual relationships into a cohesive, project team with a single set of goals and established procedures for resolving disputes in a timely and effective manner (Larson, 1995).

The definition as described above is also the working definition for this research, as it comprises the aim of the research and the way of how project partnering is able to achieve that aim. Partnering helps to stimulate collaboration by systematically structuring partnerships, involving charters and team building (Bresnen & Marshall, 2000a).
Within a project, an integrated team works on partnering principles, which result in a partnering agreement. This partnering agreement does not change allocation of risks among parties, but usually leads to open communication to discuss issues, quicker issue resolution and simpler variation management. To maintain the right partnership, the relationship is monitored in order to take preventive actions where possible (Suprapto, 2016). Furthermore, a partnering agreement contains parties jointly agreeing on mutual objectives, devising a way for resolving disputes, measuring progress and pain/gain sharing (Egan, 1998).

Benefits of project partnering
Multiple researches report positive results of collaborative client-contractor relationships relative to adversarial relationships. The following empirical studies are most famous in terms of proving that project partnering is a way of moving away from adversarial relationships and increasing project performance. The case studies include projects executed outside of the Netherlands. No useful empirical study on project partnering in the Netherlands is done, but the presented studies below already show a lot of potential on project partnering in infrastructure/construction projects. Both studies are conducted in Anglo-Saxon countries, characterised by a working environment where inequalities amongst people should be minimized, people possess a positive and optimistic attitude, and are able to control their desires and impulses (Hofstede, Hofstede, & Minkov, 2005). These characteristics are able to contribute to a more cooperative mindset and ability to stimulate collaboration. According to Hofstede (2005), people in the Netherlands poses the same characteristics, which displays that the potential shown in the studies below may also be of added value in the Dutch construction and infrastructure sector.

- *Project partnering: results of a study of 280 construction projects* by *E. Larson* (Larson, 1995)

Larson (1995) investigated a total of 280 construction projects in terms of relationships between project performance and partnering, as well as other approaches to managing the client-contractor relationship. Project performance is measured in terms of time, costs, quality, customer needs, litigation avoidance and participant satisfaction. Overall project performance is perceived higher as a partnering client-contractor relationship is present compared to an adversarial relationship. This means that moving away from an adversarial relationship, proves to be beneficial. This proves the potential of project partnering to contribute to the solution to the problem as stated in this research.

- *An analysis of success factors and benefits of partnering in construction* by *Black et al*. (Black, Akintoye, & Fitzgerald, 2000)

Black et al. (2000) issues a UK-wide survey to assess the opinions of the consultant, contractor and client towards partnering in a construction project. A total of 78 survey replies were received, including 32 contractors, 25 consultants and 21 clients. Most of the contractors (around 90%) were involved in partnering for construction projects, around 50% of the consultants and clients were involved in partnering for construction projects. The most outstanding benefit of partnering as displayed in the research is that parties move away from the adversarial relationships. This shows promising results for this research to move away from adversarial working attitudes, again showing the potential of project partnering to contribute to the solution to the problem as stated in this report.

Challenges
Apart from the before-mentioned benefits of project partnering, challenges occur when changing from conventional contracting to project partnering. In his dissertation, Kamminga (2008) elaborates on the obstacles that can arise when implementing and maintaining partnering in the organization. His findings are based on other relevant partnering literature, of which most are also present in Appendix A. In his research he elaborates on the following obstacles:

- Tension between relational contract principles and adversarial culture in construction, collaboration needs to be made operational and everyone up to the senior managers need to be convinced that partnering is the new way forward. Especially when partnering was introduced, it was not expected to work in a hard-bid environment such as the construction industry. A cultural and organizational change is necessary to facilitate partnering (Latham, 1994).
- Misunderstanding about the concept of partnering, partnering can lead to ambiguity due to abstract notions of trust and common goals is not made specific. This may thereafter result in different interpretation and lack of clarity.
- Difficulties with evaluation behaviour, critics are shows towards the difficulty of valuing each other's input in the relationship. As a result of this, sceptics say that partnering will be seen as a workshop, but not actually implemented in practice.
- Tendency not to escalate disputes, trust building may be jeopardized by the human tendency to not escalate personal issues.
- Lack of adequate skills, a main factor of project success is the competence of project participants. In practice it is seen that a lack of "take-charge" people in critical-decision-making roles resulted in not implementing project partnering principles successfully.
- Maintaining cooperative attitude after implementation, in his study, Kamminga (2008) shows that after implementing a project partnering principle, it was difficult to maintain the cooperative attitude. One of the reasons for this was the political and bureaucratic pressure from outside the project.
- Cost of implementing and maintaining a partnering, some participants in the study of Kamminga (2008) suggested that partnering may only be worth the investment in very

complex and high-cost projects. The main costs are related to training, early commitment and involvement of management. Ongoing costs are related to workshops, monitoring and evaluating, and training new team members.

- Pressure on contractors, in his research, Kamminga (2008) saw that contractors perceived added pressure by the client in terms of being available all the time and communicating all the time with the contractor. This puts pressure on the contractor in terms of money and time, affecting the collaborative relationship.

3.5 NEC4 ECC

Project partnering in itself is seen as a method of executing projects and setting out relationships within the project environment. To assist in project partnering being implemented in a project, a well written contract is necessary to set out the rules to which the players (parties) can play.
As elaborated in the literature, the New Engineering Contract (NEC) is committed to project partnering, or at least to creating an appropriate contractual environment for project partnering. It does so by presenting a bi-party contractual contract which embodies the fundamentals of partnering directly in its general conditions (Arup, 2008; Latham, 1994; Skeggs, 2003).
The following section goes into further detail on what contractual elements need to be included to facilitate project partnering. Chapter 4 is dedicated to the NEC and specifies how the contract is able to stimulate collaboration.

3.5.1 Elements of partnering

Analysing the literature, authors emphasize that the creation of collaborative working relationships depend on the presence of specific elements. Hosseini (2018) made an analysis of relevant partnering literature, which of most are also present in Appendix A and came to the conclusion that multiple elements of establishing and practising a partnering relationship are mentioned in the literature. To distinguish between the different elements, Hosseini made a distinction between hard and soft elements. Soft elements are able to contribute to the relationship between the people in the project. Hard elements are directly regulated by the contract or have their basis in the procurement process. Below, the soft elements as Hosseini distinguished from the analysed literature are displayed. These factors must be present in a project to facilitate partnering.

- Mutual objectives
- Client's ability to make decisions
- Team building workshops
- Trust
- Commitment
- Competence
- Communication
- Choosing the right people

Soft elements are not only limited to project partnering however, they are to a large extend also present in all successful construction projects (Hosseini et al., 2018). Therefore, it is more interesting to focus on the hard elements which are displayed below. The hard elements are a combination of procurement strategies and contractual methods. This list of hard elements will, in chapter 4, be linked to contractual clauses from the NEC4 ECC to show which clauses correspond with the partnering elements and thus show potential to stimulate collaboration.

- Start up workshop

- Partnering based on turnkey/design-build contract
- Early involvement of supplier(s)
- Contractual right to replace people
- Functional description
- Value-based procurement
- Target document
- Intention/cooperation agreement
- Binding cooperation agreement
- Contractual right to replace firm
- Open-book economy
- Continuous workshops
- Target price with bonus/malus
- Measurement during project
- Prequalification
- Final workshop
- Conflict resolution mechanism
- Operational responsibility of contractor
- Co-location of partnering group
- Remuneration for accepted offer

3.6 Conclusion

The aim of this chapter was to go further into depth on the exact problem which is related to the problem definition and secondly to find a start for the solution to how collaboration can be stimulated on infrastructure projects between the client and contractor.
The exact problem is researched and showed that five topics in a project within the UAV-GC contribute to the development of dysfunctional conflicts:

- Allocating responsibilities
- Absence of a cooperative environment
- General applicability of the contract
- Financial matters
- Delivering of information

To search for a solution to these contributions to the development of dysfunctional conflicts, the first sub-research question aims to provide a start for that search:

How can client-contractor collaboration on infrastructure projects be stimulated?

Countering the current problems as elaborated: the adversarial relations between the client and contractor resulting in bad project performance, this research question aims to provide a solution. Stimulating client-contractor collaboration, adversarial relationships can be resolved to increase project performance (Black et al., 2000; Larson, 1995).
The following definition of collaboration is used in this report:

> *"Collaboration is the behavioural interaction between client and contractor working together for the purpose of achieving specific project and business objectives by effective utilization of each party's specific resources and capabilities based on shared values and norms (Suprapto, 2016)."*

Researchers have tried to come up with proposals to improve in-project collaboration. One of their main findings was to introduce relational contracting (project partnering, project alliancing and integrated project delivery). A reason for this is the ability of relational contracting to offer contractual flexibility, facilitate team building, ease ongoing contractual relationships and enable parties to achieve a common goal (Gil, 2009; Rahman & Kumaraswamy, 2004).
Project partnering as a way of practicing relational contracting shows most potential as a contribution to find a solution to the problem as mentioned earlier in the report. A contractual environment to support project partnering is found in the NEC4 ECC. Figure 7 provides an overview of the findings in this chapter. Most important is the relation of NEC4 ECC to project partnering and to relational contracting. The following chapter goes further in dept on the NEC4 ECC and how his contractual model is able to stimulate collaboration.

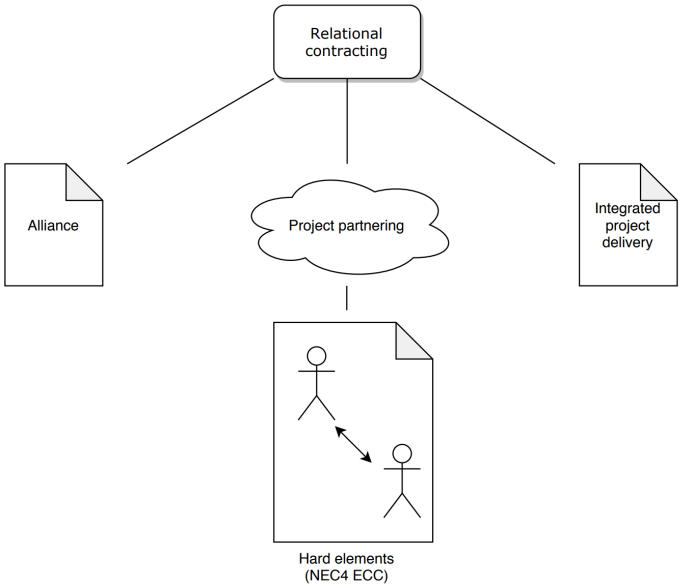

Figure 7 NEC4 ECC in relation to relational contracting

4. NEC4 ECC

The problems as elaborated earlier in this report, increased disputes and claims, and the seeming inability of traditional contracts to provide certainty of cost, time and quality resulted in the development of a new collaborative oriented contract form: the New Engineering Contract (NEC) (Mitchell & Trebes, 2005). This chapter starts by elaborating on the development of the NEC4 ECC (here after: ECC4), secondly the general conditions and options within the contract are given. Finalising this chapter, general conditions and options that are able to stimulate collaboration are given.
The following sources are used to explore and substantiate the application of the ECC4:

- NEC4 Engineering and Construction contract (Ltd, 2017a)
- NEC4 Resolving and Avoiding Disputes (Gerrard & Waterhouse, 2019)
- Establishing a procurement and contract strategy (Ltd, 2017b)
- NEC managing reality (Mitchell & Trebes, 2005)
- Webinars from the NEC organization on the application of the NEC4 contracts
- Relevant literature

4.1 Development of the NEC4 ECC

The first NEC (New Engineering Contract) was introduced in 1993, in the United Kingdom by the Institution of Civil Engineers (ICE), written in plain language, with the aim to stimulate good management and bring an end to the adversarial approach in the construction industry (Ltd., 2014) (Masons, 2011). The second issue, branded as the "Engineering and Construction Contract" (ECC) and the NEC2, issued in November 1995, had the intent to make it clear that the contract was applicable for the wider construction sector (Gould, 2008). As a result, the NEC2 has been widely adopted within UK construction sector on projects as the construction of Terminal 5 at Heathrow, national procurement projects by the National Grid (Transco), projects by the English National Health Service etc. (Gould, 2008). The follow up of the NEC2 is the NEC3, released in June 2005. The NEC3 consists of three core principles (Masons, 2011):

1. flexibility;
2. simplicity and clarity;
3. a stimulus for good management.

The NEC3 has been applied to multiple leading international project as for example the expansion of Heathrow Terminal 2, the expansion of the Indira Gandhi airport in New Delhi Terminal 3 and the construction of the velodrome of the London Olympic games (Chao, 2016).

Marketing the phrase: evolution not revolution, the ECC4 was introduced in 2017 (Eggleston, 2019). Comparing the ECC4 with its predecessor, some minor changes can be observed in terms of clarifying clauses which in previous editions have been sources of concern. Significant changes can be observed in the increased range of Secondary Option clauses and a completely new approach in avoiding and resolving disputes (Eggleston, 2019)

The ECC4 as the ECC3 is structured in the following way (Strang, 2017):

- core clauses;
- main option clauses;
- dispute resolution;
- secondary option clauses;
- schedule of cost component;

- contract data.

4.2 Core clauses

The Institution of Civil Engineers included core clauses, set out in appendix B, to which all parties must comply. These core clauses are grouped into nine different categories (Eggleston, 2019; Ltd, 2017a).

1. General

The first chapter of the ECC4, general clauses, provides the backbone for the contract. It starts by setting out the two most important actions for the client, contractor, project manager and supervisor: to act as stated in the contract (10.1) and to act in a spirit of mutual trust and cooperation (10.2). As elaborated in the previous chapter, key aspect in stimulating collaboration are stated in the general clauses: clause 13 clarifies how communication is taken care of within the project organization, clause 15 elaborates on the early warning mechanism and clause 16 provides the contractor with value engineering opportunities. Furthermore, key terms are identified, interpretations are discussed, and ambiguities are clarified.

2. The contractor's main responsibilities

This group of core clauses elaborates on the responsibilities for the contractor as the design, works, people and subcontracting.

3. Time

Core clause three contains information concerning time aspects of the project. It starts of by defining the starting, completion and key dates (30). The programme (31) contains all the information concerning these dates. Especially the key dates, which are fundamentals for the contract contribute to setting out a fit-for-purpose programme. Experts mention that a well thought out programme including conversations between the project manager and contractor concerning the detailed content of the programme often result in successful projects. Key dates help all parties to keep track of the progress of the project. Further content mentioned in this core clause are access to the site, take over and acceleration of works.

4. Quality management

In the fourth group of core clauses, the way of quality control is set out and how different parties are responsible in managing the quality of the works. Subclauses include tests and inspections, searching, correcting, accepting and notifying defects.

5. Payment

This group of core clauses includes details concerning the payment process for the works and/or part of the works. Factors concerning the payment process as mentioned in this core clause are assessing the amount due, way of payment, defining the costs and the final assessment of works.

6. Compensation events

The sixth group of core clauses takes scope changes and unexpected or unforeseen events into account. Each event is assessed separately to decide on the compensation for the contractor. The sub clauses included in this core clause consider the type, way of notifying, quotations and assessing compensation events. For the client's side of the compensation event, subclauses including the project manager's assessment techniques, instructions and implementation of compensation events are provided.

7. Title

This group of clauses is seen as a more formal clause, as it includes the client's title to plant and materials, and the access to materials and objects on site.

8. Liabilities and insurances

Core clause eight contains all liabilities for the client and contractor. Furthermore, insurances are discussed where an insurance table shows against what actions an insurance must be taken into account and for what amount. Also, specific insurance by the client is stated as well as consequences if the contractor does not insure.

9. Termination

For multiple reasons, a contract can be terminated. The final group of core clauses (9) deals with that, by firstly defining what termination is. Following, the possible reasons for terminations of a contract are given, which are most often failures of one of the parties to fulfil a certain action. Finalising this group of clauses, the procedures following the termination are provided as well as the payment procedures.

4.3 Main option clauses

The same main option clauses as in the ECC3 are present in the ECC4, these include (Eggleston, 2019):

Option A: Priced contract with activity schedule

This option includes a fixed price for the agreed works (lumpsum). As a result, the contractor bares all the risk for the correct pricing of the construction works. Solely, compensation events can result in financial support from the client (Chao, 2016).

Option B: Priced contract with bill of quantity

Option B requires a bill of quantity, which means that the client pays the contractor the exact amount of work. This means that in this case, the client bares all the risk for the incorrect pricing of the construction works (Chao, 2016).

Option C: Target contract with activity schedule

Both options C and D are target contracts, which means that the exact works are not fully specified on forehand or that then expected risks are much bigger than the contract options A and B. Target contracts apply the principle of the client paying the contractor a fixed amount of money for certain activities whereas the precise amount of compensation only is determined at the end of works (price of work done to date). The contractor receives a certain amount of compensation if the works are finished within budget. Opposite, the contractor contributes a certain amount of compensation if the total amount of works is over budget (Chao, 2016).

Option D: Target contract with bill of quantity

Option D is comparable to option C, however option D uses a bill of quantity to mark down the total cost of a project instead of a list of activities (option C) (Chao, 2016).

Option E: Cost reimbursable contract

Option E is applied when both the client and contractor are unable to decide on the exact amount of work and costs, but the works have to start as soon as possible. As a result of this, the client pays the contractor on basis of the exact amount of work, minus the costs made by the contractor that are a result of inefficient deployment of staff and usage of other resources (Chao, 2016).

Option F: Management contract

The contractor receives a fee for the management of the project and engages a subcontracting agreement for every part of the project with the client. The client bears all the costs for the subcontracting agreement (Chao, 2016).

Figure 8 depicts the distribution of risks across the contractor and the client (employer) per option chosen in the contract. Also, the payment mechanism from the client towards the contractor is displayed.

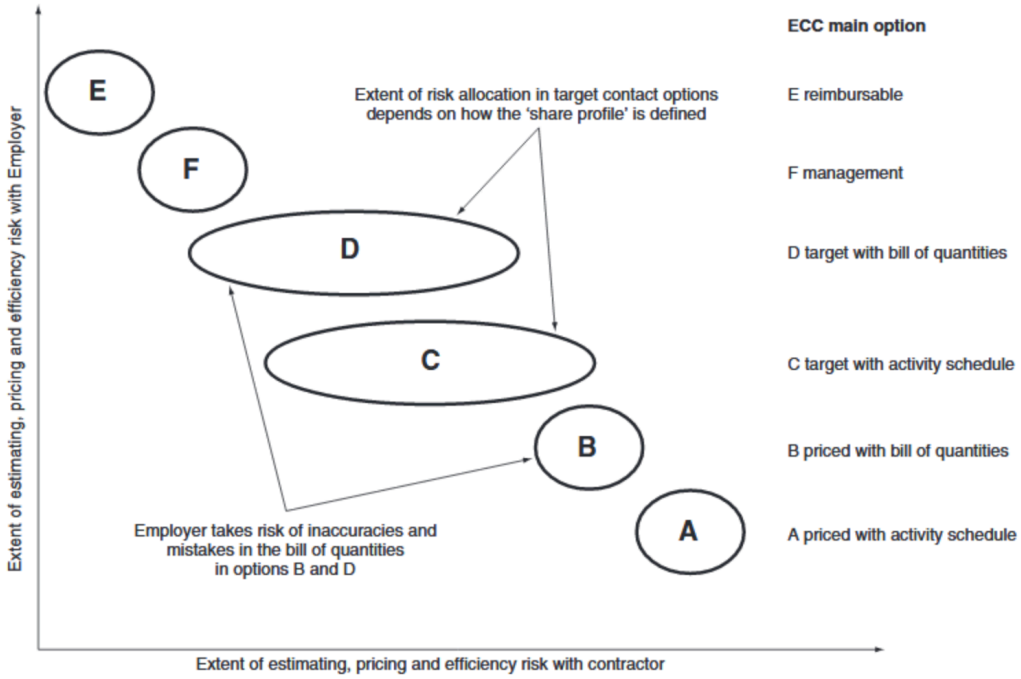

Figure 8 Risk distribution across contractor and employer (client)(Patterson, 2009)

4.4 Secondary option clauses

To further tailor the contract, secondary option clauses can be added to the existing main option clauses. In total there are 21 secondary option X clauses, 3 option Y(UK) clauses and a Z clause (Table 2). The Z clause is used to include extra information in the contract; however, the application of the Z clause has proven to be problematic and can destroy good management practice due to ambiguity (Norris, 2017). Clients should therefore be careful when formulating a Z clause.

Table 2 Secondary options

Option		Option	
X1	Price adjustment for inflation	**X14**	Advanced payment to the contractor
X2	Changes in the law	**X15**	The Contractor's design
X3	Multiple currencies	**X16**	Retention
X4	Ultimate holding company guarantee	**X17**	Low performance damages
X5	Sectional completion	**X18**	Limitation of liability
X6	Bonus for early completion	**X20**	Key performance indicators
X7	Delay damages	**X21**	Whole life costs
X8	Undertakings to the Client or Other	**X22**	Early Contractor involvement
X9	Transfer of rights	**Y(UK)1**	Project bank account
X10	Information modelling	**Y(UK)2**	Housing Grants, Construction and Regeneration Act 1996

X11	Termination by the client	**Y(UK)3**	Contracts (Rights of Third Parties) Act 1999
X12	MultiParty collaboration	**Z**	Additional conditions of contract
X13	Performance bond		

4.5 Dispute resolution options

Next to the two existing dispute resolutions in the ECC3 (W1 and W2), the ECC4 introduces one new option for dispute resolution (W3). The following options for dispute resolutions are present in the ECC4 (ICE, 2014):

- Option W1: applied where adjudication is used as a method for dispute avoidance and the United Kingdom Housing Grants Construction and Regeneration Act does not apply
- Option W2: applied where adjudication is used as a method for dispute avoidance and the United Kingdom Housing Grants Construction and Regeneration Act does apply
- Option W3: used where a Dispute Avoidance Board (DAB) is the method of dispute avoidance and where the United Kingdom Housing Grants Construction and Regeneration Act does not apply (Garrett, 2017).

From the dispute resolution options above, it can be concluded that for international projects (projects in the Netherlands), only option W1 and option W3 can be applied as the United Kingdom Housing Grants Construction and Regeneration Act (W2) does not comply with the Dutch law.
Therefore, the focus in this section is only on option W1 and W3. As the focus of this research is to avoid disputes, further attention to dispute resolution options is not taken into account. However, if a dispute emerges, it is useful to know how to deal with such an event. Figure 9 presents an overview of dispute resolution options as interference points in the conflict development scheme of Figure 5. The green boxes represent option W1 and the orange box presents option W3.

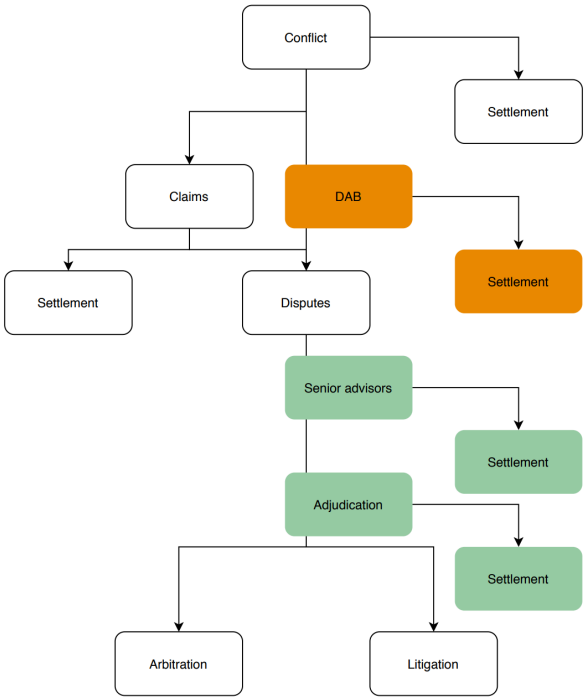

Figure 9 Dispute resolution options, based on (Gerrard & Waterhouse, 2019; Ltd, 2017a)

Option W1

Dispute resolution option W1 does not contain obvious provisions for avoiding disputes and its major function is therefore to solve disputes as fluent as possible.

If a conflict arises between the two parties and they are not able to agree on a single solution, the parties are obliged to refer the dispute to senior representatives. Following, if even the senior representatives are unable to agree on the dispute, it is referred to the adjudicator (W1.1(1)). After even the adjudicator is unable to come with an advice which both parties agree on, the dispute is referred to the tribunal (arbitration or litigation).

Table 3 presents the dispute reference table, which includes how certain disputes are handled and what responsibilities each party carries.

Table 3 Dispute reference table (Ltd, 2017a)

Dispute reference table		
Dispute about	**Which party may refer it to the senior representative**	**When may it be referred to the senior representative**
An action or inaction of the project manager or the supervisor	Either party	Not more than four weeks after the party becomes aware of the action or inaction
A programme, compensation event or quotation for a compensation event which is treated as having been accepted	The client	Not more than four weeks after is was treated as accepted
An assessment of defined cost which is treated as correct	Either party	Not more than four weeks after the assessment was treated as correct
Any other matter	Either party	When the dispute arises

Option W3

The newest dispute resolving option to the NEC contracts is option W3, when a DAB is the method of dispute resolution. The parties in the contract appoint the members of the DAB in contract data part one. In this section, it needs to be specified how often the board visits the site in order to keep track of the progress and to be aware of the roles of each party (W3.1(5)). In practice, this is quite time consuming and may not always be beneficial, especially for relatively small projects. The cost however is relatively low to the value that the DAB's deliver. A study in Australia showed that in general, 0.1 to 0.2% of the total project cost for projects over 100 million Australian dollar (60 million euro) were the costs of a dispute board. The Dispute Resolution Board Foundation's website reports that under 80% of the DAB projects have been completed without a single referral to the DAB for a decision. Compared with the industry norm of less than 40% completed without off-site dispute resolution processes being involved (Hayford, 2020).

The DAB consists of one or three members. If the contract data states that the number of members is three, the third member is jointly chosen by the parties (W3.1(1)). Most important is that the DAB acts impartial (W3.1(3)).

The role of the DAB is to assist in resolving potential disputes before they become disputes (W3.2(1)). If a (potential) dispute arises it first needs to be reported to the DAB (W3.2(2)). Afterwards, if the DAB is unable to come up with an advice which both parties agree on, the dispute is referred to the tribunal (arbitration or litigation) (W3.3(1)).

4.6 Roles

The most important and relevant roles present in an ECC4 contract are depicted in Figure 10 and elaborated below.

Employer (client)
The employer plays a small role in the contract but is the initiator of it. The employer appoints the project manager and supervisor to carry out actions according to the contract. Main responsibilities from the employer are to pay the contractor and to terminate a project when needed (Mitchell & Trebes, 2005).

Contractor
Next to the employer, the contractor is the other party in the contract. The contractor's responsibility is to carry out its duties as elaborated in the contract under core clause section 2.

Subcontractor
As defined in the contract under clause 19: '*The subcontractor is a person or organisation who has a contract with the contractor to construct, install, design and/or provide services for the works.'*

Project Manager
The project manager is employed by the client and has the main responsibility to run the contract. Therefore, he has to make sure that the responsibilities are divided equally and required decisions are made. Although the project manager is the employer's man and has to run the overarching contract, the contract does not state that he has to act impartially. The role of the project manager is defined in clause 10.1, which states that he has to act as stated in the contract and in a spirit of mutual and cooperation.
The project manager to make sure that the interests from the employer are looked after and therefore has to be aware of the progress of site, defects, compensation events and other aspects of the contract to take reasonable decisions. The project manager is allowed to delegate certain actions to others.
One of the most important responsibilities of the employer to the project manager is to provide him the authority to make sure that he is able to carry out his duties as for example increasing the total price and deducting delay damages (Mitchell & Trebes, 2005).
As stated in the core clauses, the project manager has the authority to change the scope or key dates (14.3).

Supervisor
Similar to the project manager, the supervisor's role is filled by the employer and acts as a second pair of eyes and ears to check if the works are provided according to the works information. To do so, the supervisor carries out tests and inspections, and reports defects. Next to the supervising role, the supervisor may not change the working information or give site instructions (Mitchell & Trebes, 2005).

Adjudicator
With dispute solving options W1 and W2, the adjudicator comes into play. When a dispute occurs, the first person to provide a dispute resolution is the adjudicator. If at first the contractor and project manager are not able to resolve the dispute, the dispute will be referred to the adjudicator (Mitchell & Trebes, 2005).

Dispute avoidance board
The dispute avoidance board is applicable when dispute solving option W3 is selected. The dispute avoidance board consists of one or three members as identified in the contract data (W3.1(1)). The dispute avoidance board acts impartially (W3.1(3)) when assisting the parties in resolving potential

disputes before they become disputes (W3.2(1). To achieve the full potential of the dispute avoidance board, periodical visits to the site and inspections of the works are to be facilitated (Ltd, 2017a).

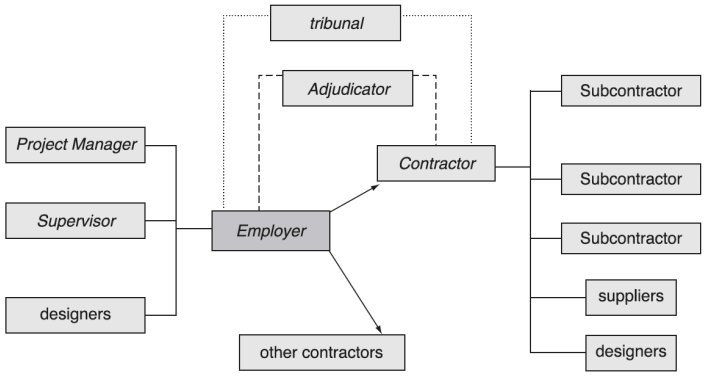

Figure 10 Diagrammatic representation of the relationship of the contract data (Mitchell & Trebes, 2005)

4.7 Benefits of the NEC4 ECC in relation to collaboration

Section 3.5.1 provides the hard elements that are present in project that are executed in the philosophy of project partnering. These hard elements include contractual elements and elements that are present in the procurement process. Below in Table 4, the contractual elements are linked to the corresponding clauses that are included in the ECC4. The following sections go further into detail on what the ECC4 clauses include and how they are able to stimulate collaboration as being hard elements with a presence in the project partnering principle.

Table 4 Hard elements and NEC clauses

	NEC Clause	
Description	**Clause nr.**	**Description**
Start up workshop	**15**	**Early warning**
Partnering based on turnkey/design-build contract	**NEC ECC**	
Early involvement of supplier(s)	**X22**	**Early contractor involvement**
Contractual right to replace people	**90**	**Termination**
Functional description	*Procurement*	
Value-based procurement	*Procurement*	
Target document	*Procurement*	
Intention/cooperation agreement	**25**	**Working with the client and others**
Binding cooperation agreement	**25 and NEC ECC**	**Working with the client and others**
Contractual right to replace firm	**90**	**Termination**
Open-book economy	**50.2, 60 and NEC ECC (target cost)**	**Payment (Assessing the amount due), compensation events**
Continuous workshops	**15, 32**	**Early warning, revising the programme**

Target price with bonus/malus	**NEC ECC (target price) + 54, X6 and X7**	**Target contract, bonus and delay damages, KPI**
Measurement during project	**32, X5, X20**	**Revising the programme, Partial completion, KPI**
Prequalification	*Procurement*	
Final workshop	**X5**	**Partial completion**
Conflict resolution mechanism	**Option W1 and W3**	**Dispute resolution**
Operational responsibility of contractor	*Procurement*	
Co-location of partnering group	*Procurement*	
Remuneration for accepted offer	*Procurement*	

4.7.1 Core clauses

15. Early warning

A way of proactive risk management within the ECC4 is the early warning mechanism from clause 15. Failure to meet the early warning obligation by the contractor may have consequences for the contractor's entitlement to receive compensation for such matter (Chao, 2016). The early warning mechanism was originally designed as a collaborative tool, assisting parties' collaborative efforts and presenting sanctions to the contractor in the event of non-compliance with the contract (Gerrard & Waterhouse, 2019).
Clause 15.1 lays down when an early warning notification needs to be given by the contractor and the project manager. If either becomes aware of any matter which could:

- increase the total of the prices;
- delay completion,
- delay meeting a key date or
- impair the performance of the works in use.

Also, the project manager or contractor may give an early warning by notifying the other of any matter which could increase the contractor's total cost. The project manager enters the matters in the early warning register. Within the first week of the starting date, the project manager issues the early warning register to the contractor (15.2), who is instructed to attend the first early warning meeting within two weeks of the starting date. As described in clause 15.2, intervals for later early warning meetings are stated in the contract data or earlier if a either the project manager or contractor instructs to.

The early warning mechanism has a lot of positive effects on the execution of the contract. To prove that collaboration is stimulated, Y. Gao (2017) sets out the results an early warning mechanism is able to achieve:

- a climate of mutual trust through equal and balanced warning responsibility;
- working together by joint problem-solving processes;
- win-win attitude;
- problem solving as quick as possible from the lowest possible authority level.

What Y. Gao also found in his research, are the two factors that need to be present in order to make sure the early warning can be applied correctly: trust and compensation events. From a contractual viewpoint, the target contract can stimulate both the factors.
In the current infrastructure sector in the Netherlands, there is too limited trust to make sure the early warning mechanism operates to its fullest. However, a virtuous circle is present as the early warning mechanism is able to stimulate building of trust (Gao, 2017).

Furthermore, through the obligation for open and honest communication as well as the involvement of management, the relationship between the client and contractor is stimulated.

25. Working with the client and others

To stimulate collaboration, clause 25 sets out responsibilities and roles by stating how the contractor is required to work together with the client and others. Especially clause 25.1 points out the importance of the contractor to co-operate with others including obtaining and providing information which is needed in connection with the works as stated in the scope (Ltd, 2017a). Therefore, the importance of a complete and accurate scope is again highlighted.

31. The programme

Central to most of the processes in the ECC contract is the programme (Bennett & Baird, 2001). The programme as specified in clause 31 sets out the roles and responsibilities for the parties according to a planning of various activities. Best practice is to make sure the contractor submits its programme as soon as possible if he/she does not submit it at tender stage (contract data part two). A detailed programme will enable a dialogue between the project manager and the contractor to understand each other's requirements. This is the starting point for a collaborative relationship.
The contractor is responsible to keep the programme up to date, where the project manager has the responsibility to check the updated programme. A high project performance depends a lot on the accepted programme, which specifies the requirements of the parties. Only through collaboration between the project manager and the contractor a reliable accepted programme is drawn.
The essence of clause 31.2 is to show when certain things will happen and how they interact with each other. It is the contractor's responsibility to show the planning of these actions and the interactions, which results in the client, project manager and the supervisor to understand how they are able to support the project (Gerrard & Waterhouse, 2019).

32. Revising the programme
Adding to clause 31, clause 32 specifies the contractor's responsibilities to show progress on the revised programme (32.1) and the contractor's responsibilities to submit the revised programme to the project manager (32.2). The revising of the programme is for the contractor a way of showing the project manager that he is aware of its plans and how he is able to deal with uncertainties and delays (32.1). This can be seen as a form of communication between the contractor and the project manager, which may result in alignment of thoughts, stimulating collaboration.
Clause 32.2 states that the contractor needs to submit a revised programme to the project manager when the contractor is instructed by the project manager, when the contractor chooses and no longer than the interval stated in the contract data.

54. The contractor's share

Considering target contract option C and D, a pain/gain sharing mechanism is present, of which clause 54 defines the contractor's share of the difference between the total of the prices and the price for work done to date. Clause 54.2 specifies that if the price for work done to date is less than the total price, the contractor is paid its share of the savings. On the other hand, if the price for work done to date is greater than the total of the prices, the contractor pays its share of the excess (Ltd, 2017a).
As set out in 4.7.2, the pain/gain sharing mechanism acts as an incentive for the contractor to reach for the highest project performance, which can only be achieved through collaboration. If parties enter the project with a wrong mindset or ignorance concerning this principle, it is difficult to achieve full benefits.

This clause is able to stimulate collaboration through its win-win characteristic included with a financial incentive. Only through open and honest communication of parties involved, the optimum can be achieved through this clause, which is also a stimulus for collaboration.

60-66. Compensation events

One of the most important events in the ECC contracts concerning payments and time aspects are the compensation events as elaborated in clause 60. In short, compensation events can be categorised into three categories:

- Additional work instructed by the Project manager
- The failure of the client, project manager, supervisor or others to do something, either at all or on time
- The occurrence of a risk-based event, such as weather or physical conditions, which has exceeded the acceptable risk that the parties had agreed the contractor should bear (Gerrard & Waterhouse, 2019).

Main goal of the compensation events is to eliminate the time and effort expended on disputes and litigation, by clearly defining the steps to be taken (Thompson, Vorster, & Groton, 2000). The four stages of the process to finalise an implementation of a compensation event are: notification (61), quotation (62), assessment (63 & 64), and implementation (66). The ECC contract aims to describe as clear as possible how the steps are to be taken and which responsibilities are linked to which party. By defining the roles and responsibilities clearly, the chances of a conflict to arise are reduced.
The result of compensation events in combination with joint risk allocation is stimulated collaboration between the client and contractor. The compensation events stimulate the parties to work together on the control of measures, resulting in effective control measures (ten Hoeve, 2018).

90. Termination

Clause 90 covers the issue of termination of the contract. The ECC4 includes reasons for both parties to terminate the contract (91), followed by the exact procedures (92) and the payment on termination (93). For this research, the presence of termination in the contract is of most interest as this is a hard element included in the project partnering way of working. According to Hoeseinni (2018), the right to replace people or organizations is an incentive for people and organization to show better results (Hosseini et al., 2018). However, when this happens, most probably a gap of information and knowledge is left within the project organization.

4.7.2 Main option clauses

To encourage collaboration, incentives in the contract need to provide each party stimulus to perform in their best manners in order to increase project performance. An incentive which provides this stimulus is the pain/gain-sharing mechanism in the target contract (option C and D). To provide the client with more insight in the activities of the contractor and to incentivise the contractor to finish activities as structured and fast as possible, a payment mechanism based on an activity schedule is most ideal (option C).
Target contract option C holds the principle that at the tender stage, the contractor assesses the cost of doing the defined work, where after he adds the fee for overhead and profit and makes other tender adjustment. The price which results from this procedure acts as the target price expressed by referencing to an activity schedule (Mitchell & Trebes, 2005).
On completion of the project, the final costs will be assessed and compared to the target price. Figure 11 depicts the principle behind the pain and gain sharing mechanism in contract option C.

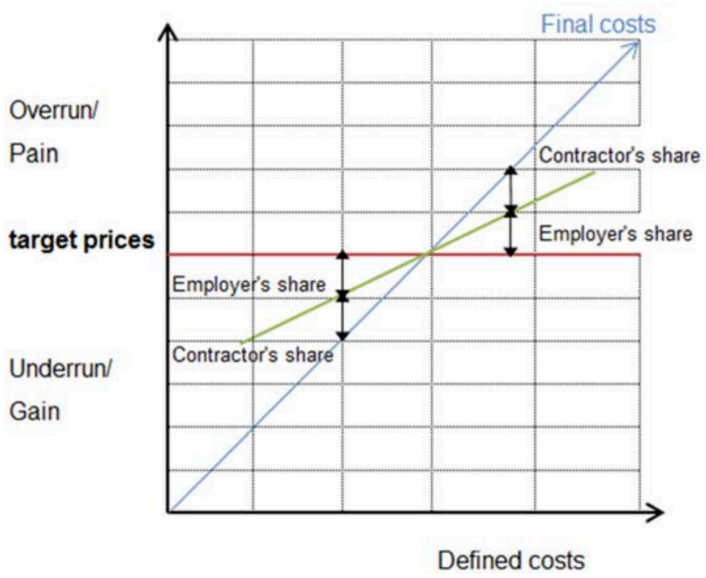

Figure 11 NEC option C target price (Geertsma, 2016)

4.7.3 Secondary option clauses to stimulate collaboration

In this section, the secondary clauses that are able to stimulate collaboration are stated. Not only the theoretical side from the contract clause aspect is highlighted, also a practical interpretation is provided where needed.

Option X5: Sectional Completion

Clients often want something done by a certain date, to make sure the contractor lives up to the expectations, option X5 can be included in the contract added by open and honest communication towards the contractor. This clause introduces sectional completion of works. Including this option into the contract, the client's wished are clear to the contractor, which can avoid conflicts (Patterson, Anders, Siljehah, & Macdonald, 2017). If a conflict unfortunately is not avoided, the client may introduce optional clause X7 to cover for delay damages, which will be elaborated later on. On the other hand, optional clause X6 acts as an incentive by providing a bonus for the contractor to complete the works earlier.

Option X6: Bonus for early Completion

As an addition to clause X5 or as a separate clause, clause X6 takes care of early completion of (part of the) works by the contractor. This clause enables the client to incentivise the contractor to finish works faster when needed. By this, a common goal for the client and contractor is established as well as a stimulus for management commitment for collaboration, which is able to stimulate overall project collaboration as mentioned in section 0 and reduce disputes or conflicts (Gerrard & Waterhouse, 2019).

Option X7: Delay damages

Opposite to clause X6 is clause X7, which includes the damages for the delay of works caused by the contractor. This clause incentivises the contractor to make sure that the works are not finished later than the agreed completion date. As clause X6, a common goal is established for the client and contractor to finish the works on or before the agreed date of completion.

Option X20: Key Performance Indicators

As mentioned in section 3.5.1, including measurement during the project in the contract contributes to stimulating a collaborative relationship. The practical application of this can be utilized by secondary option clause X20, which introduces key performance indicators (KPIs) in a contract. In order to gain most out of this clause and to not disincentivise the contractor, attention needs to be paid during tender stage to set up the key performance indicators as smartly as possible (Gerrard & Waterhouse, 2019). Furthermore, KPI's encourage the client and contractor to focus on the objectives of the parties, driving a change towards the client's objectives in a way that is consistent with achieving excellence in construction principles (Arup, 2008).
Side note: this clause cannot be used in combination with clause X12 (Multiparty collaboration) where KPI's are already implemented

Option X22: Early Contractor involvement

Option X22 can be compared to the Dutch 'Bouwteam' or the 'twee-fasen samenwerking' as elaborated in the report of McKinsey for Rijkswaterstaat (Rijkswaterstaat, 2019). Although this clause is a relative extensive optional clause, it is just an optional addition to the ECC4 contract with main option C and E, whereas the 'Bouwteam models' are often separate contracts in the Dutch infrastructure sector (Chao, 2019)

A two stage approach is provided by this optional clause, with details set out by the client in the scope. The first stage is the pre-construction stage, with the development of the scope, detailed design and agreement on the price. The second stage is the construction phase with finishing of the remaining design (Hunter, 2019).
As for ECC option C, the price for work done to date during the first stage is included in the activity schedule and added to the target price. At the end of the first stage, the client may decide to proceed to the second stage, of which the project manager notifies the contractor. Also matters including changes to the budget and the price of works must be agreed upon before moving on. However, the client may choose not to move to the second stage, which is not a reason for a compensation event or a reason for termination. If the client decides not to proceed, the project manager issues an instruction to remove the second stage from the scope. The client may decide to have the second stage carried out by another contractor.
An often-mentioned problem of a two-stage approach is the changing of key persons within the project, with a result that agreements are forgotten or interpreted differently. Clause X22.4 makes sure that key persons of the contractor's side cannot easily be replaced in the second phase.

Incentive
If the total project cost on completion is lower than the budget, the contractor is rewarded with a budget incentive payment as described in clause 54. This is different to the budget incentive as this is based on the total price and is subject to change during the first change. For contracts with option C, the pain/gain sharing mechanism reduces the risk of the target price being exceeded, improving the chances of a financial win-win scenario.
However, care needs to be taken with the development of the budget during the first stage as the unequitable share arrangement may disincentivise the contractor to reduce the target price. (Hunter, 2019). The newest aspect of the incentives in this optional clause is the contractor receiving a percentage of the savings on the client's side. This however may only work out if the contractor is also assigned to execute the second phase.

4.8 NEC4 ECC and UAV-GC

As mentioned earlier on, cases that apply an UAV-GC contract are studied in the case study because no experience of ECC4 projects have been documented on projects within the scope of this research. To make an adequate analysis of the potential of ECC4 clauses, a comparison is made with UAV-GC clauses. The analysed clauses from the ECC4 are retrieved from the general contract, therefore, to make a right comparison the basis for UAV-GC contracts (general conditions and basic agreements) is used as a comparison. Often in practice, the general conditions of the UAV-GC are applied as a basis for a project specific contract. The project specific contract always includes multiple documents as for example: demand specifications and annexes. The cases in the case study are used to analyse how the UAV-GC contract is implemented in practice and what methods are included in the additional contractual documents to aim to stimulate collaboration.
Table 5 displays the ECC4 clauses compared to the UAV-GC clauses that cover the same theme in the contract. Some of the themes of the ECC4 clauses are not represented in the UAV-GC contract, which is why not all ECC4 clauses have a similar theme in the UAV-GC. Furthermore, the overlapping themes from the UAV-GC are linked to the clauses from the ECC4.
The table indicates which number every ECC4 clause is and in which paragraph the UAV-GC clause can be found. This table is to be applied in the case study to see how the UAV-GC implementation compares to the ECC4 clauses and if the ECC4 can add to the UAV-GC clause.

Table 5 NEC and UAV-GC clauses

	NEC contract		**UAV-GC contract**	
	General clause	**par**	**Theme**	**Dutch:**
13	Early warning	4.7	Duty to warn	Waarschuwingsplicht
25	Working with the client and others			
31	The programme (key dates)	36	Milestones	Boetebeding en bonus
32	Revising the programme	7	Planning and coordination	Planning
50	Assessing the amount due (Open book economy)			
54	The contractor's share (pain/gain sharing)			
60	Compensation events	14	Deviations	Wijzigingen, schorsing, ontbinden, opzeggen
90	Termination	16	Termination of contract	Contract ontbinding
	Option W1, W3	47	Conflict resolution	Beslechting van geschillen
	Secondary clause			
X5	Sectional completion	36	Milestones	Boetebeding en bonus
X6	Bonus for early completion	36	Bonus	Boetebeding en bonus
X7	Delay damages	36	Penalties	Boetebeding en bonus
X20	Key performance indicators			
X22	Early contractor involvement			

4.9 Conclusion

Chapter four aims to provide an answer to the following research question:

How can the NEC4 ECC stimulate a collaborative relationship?

This chapter examines the potential of the ECC4 to stimulate collaboration and goes into detail on the specific clauses.
At first, the ECC4 contract is analysed to see how the contract is build up and what the different roles within the contract comprise. As mentioned earlier in this report, focus is placed on the client (employer) and contractor relation within the contract. In the contract, the project manager and supervisor are often mentioned as representatives of the client.
Characterizing about the ECC4 is its flexibility due to the freedom to pick a main option, secondary options and a dispute avoiding/solving option on top of the core clauses. In this way, for each project, a fitting contract can be written. Applying the knowledge from the literature study on contractual elements that are able to stimulate collaboration, clauses from the ECC4 are selected that show potential to stimulate client-contractor collaboration in projects. UAV-GC themes that correspond with the ECC4 clauses are used in the case study as a benchmark to study how the clauses are applied in current practice. The unique ECC4 clauses that do not have a corresponding UAV-GC theme are also studied in the case study, but this time the experiences of the interviewees with likewise clauses and situations are studied.
During the case study, the potential of the clauses as an application to the projects included in the scope is researched.

- Clause 15: Early warning mechanism
- Clause 25: Working with the client and others
- Clause 31: The programme
- Clause 32: Revising the programme
- Clause 50: Assessing the amount due
- Clause 54: The contractor's share
- Clause 60: Compensation events
- Clause 90: Termination
- Dispute resolution option W1 & W3
- Clause X5: Sectional completion
- Clause X6: Bonus for early completion
- Clause X7: Delay damages
- Clause X20: Key performance indicators
- Clause X22: Early contractor involvement

PART III CASE STUDY

Chapter 5: Case results
Chapter 6: Cross case analysis

5. CASE RESULTS

This chapter includes the case study which is based on three different cases. With the use of the case study, an answer to research question three is sought:

Which clauses from the NEC4 ECC are able to stimulate a collaborative relationship in the case studies?

Interviews (Appendix D) are used to analyse each individual case on collaboration between the client and contractor and how ECC4 clauses offer potential to improve that collaborative relationship. Per case, opportunities for improvement for the UAV-GC in relation to stimulating collaboration is shown. This analysis is concluded from the interviews with a project manager or contract manager from both the client and contractor side who elaborated on their viewpoints of the collaboration throughout the whole project.

5.1 Case 1

Case 1 is about the reconstruction of a part of the road in an inner-city environment. The existing infrastructure in this part of the road is old and in bad condition. The cycling paths and sidewalks are in bad condition, but especially the road and tramline are to be replaced due to their bad condition and age. The road, public transport road and cycle paths are all part of the main net of transportation in the city, highlighting the importance of this part of the road within the whole city transportation network. During the construction of the works, all transportation networks needed to be accessible, which gave extra complexity.
In the previous situation, the car traffic, in combination with the number of cyclists, was heavily stagnated during peak hours, which lead to a proposal to change the situation of priority for the intersecting traffic. Furthermore, changes are applied to the public transportation network.

Before the start of the project, the risks related to this project where known, next to the fact that the client had a relatively tight internal planning because of upcoming projects. Next to that, one of the main challenges for the contractor was to reduce the nuisance as much as possible for the surrounding citizens.

Phasing
Both parties started off on the wrong foot, as the client already set out milestones before the project was even rewarded to a contractor. The contractor knew of these milestones but did not account very well for the risks, which resulted in the milestones being unrealistic. From here on, the contractor finalised the designs and started with the construction. The contractor was responsible for the risks, but also collaboration with the client was necessary to mitigate certain risks. As good collaboration was not present, risks were left unattended and even deteriorated the client-contractor collaboration. At a certain point, even after a scope reduction, it became clear that this way of executing the project was not going to work. A second phase began, and the client initiated a restructuring of the project organization. After a week of heavy discussions, new roles were appointed to people in the project organization as well as setting up a more integrated team (Bouwteam like). This integrated team included buffers in the planning by combining the knowledge of the client and contractor, which also resulted in a more collaborative attitude of both sides, because the client and contractor both recognise the feasibility of the milestones. According to the client, this was the result of the increasing trust and forgiveness of both parties.

In the first phase, the project performance was low, because of the delayed progress and the related costs. After the restructuring in the second phase, the project performance improved as the progression of the construction process increased and milestones were reached.

5.1.1 Opportunities for improvement in the UAV-GC

This section summarizes situations that have led to an adversarial relationship with a link to the UAV-GC contract.
To start off, clashes between the client and contractor start off by the client setting up unrealistic expectations (milestones and responsibilities) for the contractor. The contractor underestimates the expectations and the client is unaware of the fact that the contractor is unable to achieve the expectations. This underlines the criticism as seen in the literature on the UAV-GC, which says that parties have difficulties to communicate in a good way in order to match expectations. This situation can be traced back to the client not involving the contractor early on in the project.
Secondly, the distribution of risks present in this case, due to the UAV-GC contract, resulted in dysfunctional conflicts. All risks concerning the design and execution of the project were on the contractor, however the contractor needed the client's help in order to mitigate certain risks. As seen in the case study, the client had difficulties with knowing when to assist the contractor. This resulted in the contractor having to take on too many risks that he was not able to mitigate.
Thirdly, as a result of the legal language and the way the UAV-GC is set up, parties are not open to each other. This is acknowledged by both the client and contractor in this case. The result of not being open and forgiving to each other is displayed during the first stage of the project before the restructuring of the project organization. After building a more integrated team in the second phase, the parties were more open and forgiving towards each other which resulted in a better collaboration. The principle of building a more integrated team was this time done on the own doing of the client and therefore is not incorporated in or stimulated by the UAV-GC. Both the client and contractor in this case mention that dysfunctional conflicts can arise because of financial matters. Furthermore, they mention that more insight into financial matters on both sides is a stimulus to being more honest and open to each other, which is not incorporated in and/or stimulated by the UAV-GC.

5.1.2 NEC4 ECC clauses

In this section, the ECC4 clauses presented in Section 4.7 are discussed as an application to this case. As mentioned before, certain clauses are somehow also present in the UAV-GC or are already intrinsically applied in the project. Per clause, the experiences and/or opinions of both the client and contractor are presented, which are an input for the cross-case analysis in the following chapter.

Early warning
Both the client and contractor made a risk analysis, which were later compared. In the first phase, a RISMAN risk analysis was done. According to the client, the risks were visible, but both parties had difficulties with analysing the risks and finding correct mitigation measures. Due to the UAV-GC type of contract, all responsibilities were with the contractor, who mentions that the risks were mitigated well, but in hindsight proved to be miscalculated.
In the second phase, a plan do check act method of risk analysis was applied. Due to the more integrated teams in that phase and the clear definition of roles, the risks were better visible and easier to mitigate. The integrated team formed a basis for setting up a correct risk management plan, which shows that collaboration is needed to set up a good risk management plan.

Working with the client and other (cooperation agreement)

Agreements on collaboration were made during the project start up and salvaged throughout the project. During project follow ups, the agreements were reviewed and adjusted where necessary. According to the client, they had difficulties with assisting the contractor at moments where they had project related difficulties, showing signs of bad collaboration. According to the contractor, commitment and trust in the IPM-team contributes a lot to stimulating collaboration.

The programme (key dates)
From the beginning, the client set out milestones as the project needed to be finished in time due to the dependency of other projects. The contractor underestimated and miscalculated the milestones, resulting in friction between the client and contractor. In the second phase, due to the integrated team effort, more realistic milestones were set. These helped the client and contractor to better define the roles and the responsibilities and to work towards a common goal through collaboration.

Revising the programme
According to both the client and contractor, it is of utmost importance to keep a heads up between the client and contractor to keep track of the progress. The client is eventually responsible for the end product of its own project; therefore he/she needs to know how the execution is progressing.
The contractor thinks that revising the programme together with the pain/gain sharing mechanism is a perfect combination to execute projects.

Payment (open book economy)
In current practice, according to the client, there is not a lot of openness between the client and contractor in terms of costs. Especially the specified costs of a subcontractor are not visible for a client. In complex works, it would be beneficial to be open and honest about the pricing. The contractor agrees with this, as an open book economy would stimulate trust, openness and honesty. However, the contractor thinks that both parties need to commit to the open book economy in order to make it work.

Termination
The contractor sees the organization as a dynamic body, meaning that people within a project switch roles or switch between projects. The client however sees this as disadvantageous, due to the loss of knowledge.

Partial completion
The contractor thinks that partial completion is a method currently applied by the contractor but is not recognized by the client. It does contribute to better collaboration as parties recognize each other's interest. The client mentions that partial completion is especially useful on technical complex parts within the project.

Bonus for early completion
There was no bonus applied for early completion. According to the client, the contractor sees the bonus as a profit, however the purpose is to use it as a budget for risks.
The contractor sees it as a positive mechanism to keep control of people/parties and it is fair to give a bonus for early completion if delay damages are also incorporated in the project.

Delay damages
In the first phase, delay damages were included in the contract, but this was not perceived as being a good mechanism to stimulate collaboration. During the second phase, delay damages were not included anymore as goals were more clearly set and parties combined their expertise. The contractor thinks this is a good mechanism to keep control of people/parties, but also mentions that in project where this mechanism is included, the penalties are not always given.

Key performance indicators
No key performance indicators were included in the project. Performance measurements were included though, which resulted in aggressive meetings. In the second phase, the performance measurements were better received. According to the contractor, key performance indicators could be able to stimulate collaboration when a bonus is linked to the key performance indicator. A contractor would however include this bonus as a profit, which is again the wrong intention.

Early contractor involvement
The client only involved the contractor during the tender phase. After a selection of contractors was made and their EMVI criteria were checked, a contractor was chosen. The client already set milestones due to interaction with other projects. Together with the unclear contractual documents, the contractor was not critical towards the client about the planning and set up a too optimistic planning.

Dispute resolution options W1 and W3
A conflict escalation mechanism was present within the project where members of the IPM-team of both the client and contractor are linked to each other. According to the client, this structure gave a safe feeling for the people on the project as they were able to escalate conflicts in time. According to the contractor, attention needs to be paid to how the conflict escalation mechanism is designed.

The contractor's share (Pain/gain sharing)
Both the client and contractor think the pain/gain sharing mechanism is beneficial for both. The client points out that care has to be taken towards the contractor, that not too much money is used to mitigate risks. According to the contractor, this mechanism creates a good team and commitment within the team, resulting in collaboration and involvement of all members. Both parties within the project however need to recognize the value of such a mechanism to make it work.

5.1.3 Contractual elements and effects

Table 6 displays the presence of contractual elements in the case and their effect on the relationship between the client and contractor as perceived by the client and contractor in this case. As can be seen in the table, certain elements that were present contributed to the occurrence of dysfunctional conflicts because of the way they were implemented (early warning and sectional completion), other elements that were not present and thereafter contributed to the occurrence of dysfunctional conflicts were an open book economy and early contractor involvement. A contractual element included in this project that resulted in stimulating collaboration was setting up a cooperation agreement.

Table 6 Presence of contractual elements and effects case 1

NEC clause	UAV-GC	Present?	Contributed to
Early warning	Duty to warn	Yes	Dysfunctional conflicts
Working with the client and others		Yes	Collaboration
The programme	Milestones	Yes	Dysfunctional conflicts
Revising the programme	Planning and coordination	Yes	-
Assessing the amount due (Open book economy)		No	Dysfunctional conflicts
The contractor's share (pain/gain sharing)		No	-

Termination	Termination of contract	Yes	-
Dispute option W1, W3	Conflict resolution	Yes	-
Sectional completion	Milestones	Yes	Dysfunctional conflicts
Bonus for early completion	Bonus	Yes	-
Delay damages	Penalties	Yes	-
Key performance indicators		No	-
Early contractor involvement		No	Dysfunctional conflicts

5.2 Case 2

The second case is about reconstructing a part of a train station and the public area around it. The municipality and Prorail, the two clients, both have the task to restore the value of the area around this train station. With the use of a restoration, the two clients aim to solve the current junctions, and create opportunities to involve the area around the station with the city centre. Next to the infrastructural challenge, the renovation includes the development of an underground bicycle parking.

Logistics
The station is an important hub for the city, as it is their 3rd biggest train station, including bus and tram stops. When boosting the image of this area, a lot of potential is pursued.
Next to the public transport, an important traffic intersection is present and is taken into account when creating the tram loop through the intersection.
Furthermore, cyclists and pedestrians play an important role when redefining the area. Due to differences in altitude around het station, it was difficult for disabled people to reach certain places. Everything is done to make all areas accessible for all people. For cyclists, the existing bicycle parking is expanded by doubling the amount of parking spaces. Next to that, the existing bicycle parking underneath the station is renovated and expanded, which was one of the most complex works in the projects, which was the major reason that an UAV-GC was applied. This part of the works was complex because there was a lot of interaction with daily ongoing transportation around the construction site. Also, the construction of the bicycle parking was technically complex, because of the construction under an existing monumental building.

Strategy by the client
The project is granted as a complex task due to the amount of actors and their dependencies. The client therefore developed a strategy based on three important pillars:

- Integrated approach
- Quality management
- Risk limiting

The municipality included market parties when developing the urban plan. Next to that, the market parties agreed to comply with the sustainable, energy and environmental goals as set up by the municipality.

Collaboration throughout the project was perceived as successful, which both the client and contractor claim on an extensive preliminary stage as a steady basis. The client made a conscious decision to focus

on collaboration by involving the contractor early on through multiple dialogue sessions. During the project start up, agreements concerning collaboration were made. Also, a board of advisors was assigned early on in the project. This board met early on in the project to establish a collaborative basis and to make sure that when conflicts came to light, they were solved as fast as possible.
Apart from the project follow ups, informal actions as for example organising a BBQ with all the teams contributed to stimulating the collaboration. In the end, both the client and contractor mention that no real conflicts have escalated to disputes which contributed to the project performance.

5.2.1 Opportunities for improvement in the UAV-GC

In this case, the collaboration throughout the project was perceived as successful. Both the client and contractor devote this to clear allocation of responsibilities and creating a cooperative environment. Methods that were used to achieve this are further explained. As seen in the previous case, the contractor was not involved early on in the initiation process of the project. In this case however, the client involved the contractor through a dialogue session where the contractor was able to ask questions and contribute by means of their expertise. This resulted in a change of planning, distribution of risks (allocation of responsibilities) and interactions with the environment. Both the contractor and client perceived this as a steady basis for a good collaborative relationship throughout the project.
In all cases, a dispute escalation mechanism was present. Both the client and contractor in this case however pointed out the importance of meeting with the people who are part of the dispute escalation mechanism (in this case an appointed group of people). By meeting with each other before a conflict arises, more forgiveness towards each other can be expected when a conflict needs to be solved. What was special in this project, was the appointed group of people responsible for solving conflicts (dispute board). This board consisted of managing directors of both the client and contractor. By staying in close contact with this group, conflicts could be escalated as quick as possible, subtracting the issue from the working space. This group of people also met each other every 3 or 4 weeks in order to keep each other up to date and keep control of issues.
Finally, the client pointed out that openness is key to stimulate collaboration and has to be achieved in an intrinsic way. This means that the UAV-GC does not assist in creating an open environment for both parties. Finding a way to create an open environment not only in an intrinsic way but also extrinsic by including mechanisms in the contract, can help parties in achieving an open and honest environment.

5.2.2 NEC4 ECC clauses

In this section, the ECC4 clauses presented in Section 4.7 are discussed as an application to this case. As mentioned before, certain clauses are somehow also present in the UAV-GC or are already intrinsically applied in the project. Per clause, the experiences and/or opinions of both the client and contractor are presented, which are an input for the cross-case analysis in the following chapter.

Early warning
During the tender phase, both the client and contractor made their own risk analysis. During the project start up, together with a risk manager, these separate risk analyses were compared to come up with an integral risk analysis. Collaborative meetings were periodically organized throughout the execution phase of the project in order to discuss the current status of the risks. At critical moments, extra collaborative risk meetings were organized.

Working with the client and other
During the project start up, agreements were made between the client and contractor on how to collaborate during the execution of the project. Three main goals were agreed on: to apply an

integrated strategy in order to incorporate interests of both parties, continuously check the quality of the works in the spatial environment and to apply correct risk management. Agreeing on this helped in setting out a basis for the collaboration.

The programme (key dates)
Milestones were included in the EMVI criteria. Setting out such goals contributes to stimulating collaboration as parties strive for a common goal.

Revising the programme
Discussing the programme during the execution of the project is essential according to the client. Plans are periodically discussed during progress meetings. Both the contractor and client agree on the added value of these meetings. The client says these are formal meetings, however informal discussions are maybe even more important for the collaboration.

Payment (open book economy)
Both the client and contractor are a little sceptical about the open book economy. The client points out that the relevance at first has to be examined, where after parties need to be aware of the amount of time they put in to specify the open books. The contractor thinks that it is difficult to share the prices of specific components, due to the competition between contractors.

Termination
Replacing a party or people was not included in the contract. It is never a good idea to terminate a contract, due to all the consequences. Furthermore, it is of importance to try and keep the key persons on the same project to achieve continuity and maintain knowledge.

Partial completion
The decommissioning and reconstruction of the tram line was used as a partial completion as the intersection was again commissioned after reconstruction, which served as a mechanism for achieving a common goal for both the client and contractor.

Bonus for early completion
A bonus for early completion was included in the contract, resulting in the contractor applying buffers on the planning. Setting out bonusses for early completion provided the contractor clarity in terms of the aim of the client, setting out a common goal.

Delay damages
As well as bonusses, on the other hand penalties were included in the contract. This has the same effect as giving out bonusses for early completion, as it is a motivation for the contractor set up a well thought out planning. This well thought out planning can only be written down through good collaboration.

Key performance indicators
No key performance indicators were applied during this project. As this project had a relative short lead time, no added value was seen in the application of key performance indicators by the client. The contractor included an EMVI score for the construction of a certain part of the project, which put the emphasis on the aims of the contractor.

Early contractor involvement
After an overall design was provided by the client, multiple dialogue sessions were held between the client and contractors. After scoring the EMVI criteria, a contractor was chosen. Afterwards, the contractor made the final design for construction.

Conducting multiple dialogue sessions added to the collaboration between the client and contractor as the contractor received useful feedback on their questions concerning the plans on the project.

Dispute resolution options W1 en W3
A dispute board was created to escalate conflicts in order to subtract the issue from the project team as soon as possible. The board had regular meetings to discuss the issues. This helped to achieve continuity of the project progress.

The contractor's share (Pain/gain sharing)
This mechanism is not of relevance for this project; however, the client sees potential for bigger project to combine important activities into a shared risk pot. The contractor compares this mechanism to the alliance pot, where all pains and gains are shared within the alliance organization. The contractor also points out that this mechanism could be useful if the contractor is able to take full control of all risks and on that basis calculate the budget for risks.

5.2.3 Contractual elements and effects

Elaborated earlier, in section 5.2.1, the client and contractor aimed to stimulate collaboration by allocating responsibilities accordingly and create a cooperative environment by means of including certain contractual elements. The results from the interviews with the client and contractor show that the contractual elements have indeed resulted in stimulating a collaborative relationship. Table 7 displays the results of the contractual elements that were implemented and the possible potential of contractual elements that were not implemented.

Table 7 Presence of contractual elements and effects case 2

NEC clause	UAV-GC theme	Presence	Contributed to
Early warning	Duty to warn	Yes	Collaboration
Working with the client and others		Yes	Collaboration
The programme	Milestones	Yes	Collaboration
Revising the programme	Planning and coordination	Yes	Collaboration
Assessing the amount due (Open book economy)		No	Could show potential for collaboration
The contractor's share (pain/gain sharing)		No	Could show potential for collaboration
Termination	Termination of contract	No	-
Dispute option W1, W3	Conflict resolution	Yes	Collaboration
Sectional completion	Milestones	Yes	Collaboration
Bonus for early completion	Bonus	Yes	-
Delay damages	Penalties	Yes	-
Key performance indicators		No	-
Early contractor involvement		Yes	Collaboration

5.3 Case 3

The third case includes a part of the construction of a transportation network in a city. As part of the transportation network, a bus lane was constructed to provide a connection from one end of the city to the central station. The most challenging and complex components in this infrastructure project were crossing two intersections with the use of an underground undercut. The complexity of engineering and constructing the undercut at the intersections was one of the main reasons an UAV-GC contract was used for this project.
Next to the construction of the intersections, planning the traffic closure (as well for trams) and moving the cables and pipes were complex assignments within this project for which the client and contractor really had to collaborate.

Before the design phase commenced, the client had already done added research and prescribed extra requirements towards the contractor based on the research. The client provided a reference design to the contractor who had to develop this design into a final design.
Both the client and contractor mention that the collaboration throughout the project went well and no significant disputes have occurred. Some minor conflicts happened but they did not have an impact on the collaborative relationship. At the start of the project, an emphasis was put on collaboration by means of organising a project start up and periodically planned project follow ups. Furthermore, a mirrored organizational structure in the project was applied which means that people from both the client and contractor's IPM teams had an equal on the other team whom they discussed with about every week. By doing so, minor conflicts were deescalated as fast as possible.

5.3.1 Opportunities for improvement in the UAV-GC

To start of, both the client and contractor perceived the collaboration throughout the project successful as no significant dysfunctional conflicts had occurred. The client and contractor devote the fact that a

As seen more in practice, parties still have the tendency to over-specify the works before finding a contractor. This does not comply with the aim of the design and construct contracting as the contractor is left with limited space for engineering. As a result of this, ambiguities about responsibilities can arise as a result of unclarities about who delivered what information for the design. As the interviewees mention, this could have been solved by involving the contractor early on in the tendering phase, which did not happen in this case.
Secondly, the UAV-GC stimulates the contractor to find optimizations during the tender stage, but no incentive for optimization is present during the construction stage. In this case, the contractor proposed an optimization on its own initiative. By including incentives in the contract, the contractor may be more eager to seek for optimizations, which is beneficial for both the client and contractor.
Lastly, by organizing periodically planned project follow ups, both the client and contractor are stimulated to openly communicate about risks, progress etc. Not only the project follow up meetings, but also the meetings with the equal from the other party added to stimulating open communication.

5.3.2 NEC4 ECC clauses

In this section, the ECC4 clauses presented in Section 4.7 are discussed as an application to this case. As mentioned before, certain clauses are somehow also present in the UAV-GC or are already intrinsically applied in the project. Per clause, the experiences and/or opinions of both the client and contractor are presented, which are an input for the cross-case analysis in the following chapter.

Early warning
Both client and contractor set up their own risk register, which was periodically discussed in an intensive interactive meeting. Together looking at and comparing risks and mitigation measures, stimulates the collaboration.

Working with the client and other
During the project start-up, agreements in terms of collaboration were made. Both parties agree that setting up the agreements, resulted in stimulating collaboration.

The programme (Key dates)
The most important key dates/milestones were the temporary shutdowns (buitendienststelling) of the two crossing tram lines. According to the client, to successfully organize the temporary shutdowns, the client and contractor had to collaborate in order to comply the planning with the owner of the public transport. According to the contractor, they got a good grip on the planning due to the before-mentioned set out milestones.

Revising the programme
According to the client, in the current situation, the plans of the contractor are reviewed during the project follow ups and continuous meetings with the equal from the other organization, stimulating collaboration.
The contractor looks at it from a different perspective, where the possibility to revise the EMVI plans during the execution of the project is brought to light. In the current situation this is not possible, due to the fact that the EMVI plan is a contractual document for which multiple contractors compete. If the EMVI plan could be revised during the execution, this would be beneficial for the collaboration according to the contractor.

Payment (open book economy)
According to the client, an open book economy in the current market situation is not possible, as contractors are forced to negotiate certain prices to be competitive. However, in another market situation, this mechanism could be able to stimulate collaboration.
The contractor mentions that this mechanism was applied in this project where the client asked for price specifications during the tender. If the client would also open up about its budget and risks, this would be beneficial for the collaboration, resulting in trust and honesty.

Termination
The contract did not include an option to replace people or parties. Some key persons changed on the side of the client's organization. This led to the contractor having to put in extra time and effort to educate the replacement. Besides of that, no real issues were encountered when switching people.

Partial completion
According to the client, the temporary decommissioning was seen as partial completion, contributing to the collaboration as the parties worked towards a common goal. The contractor however mentions that no partial completions were applied, but it was named early commissioning. The perception is different by the client and the contractor, but the essence is the same as both client and contractor see partial completion and early commissioning as mechanisms that stimulate collaboration through a common goal.

Bonus for early completion
The client mentions that bonusses were included in the contract but were not necessarily a driver for collaboration. The contractor however mentions the opposite, that no bonusses were included in the project and that bonusses could be able to stimulate collaboration.

Delay damages
Delay damages were included in the contract, but were not a stimulus for collaboration, because as the contractor mentions: the client did not have a tight planning. If the client had a tight planning, the contractor needed to make a well-thought-out planning, for which collaboration was needed. In this case, this mechanism would be able to stimulate collaboration.

Key performance indicators
No key performance indicators were included in the quality assessment of the project. Quality testing was done nonetheless, but no bonus was handed out when a quality was reached.
The contractor thinks that a bonus as an addition to the key performance indicator could be beneficial for the collaboration.

Early contractor involvement
During the tender phase, the contractor got involved in the project. According to the client, if the contractor was involved earlier, this would be more beneficial. The contractor agreed with this, also mentioning that the client only wanted official communication, meaning there was not a lot of room for the contractor to contribute to the plans. Earlier involvement of the contractor results in more clarity for both parties in terms of allocating responsibilities, according to the contractor.

Dispute resolution options W1 and W3
A conflict escalation ladder was present within the project, where a clear role division was set out. The couples within the escalation ladder had weekly meeting, which resulted in conflicts being resolved relatively fast and easy. Overall the presence of an escalation ladder gave a safe feeling for people acting in the project, because they knew they were able to raise a problem outside of the project organization.

The contractor's share (Pain/gain sharing)
Both the client and contractor agree that the pain/gain sharing mechanism with the target price is a good mechanism. According to the client, the target price can provide a comforting feeling for people in the project. The contractor adds to this, that all parties in the project need to recognize the added value of this mechanism and need to have the same mindset, otherwise it is not going to work.
Furthermore, the contractor mentions that they applied an optimization in the design, resulting in a profit, which was divided 50/50 over the client and contractor. This optimization was not stimulated by the contract, but was the contractors own initiative.

5.3.3 Contractual elements and effects

As elaborated in section 5.3.1, the client and contractor aimed to stimulate collaboration by allocating responsibilities accordingly and create a cooperative environment by means of including certain contractual elements. The results from the interviews with the client and contractor show that the contractual elements have indeed resulted in stimulating a collaborative relationship. Table 8 displays the results of the contractual elements that were implemented and the possible potential of contractual elements that were not implemented.

Table 8 Presence of contractual elements and effects case 3

NEC clause	UAV-GC theme	Presence	Contributed to
Early warning	Duty to warn	Yes	Collaboration
Working with the client and others		Yes	Collaboration
Revising the programme	Planning and coordination	Yes	Collaboration
Assessing the amount due (Open book economy)		No	Could show potential for collaboration
The contractor's share (pain/gain sharing)		No	Could show potential for collaboration
Termination	Termination of contract	No	-
Dispute option W1, W3	Conflict resolution	Yes	Collaboration
Sectional completion	Milestones	Yes	Collaboration
Bonus for early completion	Bonus	Yes	-
Delay damages	Penalties	Yes	-
Key performance indicators		No	-
Early contractor involvement		No	-

6. CROSS-CASE ANALYSIS

In this chapter the cross-case analysis is carried out based on the results of the three cases presented in the previous chapter. The goal of this chapter is to find clauses from the ECC4 that show potential as input for opportunities for improvement for the UAV-GC. In the first section, the opportunities for improvement in the UAV-GC that result from the case study are summarized. In the second section the clauses that show potential for stimulating a collaborative relationship are summarized. The chapter concludes by providing an answer to sub-research question three:

Which clauses from the NEC4 ECC are able to stimulate collaborative relationship in the case studies?

6.1 Opportunities for improvement in the UAV-GC

Comparing all the cases, different points of criticism towards the UAV-GC are heard. Two points out of all the topics of criticism displayed in Table 1 concerning conventional contracting and the UAV-GC are seen in the first case. These points of criticism were the allocation of responsibilities and the absence of a cooperative environment in which the client and contractor act. The second and third case aimed to stimulate collaboration by proactively setting up a cooperative environment and allocating responsibilities in consultation. Below, the opportunities for improvement in the UAV-GC resulting from the case study are further elaborated.
Section 6.2 goes further into detail how the second and third case were able to stimulate collaboration by means of clauses found in the case study by linking them to the opportunities for improvement.

Allocating responsibilities

In all the cases, distribution of responsibilities was considered as a key element in stimulating collaboration and in the end improving project performance. In case 1, the distribution of responsibilities was mentioned as one of the reasons the collaboration during the first phase was not established as desired which effected the project performance in the first phase. In case 2 and 3, both the client and contractor mention that extra attention was paid to allocating responsibilities. This was done by either involving the contractor early on before the design phase or by discussing the matter of responsibilities during the project start up. These two methods are not standardized in the UAV-GC and were introduced by the client. Adding certain methods to the UAV-GC is elaborated in the next chapter. In two cases, the client over-specifies the works which can lead or either have led to dysfunctional conflicts countering the objective of establishing a collaborative relationship. Different solution to the problem of allocating responsibilities are elaborated in chapter 7.

Cooperative environment

A second reoccurring opportunity for improvement to the UAV-GC is the establishment of a cooperative environment in which both the client and contractor can discuss issues concerning for example risks, progress and conflicts. Case 1 clearly shows the possible bad outcomes of not communicating open and honest during the first phase. In the second phase an integrated team provided a cooperative environment in which the client and contractor were able to communicate in an honest and open way. In the second and third case extra attention was paid to facilitating an open environment for discussions. This was done by either involving the contractor early on in the project, by organizing a project start up and project follow ups, by organizing informal activities and by appointing a dispute board to make sure conflicts are solved as fast as possible.

6.2 NEC4 ECC clauses

Comparing the individual ECC4 clauses from the different studied cases, the potential of each clause is elaborated in this section to evaluate the opportunity of the clause for improving the UAV-GC. Appendix E includes an overview of all the interview results by summarizing all the answers to the interviews and setting them out next to each other.
Below, each clause is presented, containing the combined experiences and opinions from the interviewees from the individual cases. These results showcase a combined viewpoint from the interviewees included in the case study.

15. Early warning

As seen in all cases studied, both the client and contractor developed their own risk analysis, which they later on reflected with the other party. In this way, the client can check if the contractor has a holistic view of the risks in the project and the contractor is able to use the knowledge of the client concerning the risks related to the project. Comparing the risk analyses of both parties happens during the project start up, which can be compared to the first early warning meeting as elaborated in the ECC4. Both the timing and the intention of both the project start up (UAV-GC) and first early warning meeting (ECC4) are the same. Later early warning meetings can be compared to the periodical risk meetings as seen in all the case studies. It is key to organize these periodical risk meetings due to the integration of the teams, which stimulates trust, commitment and a relational attitude. In these meetings, it is of importance to clearly state the roles of each person/party to make sure that each person/party knows what is expected from them and responsibilities they have. The way the risk management (early warning) was applied in the first case, contributed to dysfunctional conflicts between the client and contractor. The second and third case applied the risk management (early warning) in such a way that it was able to stimulate collaboration.

25. Working with the client and other

The ECC4 includes clause 25 which sets down how parties are supposed to collaborative with each other. The UAV-GC does not include such a clause, but seen in the case study, cooperation agreements are made in the project specific contract. In all the cases studied, during the project start up, agreements concerning collaboration between the client and contractor were set out. Accompanying the agreements, main goals and responsibilities were set out during the project start up, which contributed to a relational attitude and commitment. Seen in all cases, setting up a cooperation agreement contributed to a collaborative relationship. A cooperation agreement is a good starting point for parties to know what everyone's expectations are and how parties are supposed to communicate. By doing so, an open and cooperative environment can be established.

31. The programme (Key dates)

Key dates, which are a basis for the ECC4 contracting, also show importance in the UAV-GC projects. These key dates are called milestones in the UAV-GC and have the same result as setting key dates: the client and contractor can work together towards a common goal. Milestones play a major role in a project as the client often has an internal planning including multiple other projects. It is key though, to set realistic milestones on which both the client and contractor agree. Otherwise, as seen in case 1, conflicts can occur as a result of unrealistic milestones to which the contractor cannot comply.

By means of trust and open communication, the client and contractor can agree on realistic milestones to which the contractor can adjust its planning and include buffers where necessary as can be seen in case two and three. According to the contractors in the cases, a good grip on a planning is gained by including milestones. Going further into detail, linking roles and responsibilities to the milestones or key dates provides both parties with more control and results in better collaboration.

32. Revising the programme

As seen in all the studied cases, it is of utmost importance to stay in contact as a client and contractor. Interviewees from the second and third case mention that the presence of this contractual element contributes to stimulating a collaborative relationship.
Although the contractor is responsible for delivering the product/project to the client, the client is eventually responsible for displaying the project, which means both parties have a stake in the end-product. At the start of the project, the contractor makes plans in accordance with the client's requirements. During the project, because of for example changing circumstances, the contractor's plans have changed. To keep the client up to date about the changes, a revising of the programme is necessary. In the studied cases, changes of plans are openly discussed during planned project follow ups and continuous meetings with the equal from the opposite party which establishes a cooperative environment. Not only these formal moments are used to discuss the plans of the contractor, maybe even more important, informal moments are used to discuss the plans.
However, attention needs to be paid when changes are made to contractual plans written down in the EMVI plans, because no essential changes can be made to the plans in relation to competition with other parties. As seen in the case study, for the contractor and the overall collaboration it would be beneficial to also be able to make a change to those plans when needed.

X5. Partial completion

Analysing the answers of the interviewees in all the cases, some ambiguity about the term 'partial completion' is seen. Some interviewees see partial completion as *early commissioning* of certain parts of the work, which means that the construction of certain parts of the project are finished by the contractor and the client can commission that part of the works as well taking over responsibility over that part after checks. Another interpretation of the term 'partial completion' is the literal taking over by the client of specific parts of the work as specified in the contract. As seen in the cases, this often happens with technical complex parts of the work. The last interpretation can best be compared to the optional clause X5 as written down in the ECC4. In the second and third case, the use of partial completion, regardless of which interpretation is used, contributes to stimulating collaboration as client and contractor work towards a common set goal. In the period towards a partial completion, all parties need to communicate in an open way to combine expertise in order to make sure that the deadline is reached, which results in a cooperative environment. As seen in the first case, the milestones related to the partial completion contributed to dysfunctional conflicts as these milestones were unrealistic for the contractor to reach. Therefore, the importance of setting out milestones in consultation is again highlighted.

50. Assessing the amount due (open book economy)

Comparing all cases, varying outcomes are displayed. However, it is clear that in the current market, not an open attitude between the client and contract in terms of budget, risk and planning is present. So, looking at the open book economy being a key factor in the ECC4 contract option C, a change in mindset has to take place. According to the interviewees, there is a lot of potential to the open book economy as contractor and client gain more insight in each other's interest. As seen in the first case, the absence of an open book economy contributed to dysfunctional conflicts on financial matters. The interviewees in the second and third case mention that the open book economy might even improve

the collaborative relationship even more. The improvement could especially happen in complex works with unknown risks. An undertone from the interviewees towards the open book economy is a little sceptical due to two causes. The first cause is the way of tendering projects, which often happens through competition between contractors where each contractor tries to be the cheapest. This way of tendering in combination with the open book economy is not a good combination according to the interviewees. The second cause of scepticism is the relevance of specifying all costs, which takes a lot of effort resulting in higher costs. This point of scepticism is valid, which means that attention has to be paid to which costs needed to be specified in order for the client and contractor to reach consensus. This can eventually result in a more relational attitude and trust (cooperative environment), through commitment from management on both sides.

90 Termination

Replacing people and/or parties within a project is in the literature seen as a way of stimulating project partnering and thus stimulating collaboration in the end. This way of thinking is not seen in the conducted interviews. A unanimous opinion from all the interviewees is the fact that replacing people and especially replacing parties in a project costs time and a lot of effort in terms of the loss of in-project knowledge. As organizations are seen as dynamic bodies, it is key to try and keep the people in key positions in place. As mentioned by the interviewees and seen in a case, the principle of retaining key persons is sometimes included in the contract. In cases where this is included in the contract, key persons may only be replaced in accordance with both contracting parties.

X6 Bonus for early completion and X7 delay damages

A way of including an incentive to find optimizations is to include bonus for early completion and/or penalty for delay. By doing so, the client and contractor are on the same wavelength in terms of priorities and they can focus on a common goal. Analysing the cases, in some projects a bonus was applied for early completion and in some it was not. In the cases that applied a bonus for early completion, the contractor took the bonus as a driving factor to focus on the planning. This means that if the client has a benefit with the work or parts of the work finishing in time, adding a bonus for early completion makes their interests clear to the contractor who can then focus on finishing the work or parts of the work in time. However, an interviewee points out that care has to be taken as to how the contractor takes on the challenge. With this argument, the interviewee wants to point out that adding a bonus for early completion can work out the opposite from stimulating collaboration. To clarify on this, the contractor may see the bonus for early completion as a profit and include it in its proposal to the client. Because of the thin profit margins for the contract, all the focus is on finishing the work early which thereafter can result in even more conflicts. On the other hand, a multiple mentioned comment by the contractor is that in the current situation, often a delay damage is present but no bonus for early completion. In order to stimulate collaboration by means of a relational attitude, joint working, team integration and trust, if delay damages are included in the contract, also bonusses for early completion should be present.
In all the analysed cases, delay damages were included in the contract. Only in one case this led to arguments between the client and contractor. It is not clear if this had to do with the unrealistic expectations from the client and miscalculation of the contractor, but that could have been a factor that led to arguments together with the penalties linked to milestones. In the other cases, including delay damages incentivised the contractor to develop a well-thought-out planning. In the end, no consensus is given on these clauses as being a stimulus for collaboration.

56. The contractor's share (pain/gain sharing)

The mechanism of the ECC4 option C contract with target contract with activity schedule is in its form as presented in the NEC not present in the current Dutch infrastructure sector. As an interviewee

mentions, this mechanism can be compared to the alliance pain/gain sharing, but this is applied in a completely different setting, where two or more parties are merged, often in a temporary overarching organization. Interviewees from the second and third case mention that this clause might show potential to contribute to stimulating a collaborative relationship.
At first, setting out a target price, as mentioned by interviewees, is a good way to comfort people's feeling as they know what is expected from them. Secondly, risks for the contractor are contained because if a project exceeds the target cost, the biggest part of the exceeded costs are at the expense of the client. This, of course, brings an uncertainty for the client which will be discussed later on. Setting out the risks in advance and allocating responsibilities accordingly contributes to stimulating a collaborative relationship.
Having a look at the pain/gain sharing mechanism, different opinions are shown in the results of the interviews. Overall, most of the opinions were positive towards this mechanism as it stimulates forming a good team and commitment within the team. In the end, the aim of the mechanism is to stimulate the team to come up with optimizations to cut costs. In none of the cases, such an incentive was present, however in one project the contractor proposed and executed an optimization out of its own initiative. The gain of this optimization was shared 50/50 over the client and contractor. If an incentive to seek for optimizations, like the pain/gain sharing mechanism is included in the contract, this would maybe result in more contractors applying optimizations in the design or in the way of carrying out the works. Furthermore, the target cost with pain/gain sharing incentivises the contractor and client to communicate more open with each other and create an environment based on trust because of the open book mechanism in the option C.
As an interviewee justly points out, is that there have to be some conditions to this mechanism to be included in the contract. This interviewee, a contractor, says that if a pain/gain sharing mechanism with a target price is used, the contractor needs full control of all risks. On that basis, the contractor can calculate the budget for the risks and thus for the target price. Another condition mentioned by multiple interviewees, is the fact that both parties in the contract need to commit to this mechanism. Only if both parties recognize the added value of the pain/gain sharing, the same mindset can be generated resulting in team integration, joint working and trust.

X20. Key performance indicators

In none of the projects, key performance indicators were included. However, in all projects, quality testing was carried out to check if the required level of quality was reached. The contractors knew what was expected from them and therefore made sure a certain quality level was reached.
When asked about linking bonusses to key performance indicators, most of the interviewees saw this as an opportunity to stimulate collaboration and incentivise the contractor to seek for optimizations. This bonus on top of the key performance indicators again highlights the client's interest. As bonusses for early completion highlighted the importance of a planning (time), a bonus linked to key performance indicators highlight the importance of a certain level of quality.
As an interviewee justly mentions about the bonus is that care has to be taken to how the contractor takes on the challenge. For example, a contractor may include the bonus as a profit and therefore solely focus on this challenge. This can result in the contractor slacking on other parts of the work to which the client did not link a bonus.

X22. Early contractor involvement

As seen in the second case, the use of early contractor involvement resulted in stimulating a collaborative relationship, whereas in the first case the absence of early contractor involvement contributed to dysfunctional conflicts. This shows that the optional clause in the ECC4 on early contractor involvement might potentially stimulate collaboration between the client and contractor. Through communication and commitment in an early phase, it becomes clearer for both the client and

contractor what expectations there are and how different parties interpret responsibilities in a different way.

Dispute avoidance options W1 and W3

In all studied cases a pre-arranged conflict resolution and/or escalation mechanism was present. As seen in one case, the way the conflict resolution scheme was arranged was slightly off, which resulted in some discussions. It can thus be concluded that the way of organizing a conflict resolution mechanism including roles for the right people is of high importance.
However, a good conflict avoidance scheme is able to extract an issue quickly from the onsite project organization. This results in a better focus of the project team on the project itself and let people make decisions concerning the issue who are best able to do so. These people often do this in a dispute board, in which open communication about the issue is key to come up with a solution, stimulating the establishment of a cooperative environment. Interviewees points out that it is important for people in the organization to dare to escalate an issue higher up in the organization as this results in faster problem solving and maintains the focus on the project progress. Interviewees from the second and third case mention that a correct dispute avoidance/resolving mechanism and a dispute avoidance board as present in the second case contribute to stimulating collaboration and a cooperative environment as parties can more easily discuss conflicts.

6.3 Conclusion

To conclude this chapter, an answer is given to the third sub-research question:

Which clauses from the NEC4 ECC are able to stimulate collaborative relationship in the case studies?

The answer to this question is captured in Table 9. In this table, the ECC4 clauses that show potential to stimulate collaboration for the cases included in the case study are shown. Two of the ECC4 clauses are not found in the cases, which are the open book economy and the pain/gain sharing. These two clauses could potentially prove being able to stimulate collaboration by adding it to the existing contract. The other clauses are in some form also found in the UAV-GC contracts in the cases, which shows that the ECC4 clauses indeed prove to be able to stimulate collaboration or might even be of added value to the current way of implementing the clauses in Dutch practice.

Table 9 Potential of NEC clauses in cross-case analysis

NEC clause	Potential	Improvement/addition
Early warning	Yes	Improvement
Working with the client and others	Yes	Improvement
The programme (key dates)	Yes	Improvement
Revising the programme	Yes	Improvement
Assessing the amount due (Open book economy)	Yes	Addition
The contractor's share (pain/gain sharing)	Yes	Addition
Dispute option W1, W3	Yes	Improvement

Sectional completion	Yes	Improvement
Early contractor involvement	Yes	Improvement

In order to deliver a practically applicable result, the opportunities for improvement for the UAV-GC and the potential clauses from the ECC4 are linked with each other based on the cross case analysis, which is captured in Table 10. The following chapter aims to validate the potential of the ECC4 clauses to stimulate collaboration and to provide an input as an opportunity for improvement to the current UAV-GC.

Table 10 Opportunities for improvement through the ECC4

Opportunity UAV-GC	**ECC4 clauses**	
Allocate responsibilities	**General conditions** Early warning Pain/gain sharing Open book economy	**Secondary option clause** Early contractor involvement
Cooperative environment	**General conditions** Cooperation agreement Key dates Set up (and revise) the programme Early warning Pain/gain sharing Open book economy	**Dispute resolution option** Dispute avoidance board **Secondary option clause** Early contractor involvement Partial completion

PART IV SYNTHESIS

7.Validation
8.Conclusion
9.Discussion

7. VALIDATION

This chapter aims to validate the results found in the cross-case analysis and goes further into the details on how the clauses are potentially able to improve the client-contractor collaboration in inner-city infrastructural projects in the Netherlands. To substantiate the applicability of the clauses to cases included in the scope, experts in the field of the scope are interviewed. The list of experts is included in Appendix F, which shows the name of all the experts including their expertise and how they are able to contribute to validating the results. The experts all have varying backgrounds (lawyers, contract managers, project managers and policy makers), which provides multiple viewpoints on the subject, as for example legal and practical implementation. The interviews with the experts are included in Appendix G, of which a summary is provided in Appendix H.
The expert interviews provide the following results included in this chapter:

1. Validate the opportunities for improvement for the UAV-GC
2. Validate the potential of the ECC4 clauses
3. Analyse the applicability of each ECC4 clause

The following sections go into detail on the applicability of the ECC4 clauses as opportunities for improvement for the UAV-GC. This chapter concludes by providing an answer to the main research question: *Which clauses from the NEC4 ECC are able to stimulate collaboration in Dutch inner-city infrastructure projects?*

7.1 Allocating responsibilities

As elaborated in the previous chapter, the interpretation and thereafter allocation of responsibilities within the UAV-GC differ a lot per organization and project. This results in a lot of ambiguity and sometimes dysfunctional conflicts. As can be seen in Table 11, the allocation of responsibilities using the UAV-GC on project included in the scope often results in dysfunctional conflicts according to almost all experts.

Table 11 Expert panel on allocating responsibilities

Expert	Allocating responsibilities
Expert 1	Affirmative
Expert 2	Affirmative
Expert 3	Affirmative
Expert 4	-
Expert 5	Affirmative
Expert 6	Affirmative

During the interviews on the expert validation, almost all the experts elaborate on dysfunctional conflicts that results from the allocation of responsibilities in projects applying the UAV-GC. Three different viewpoints can be taken on why the allocation of responsibilities in projects with an UAV-GC contract results in dysfunctional conflicts:

1. How does the UAV-GC allocate responsibilities?

The UAV-GC is very clear about the allocation of responsibilities as the client is responsible for supplying the correct information to the contractor which is necessary for him/her to set down a correct pricing (Expert 2, 2020; Expert 3, 2020).
Responsibilities can be divided into two categories: design responsibilities and process responsibilities. Process responsibilities are with the client who often provides certain systematics that the contractor has to apply. The client is therefore responsible for the process responsibilities (Expert 5, 2020). Next to the process responsibilities, the design responsibilities included in the UAV-GC can result in dysfunctional conflicts if not clearly distinguished in the contract how the responsibilities are allocated (Expert 2, 2020). Furthermore, the UAV-GC says that the client is responsible for delivering design solutions and reference designs to the contractor. Often seen in practice, the contractor tends to only criticize the information provided where the client expects that the contractor collaborates to try and come up with the best design (Expert 3, 2020).

2. How does the client allocate responsibilities and risks in its contract in contrast with the UAV-GC?

Often, the client decides to allocate responsibilities and risks on its own initiative. This often results in the risk management plan not being set up and unforeseen risks result in a lot of difficulties for the client in terms of mitigating and resolving risks (Expert 3, 2020). Another result of the client shifting certain responsibilities is both the client and contractor losing sight over who is responsible for what (Expert 5, 2020).
Seen in practice and also in the case study is the fact that the client sets up requirements that are not feasible for the contractor (Expert 3, 2020). This is a result of the client and contractor not communicating in order to make sure what every party is capable of (Expert 3, 2020).

3. How do parties allocate responsibilities in practice?

The UAV-GC only provides a basis for the risk management in a project. The contract itself and the information needs to be adjusted to the basis of the UAV-GC (Expert 3, 2020). When a contract is set up, extra care needs to be taken to how the responsibilities are divided and if both parties agree with the allocated responsibilities, because contractors have a tendency to underestimate the risk profile (Expert 2, 2020). A reason for this could be that the client often has a considerable amount of time to prepare a project, whereas the contractor only gets involved after an extensive research period by the client (Expert 6, 2020). Another reason for this might be the market forces that result in the contractor willing to take on extra risks in order to get awarded projects and keep their employees at work (Expert 1, 2020).

The following ECC4 clauses could potentially be used as an opportunity to improve the UAV-GC in terms of allocating responsibilities to prevent dysfunctional conflicts from happening.

Contractor's share (Pain/gain sharing)
Contract option C including the target (cost) contract and activity schedule with the pain/gain sharing mechanism clarifies the intentions of both parties in the contract. The target contract sets out the goal, to which both parties have to commit. By doing so, a collaborative basis is set, and parties know what to expect from each other. The pain/gain sharing mechanism adds to this by laying down the pain/gain percentage (ECC clause 54) of the client and the contractor, preventing conflicts on this matter. When applying this mechanism, it is of utmost importance to clarify which risks are included in the target cost (Expert 3, 2020).

An example of a target cost mechanism as applied in a project, included a fixed part and a flexible part of the pricing. The fixed price (about 95% of the contract price) included the following costs:

- Direct construction site costs (open book)
- General construction site costs (open book)
- General costs (fixed percentage)

- Risks of the core business (fixed percentage)

The flexible part (about 5% of the contract price) only included the project specific risks. These risks included:

- Appointed risks to which mitigation measures are included in the contract price (variable)
- Residual risks with a chance of occurring with the use of a Monte Carlo analysis (variable)
- Purchasing pros and cons achieved during the design stage discounted in the offer (variable)

Up front, the profit rate of the contractor was determined. If in the end the flexible part of the pricing resulted to be lower than expected, the client receives back the difference in pricing and costs minus the profit rate of the contractor. On the other hand, if in the end the flexible part of the pricing resulted to be higher than expected, the client pays the difference in pricing and costs minus the profit rate of the contractor (Expert 5, 2020).
By including this mechanism and thus specifying the financial matters up front, responsibilities are set out as well. The contractor knows what responsibilities it has been assigned up front and therefore the probability of the contractor underestimating the risk is lower (Expert 6, 2020).
During the interview with expert 1 (2020), it became clear that a target cost contract with pain/gain sharing brings some risks in terms of determining the final total contract price, which is not determined in the beginning because of the "target" price. The term "target" already shows that the final contract costs are not definite for the client and it is not clear up front what the total costs of a client are going to be in the end. Because of the reputation of large construction projects in the Netherlands being over budget, it is difficult for public clients to get financing (Expert 1, 2020). A solution to this problem needs to be found in order to apply the target cost contract on big projects.

Early warning
Clause 15 (early warning), being a clause on general client-contractor collaboration, can add to a clearer allocation of responsibilities by means of the early warning register that is set up in consultation with both the client and contractor. When discussing the content of the early warning register, both parties become aware of the risks and the allocation of the responsibilities. Furthermore, the roles of each person/party are set out in order to link the responsibilities. The risk analysis and role division that results from this first early warning meeting, is periodically discussed and updated, contributing to a clearer view on the risks for both parties. During the early warning meetings, all participants are supposed to collaborate in order to discuss effects and mitigation measures of risks (Chao, 2019). This process is also seen in cases with an UAV-GC contract and the way the risk management is arranged.
However, there are two big differences between the early warning clause and the way the UAV-GC includes the risk management. The early warning clause elaborates on the responsibilities of each parties in relation to the early warning register and the risk management in the ECC4 contract itself. The general conditions of the UAV-GC do not include a guideline for how to organise the risk management, only by means of additional contractual documents this is facilitated. The second difference is the proactive role of the contractor to report risks as soon as the contractor becomes aware. As elaborated in chapter 4; failure to meet the early warning obligation by the contractor may have consequences for the contractor's entitlement to receive compensation for such matter (Chao, 2016). This is not present in the UAV-GC where risks tend to be neglected until the risk turns into reality (Expert 3, 2020). This second difference has more potential to provide a solution to the second opportunity of improvement in the following section. Therefore, this will be elaborated upon in section 7.2.

Early contractor involvement
Early contractor involvement, being a clause on general client-contractor collaboration, shows potential to allocate responsibilities accordingly. Not involving the contractor early on with the decision making and designing process counters the opportunity to stimulate collaboration. As seen in

the case study, involving the contractor early on by for example dialogue questions, was seen as beneficial.
In current practice, the client often starts with the design on which the contractor often only provides criticism. In the most ideal situation, the client and contractor discuss and make plans as far as to the point where the scope is stable, and the risks are clear to everyone. At this point, a correct pricing process can take place. This can be facilitated by the "twee-fase aanpak" (two phased approach), which is recently introduced in the Dutch infrastructure market (Expert 3, 2020).
The first phase of the "twee-fase aanpak" is the design phase, where both the client and contractor collaborate to come up with a fitting design. In the most ideal situation, the development of the final design (uitvoeringsontwerp) is part of the first phase, because through collaboration, a lot of risks can be brought to light when establishing the final design as both parties are aware of the practical implications. This process needs to be managed closely, which will result in clearer design responsibilities (Expert 5, 2020). In the first phase the open book economy is applied to stimulate collaboration.
Although a "twee-fase aanpak" should be applied more often for integration of teams, for a straightforward project it is not of added value as well as a situation where one of the parties does not have anything to add during the design stage of the project (Expert 2, 2020). Lastly, if the contractor gets involved early on, there are less possibilities for him/her to tell the client that certain design choices have not been discussed. In this way, the contractor has to take responsibilities for design choices that are mutually set out (Expert 3, 2020).
As an addition to the early contractor involvement mechanism, a different approach to tendering needs to be facilitated. De Bruin (2020) suggests that tendering on basis of availability (of the right people) and competences would be a fitting approach, because proper collaboration is based on the attitude of the people involved with the process (Expert 5, 2020).

7.2 Cooperative environment

The UAV-GC does not stimulate parties to be open and honest to each other as seen in the case study. All of the experts in the panel confirm that the UAV-GC does not stimulate in establishing a cooperative environment (see Table 12). As a result of this, dysfunctional conflicts can arise, which is the opposite of collaboration.

Table 12 Expert panel on the cooperative environment

Expert	Cooperative environment
Expert 1	Affirmative
Expert 2	Affirmative
Expert 3	Affirmative
Expert 4	Affirmative
Expert 5	Affirmative
Expert 6	Affirmative

Aalstein (2020) clearly explains during the interview what the UAV-GC's viewpoint is towards stimulating a cooperative environment: the UAV-GC provides a contractual environment where parties can be open to each other but if they choose not to, the UAV-GC can also provide a contractual environment for such situations. It thus depends on how parties aim to collaborate, which needs to be stated in the contractual arrangements (Expert 3, 2020).
UAV-GC contracts as seen in the case study included additions to the standard contract, to stimulate the creation of a cooperative environment. Certain additions included: scheduling PSU's and PFU's, setting up an integrated team, setting out common goals, involving the contractor early on and setting

up a dispute board. These methods are also included in the following ECC4 clauses that show potential to establish a cooperative environment.

The contractor's share (pain/gain sharing)
The target cost contract with a pain/gain sharing mechanism is a stimulus for the client and contractor to be more open to each other (Expert 2, 2020). By introducing the target cost contract with the pain/gain sharing mechanism, discussions about the price of the works happen early on in the project. This can result in the client and contractor shifting their focus from the financial aspect to other relevant things. A result of this again can be that because of the shift in focus, the client and contractor are able to discuss more easily and more open with each other about financial matters (Expert 5, 2020). To link the principle of pain/gain sharing with the current risk-alliance pain/gain sharing mechanism, it would be possible to only include certain risks in a pain/gain sharing pool. According to Kamminga (2020) this principle would trigger openness between the client and contractor. However, if the pain/gain sharing is only applied to certain risks, a discussion would still rest on the works outside of the risks (Expert 4, 2020).

Assessing the amount due (open book economy)
The target cost contract with the pain/gain sharing mechanism comes with the **open book economy** as present in the ECC4. The open book economy is characterized by the fact that the contractor is open and honest towards the client in terms of pricing, risks and budget. Results from the case study show that some dysfunctional conflicts arise because of discussions concerning the matter of budget and pricing. To create a more open environment within a contract, being more open and honest to each other on this point can contribute to stimulating collaboration (Expert 1, 2020; Expert 2, 2020; Expert 4, 2020).
Before applying the open book economy, parties need to agree on how they will be applying this mechanism. By doing this correctly, trust can be generated between the parties.
The open book economy however only works in one way, where the contractor needs to be open and honest towards the client. To stimulate collaboration even more, a two-way open relationship needs to be established. This can be done by introducing an extra element into the contract (in the ECC4 as well as in the UAV-GC) to include the client in the two-way open relationship. By doing so, the client has to be more open towards the contractor early on, in terms of planning (milestones), costs and risks. This does however need some extra legal paperwork in order to establish such an extra contractual element (Expert 4, 2020).
Results from the case study also show some scepticism concerning the combination of the open book economy with the current way of tendering projects and the relevance of specifying all costs. On the latter argument; the level of specifying costs can be decided at the start of the project and experience of employees can be applied to decide the relevance on each moment when required. The former argument is more difficult to solve, as the way of tendering is not easy to change. Although tendering solely based on the lowest bid is not applied as often anymore, applying an EMVI method may still result in the lowest bidder getting priority opposed to other parties, because there still has to be an objective factor (pricing) included in the bid (Expert 6, 2020).

Cooperation agreement

The ECC4 focusses on collaboration and therefore includes clause 25 to set out how parties are expected to collaborate. The UAV-GC does not incorporate such a clause, which results in parties choosing their own ways of collaborating. Although the clause is not included in the general conditions of the UAV-GV, project specific contracts as seen in the case study include a PSU and PFU's. These methods are seen as beneficial and contribute to creating a cooperative environment (Expert 1, 2020; Expert 2, 2020; Expert 3, 2020).

During the PSU and PFUs a coach can be used who is able stimulate parties to be open and honest to each other about their personalities and attitude. The addition of a PSU and PFU's can be contractually captured in the UAV-GC (Expert 5, 2020).

Partial completion and key dates (common goals)
Both the clause on partial completion and key dates have the same intention: to create a common goal for the client and contractor. Therefore, these two clauses are reviewed jointly.
By including a common goal in the planning of the projects by means of the optional clause X5 and/or key dates, common goals are set. Towards the common goal, parties combined expertise to reach the deadline. This proves to stimulate collaboration as parties need to be open to each other in order to trigger the expertise. Manageability is stimulated by including key dates and/or partial completion. However, parties need to be able to be open towards each other and trust each other in order to discuss the manageability of the project (Expert 3, 2020).
Expert 6 (2020) mentions that the common goals, often set out by the client, need to be realistic and feasible for the contractor in order to result in a cooperative environment. It is therefore of importance to set out common goals in consultation in order to make sure that the key dates and/or partial completion dates do not result in extra pressure on the planning and thereafter dysfunctional conflicts (Expert 1, 2020).

Set up (and revise) the programme
Setting up **a** programme as described in the ECC4 shows the client what plans the contractor has. This in itself already contributes to the openness of parties to each other. Adding to this, reviewing the programme periodically stimulates collaboration by the obligation of showing the client what the contractor's plans are and thus being more open.
As seen in practice with the UAV-GC, the contract tends to stimulate the contractor to develop a programme, but due to the often-tight schedule, the contractor has no time to first develop a programme before starting the works (Expert 3, 2020). The client therefore has to include capacity in the planning of the project for the contractor to develop a programme.
Lastly, for example a quality management system of the contractor can change, which officially needs to be elaborated in the revised programme. Due to additional administrative effort, this often only happens by sending an email and not revise the programme (Expert 6, 2020). This can result in ambiguity in later stage, which can escalate to dysfunctional conflicts. This shows that care has to be taken to what level of detail the programme needs to be revised.

Early warning

The early warning meetings as described in clause 15 in the ECC4 also proactively stimulates both parties to be more open to each other as they need to discuss the foreseeable risks. This principle is already applied in practice as seen in the case study, however in the current situation the distribution of roles and responsibilities have not been clearly set out and there is no incentive for the contractor to proactively address risks. The early warning in ECC4, being a general client-contractor collaboration clause, is more proactive in terms of foreseeing risks. In terms of compensation events, the contractor is obliged to warn the client as soon as possible as it becomes aware of a risk. Failure to meet the early warning obligation by the contractor may have consequences for the contractor's entitlement to receive compensation for such matter. This clause in itself can be implemented in the UAV-GC, as it already is implemented in some contracts (Chao, 2016). In practise it is however difficult to prove that the contractor is responsible for not warning about the risk earlier. Linking a penalty to the fact that the contractor could have been able to warn about a risk is even more difficult to substantiate in practice (Expert 6, 2020).

Dispute avoidance board option W3

Discussed in the chapter before, the UAV-GC does not elaborate on the best way to avoid dysfunctional conflicts. In the general conditions of the UAV-GC contract, there is only one straight forward way of resolving disputes and that is through the use of arbitration. Often in the additional contractual documents, different ways of dispute resolution are included. Often a conflict escalation mechanism is present in an UAV-GC contract specified for a project, but the way this is organized is not always fitting. As seen in the case study, appointing a group of people (board) at the start of the project who carry the responsibility to continuously communicate to recognize conflicts and smother them as early as possible is beneficial to the performance of the project.
The idea behind this mechanism can be compared to the dispute resolving and avoiding option W3 where a dispute avoidance board is present. This option is seen as a general client-contractor collaborative agreement. By periodically updating the board about the project, they are aware of what is going on and they can make more adequate decisions. In practice this may seem to take up extra time and thus costs (Expert 1, 2020), but as seen in the literature study in section 4.5 the costs can turn out to be relatively low in comparison with the savings from the cost of an arbitration process.
In international projects, a dispute board is often applied with success and was adjusted to the personalities within the project. Compared to international projects, the Netherlands is one of the fewer countries where a dispute board is not successfully applied (Expert 4, 2020).
The experience of experts on the matter of assigning a dispute board to a project, shows that a dispute board is of added value to avoid conflicts by facilitating an open environment to discuss conflicts (Expert 2, 2020; Expert 3, 2020; Expert 4, 2020). As seen in the cases, people working on the project have sometimes difficulties with notifying a conflict higher up (escalating), which will often result in a conflict disturbing the project performance. Having a dispute avoidance board, this problem can be solved, as the conflicts are recognised and discussed by the people who are able to make the decisions through continuous open communication. Furthermore, having a clear conflict resolution mechanism contributes to stability and clarity in the project organization as they know that they are able to raise the conflict out of the internal project organization.

Early contractor involvement (Secondary option clause)

Apart from the potential of the early contractor involvement to allocate responsibilities in a correct way, it also shows potential to establish a cooperative environment. By involving the contractor early on in the process, expectations can be discussed, resulting in less unexpected situations for both parties. If risks and responsibilities are discussed early on in the process in combination with the early warning clause, both client and contractor know what is expected from them. Therefore, if an unexpected situation arises, both parties know how the responsibilities are divided, because they can relate back to the discussions that resulted in the early warning register. As a result of this, both parties can openly communicate about the matter, instead of pointing fingers (Expert 1, 2020).
De Bruin (2020) adds that tendering based on the availability of people and on competences is fitting for an early contractor involvement method, because a cooperative environment can only be established through the right mindset of the right people (Expert 5, 2020; Expert 6, 2020).

7.3 Conclusion

To conclude this chapter, an answer is given on the main research question:

Which clauses from the NEC4 ECC are able to stimulate collaboration in Dutch inner-city infrastructure projects?

The clauses from the ECC4 that are able to stimulate collaboration in Dutch inner-city infrastructure projects that result from the cross-case analysis and are validated by the expert panel are bundled by their general theme and displayed below.

General collaboration
- Early warning
- Cooperation agreement
- Dispute avoidance board
- Early contractor involvement

Time
- Setting up the programme (key dates)
- Revising the programme
- Partial completion

Payment
- Assessing the amount due (open book economy)
- The contractor's share (pain/gain sharing)

The clauses within the themes of 'General collaboration' and 'Time' are also found in the UAV-GC contracts. Therefore, these clauses prove to be able to stimulate collaboration and may even add to this by the way they are approached in the ECC4 contract. The clauses within the theme of 'Payment' are not found in the UAV-GC contracts in the way they are stated in the ECC4. Therefore, these clause are an addition to the current UAV-GC contracts.
The applicability of each clause and their potential to provide an opportunity for improvement to the current way of UAV-GC contracting results from the interviews with the expert panel. The expertise from each expert is applied to provide the most realistic results on how to implement each clause. Table 13 shows the results of the validation by the expert panel on the potential of the ECC4 clauses as an opportunity for improvement to the UAV-GC. The numbers in the table indicate how many experts have validated the use of the ECC4 as opportunity of improvement to either allocate responsibilities better or to stimulate a cooperative environment. The low number for early warning as potential to allocate responsibilities in a better way can be related to the fact that the early warning clause as a risk management way is already present in current practice and therefore may not be the ultimate solution to the problem of allocating responsibilities in the best way. The higher numbers on early contractor involvement and the pain/gain sharing mechanism show that the experts see a lot of potential for these clauses as a basis for allocating responsibilities withing the project organization.
Nearly all the clauses as input for stimulating a cooperative environment show high numbers. This could mean that the experts see an overall potential of the ECC4 to improve the way a cooperative environment is created in current practice with the UAV-GC. The clauses in the themes of general collaboration and time thus could potentially improve the current UAV-GC clauses whereas the clauses on payment could be added to the current UAV-GC contracts as they are not there yet in this form.

Table 13 Expert panel on the ECC4 clauses as opportunity for improvement to the UAV-GC

	Allocating responsibilities	Stimulating a cooperative environment
General collaboration		
Early warning	1	4
Cooperation agreement	0	3
Dispute avoidance board	0	4
Early contractor involvement	3	4
Time		
Setting up the programme (key dates	0	1
Revising the programme	0	3
Partial completion	0	3
Payment		
Assessing the amount due (open book economy)	0	4
The contractor's share (pain/gain sharing)	4	4

8. CONCLUSION

This thesis presents a study of the ECC4 and its clauses to stimulate collaboration in a Dutch inner-city infrastructural project. This chapter proceeds to conclude the most relevant findings of this research. The main objective of the research is to find the potential of the NEC4 ECC to stimulate collaboration in Dutch inner-city infrastructural projects in order to move away from adversarial relations. By providing answers to the sub-research questions, an answer to the following main research question is generated which captures the objective of this research:

Which clauses from the NEC4 ECC are able to stimulate collaboration in Dutch inner-city infrastructure projects?

Based on the cross-case analysis and the expert validation, this research shows that the following clauses from the NEC4 ECC are able to stimulate collaboration in Dutch inner-city infrastructure projects. The clauses are divided over three different themes: General collaboration, Time and Payment.

General collaboration

- Early warning
- Cooperation agreement
- Dispute avoidance board
- Early contractor involvement

Time

- Setting up the programme (key dates)
- Revising the programme
- Partial completion

Payment

- Assessing the amount due (open book economy)
- The contractor's share (pain/gain sharing)

8.1 Practical applications

During the research, more knowledge has been gained in terms of the application and opportunities for improvement for the UAV-GC and the applicability of the ECC4 to stimulate collaboration. This knowledge is used when concluding on the findings of the research. To make the conclusion as practical as possible, each ECC4 clause that is able to stimulate collaboration is elaborated upon by mentioning how it is able to stimulate collaboration and how it can be implemented in practice.

- Early warning

It can be concluded from this research that clause 15, early warning, is able to stimulate collaboration by providing a guideline to allocate responsibilities and to stimulate the establishment of a cooperative environment.
In the basis, the early warning clause's main goal is to allocate responsibilities in accordance with both parties. This is done by the early warning register, which is discussed during the first early warning meeting. During this first early warning meeting, roles and responsibilities related to risks are allocated. Followed by this, early warning meetings are held periodically to discuss the progress of the

works. During these early warning meetings, again (new) risks and allocated responsibilities are discussed, which also contributes to stimulating the establishment of a cooperative environment in which risks are openly discussed.
The early warning clause includes the obligation for the contractor to report a risk as soon as it becomes aware. If the contractor fails to do so, this may have consequences for the contractor's entitlement to receive compensation for such matter. In the Dutch infrastructure sector, certain risks tend to be neglected but the early warning clause solves this by incentivising the contractor to proactively report risks. This principle has a good legal basis as seen in the expert validation, but in practice it is difficult to prove that the contractor was indeed able to warn earlier about the risk.
The early warning clause in its basis can be compared to the risk management principle, which is included in the additional contractual documents. However, the proactive attitude of the contractor is not present in current practise. The obligation to report the risks as soon as the contractor becomes aware of it, is an addition to current practice and can be included in the additional contractual document in a project specific UAV-GC contract.

- Cooperation agreement

Adding an agreement on how to cooperate between the client and contractor assists in stimulating the establishment of a cooperative environment. This clause is not seen in the UAV-GC main clauses but can be added to the project specific UAV-GC contract as the agreement on how to collaborate is specific for each project. It is therefore important how parties express their expectations in relation to the project and how both parties perceive collaboration throughout the project. However, attention needs to be paid to the fact that only contractually including the agreement to collaborate is not enough, because you cannot be sure if both parties interpreted the intentions in the exact same way and know what they both expect. A solution to this might be to set up requirements during the tender phase on basis of the view of the client to engage in a conversation after awarding the works to set out concrete arrangement for the contractor.
To invigorate the cooperation agreements, a PSU and PFU's can be held with the assistance of a professional coach to solely focus on behaviour and collaborative expectation from both parties instead of focussing on the project execution related matters.

- Dispute avoidance board

A dispute avoidance is able to stimulate collaboration by stimulating the establishment of a cooperative environment. The disputes avoidance board gets updated on the progress in the project and has the main focus of detecting possible conflicts and smothering them as soon as possible to avoid conflicts. This can be done by openly communicating about (personal) issues by both the client and contractor.
The dispute avoidance board can be compared to the Dutch Raad van Deskundigen (RvD) who also act as a dispute board. The biggest difference is the fact that the dispute avoidance board does not give a binding advice and the RvD does. When applying a RvD it is of importance to analyse the personalities in a project and types of problems to align the method the RvD uses to avoid and solve the conflict. A decision tree can be set up to match the method of handling a conflict with the corresponding situation.
Furthermore, having a clear conflict resolution mechanism contributes to clarity in the project organization as they know that a conflict can be raised outside of the internal project organization.

- Early contractor involvement

Early contractor involvement (clause X22) is a way to distribute responsibilities accordingly and to establish a collaborative environment. When involving the contractor early on in the decision-making

process, the client and contractor can share expertise and discuss risks and ideas. During the design stage, if everything is managed closely, it becomes clear who provides which ideas and thus who is responsible for those ideas. When expectations are discussed during the early involvement, parties know what to expect during the course of the project which makes it easier to go into discussion on certain matters.
The early contractor involvement can be compared to the "twee-fase aanpak" which has already been applied to some projects in the Netherlands. This principle integrates the two phase: design and execution, to assure continuity throughout the whole project.
The pricing mechanism of early contractor involvement is not based on competition between contractors. As a result of this, the contractor is not incentivised to reach for the cheapest pricing. To prevent a conflict on this matter, tendering based on availability of the right people and on competences can be applied. In this way, a suitable team may be formed that is able to establish a collaborative relationship. The competence of the available people is seen as one of the driving factors of collaboration.

- Set up (and revise) the programme

Setting up and revising the programme (clause 30 and 32) is able to stimulate collaboration by stimulating the establishment of a cooperative environment by communicating the plans of the contractor with the client. By periodically reviewing and revising the programme, collaboration is stimulated through the obligation of the contractor to openly discuss its plans.
Setting up and revising the programme can be compared to the project management plan, which is often present in project specific UAV-GC contracts. The client however needs to facilitate the contractor in setting up a programme, by providing extra time up front. A well thought out programme is often a result of consultation between the client and contractor. A dialogue session in the early contractor involvement procedure can for example facilitate the discussion up front.

- Partial completion and key dates

It can be concluded from this research that clauses X5 and 30, respectively partial completion and key dates, are able to stimulate collaboration by stimulating the establishment of a cooperative environment. These clauses facilitate in that by setting out common goals for the client and contractor by including key dates in the contract and optional partial completion. Working towards the common goal, parties are stimulated to openly communicate to combine expertise in order to reach the deadline. The increased communication is a way to stimulate collaboration when working towards a deadline/milestone. Furthermore, manageability is stimulated by including common goals, but parties need to be able to trust each other in order to discuss the manageability. This can be stimulated by other clauses as for example the early warning mechanism, the open book economy and a target cost contract.
Partial completion and key dates can be included in the project specific UAV-GC contract. Care has to be taken that the milestones that are linked to the partial completion and key dates need to be of added value for the client. When adding unnecessary milestones, unnecessary pressure on the contractor is expressed. This often results in more conflicts. Also, milestones need to be set in consultation to be sure that the dates are realistic and feasible to both parties.

- Assessing the amount due (open book economy)

The open book economy found in target cost contract option C adds to the establishment of a cooperative environment by stimulating the opportunity to have an open and honest conversation on costs and risks. The open book economy is often seen as the most honest form of collaboration as parties have to be completely open to each other in terms of costs.
The principle of the open book economy is not found in the UAV-GC and has to be added to the contract for its full potential as elaborated by the experts.

- The contractor's share (pain/gain sharing)

It can be concluded from this research that the target cost contract with the pain/gain sharing mechanism is able to stimulate collaboration by providing a guideline to allocate responsibilities and to stimulate the establishment of a cooperative environment.
The clear allocation of responsibilities is facilitated by setting out common goals up front when specifying the included activities in the target cost. Next to the common goals, clarity about the intensions of both parties are corresponded. Lastly, responsibilities are allocated early on in the project. As a result of this, contractor has more insight in the total risk profile and therefore the tendency to underestimate the allocated risks is reduced.
Option C also facilitates in establishing a cooperative environment by means of allocating risks and costs related to risks early on. As a result of this, discussions about finances happen early on and may thereafter take away the boundary to go into further detail later on.
The principle of option C from the ECC4 can be incorporated in Dutch practice by means of the risk-alliance. The risk-alliance includes the pain/gain sharing principle on certain risks that are difficult to be estimated in the early stages of the project. The risk-alliance can be applied based on the UAV-GC and be added to the additional contractual documents for the project specific contract. When applying this principle, care has to be taken to what risks are included in the pain/gain sharing. Aligning the included risks, activities and the additional profit rate is best facilitated through consultation between the client and contractor.

9. DISCUSSION

This chapter provides a critical viewpoint on the research report. At first, the limitations to the research are given. By doing so, it shows where the emphasis is applied, and which aspects need extra attention. Secondly, the relevance of the research is highlighted to elaborate on how this research aims to fill in the research gap. Thirdly, the information provided in this research is based on literature and the case study. The results of the research try to add to the scientific knowledge available and also keep the practical implementation in mind. Due to the scientific relevance, practical implications arise which are elaborated in this chapter. Lastly, recommendations for further research are given to provide aspects where further research is needed to go into further detail and add to this research.

Limitations to the research

The research in this report has made a start with exploring the opportunities to apply the ECC4 contract in the Dutch infrastructure sector. Therefore, this research is of exploratory nature. The biggest limitation to this research is the lack of projects executed with the use of the NEC in the Netherlands. This factor makes it difficult to conduct a case-based research on the NEC. Therefore, a comparison is made to the UAV-GC contract and expert validation is conducted to validate and substantiate the results. Furthermore, because of the lack of experience on the NEC, only individual clauses could have been analysed. Combining clauses could have a different effect on the relationship and project performance. Lastly, no research is conducted into the behaviour of people as a result of the contractual clauses, because of the lack of experiences with NEC. As Kamminga mentioned in his interview, the contract is only one of the four mechanisms that are able to affect behaviour and therefore collaboration. Next to the contract, the organizational structure, the economic aspect and the mutual relation between people play an important role in stimulating collaboration (Expert 4, 2020). For sake of the scope it is not studied in what way the contractual clauses as stated in a contract influence the behaviour of people. This research report only tried to improve the contractual environment in which the people who execute the works behave.

Strategic versus project partnering

During the research, only collaboration on single projects is considered. Long-term collaborations are also a way to facilitate a collaborative environment, but this is a whole different kind of mechanism. A long-term way of partnering is the strategic partnering option. By doing so, parties agree to commit to a long-term strategic partnership through a contract. An example of a long-term partnership is also studied on the case of Schiphol with its contractors who are devoted to different lots. The studied case concerns the construction of a platform for large body airplanes. The interviews with the contractor and client are included in Appendix I. The most interesting points concerning the comparison of project partnering and strategic partnering are the following:

- During a strategic partnership, long-term goals can be set, and parties gain knowledge on collaborating as they progress through different projects. Remarkable about the case study is the fact that through setbacks during the projects, parties only experience that collaboration got better because of trust and openness. After the project was finished, a reviewing session was held, and different collaborative elements were discussed to further improve collaboration in following projects: enthusiastic team, common working areas, teambuilding, equality for parties, joint contract, integral design and involving the contractor early on in the project.
- Although this strategic partnership includes only UAV contracts, where an engineer designs the works, the contractor also got involved through the engineer in the designing process.

After the final design was finished, the contractor modelled the design in 3D, adding to the knowledge on the technical aspects of the design up front by the contractor.

- The open book economy as elaborated in chapter 6 and 7, is present in the strategic partnership. This system can be applied in this situation, because the contractor does not have to compete with other contractors, because they already won the long-term contract. According to the interviewees, outside of the contract with Schiphol, contractors are more competitive on winning contracts and therefore are not very eager to apply the open book economy.

Relevance and scientific contribution

Contributing to scientific relevance through this report was a challenge. Especially because of the limited experiences with the ECC4 in the Dutch infrastructure industry it was difficult to contribute to the qualitative relevance. By means of comparing the ECC4's clauses with the UAV-GC's clauses it was tried to contribute to the qualitative relevance. The experiences of the interviewees were as much as possible connected with the clauses from the ECC4 to study the effect of each individual clause. Because not a lot of research is conducted into the ECC4 as an application in the Dutch infrastructure sector, this research aims to provide a first insight into the possibilities and potentials of including ECC4 clauses in a Dutch infrastructure environment.

Practical implications

- According to this study, implementing certain clauses in a contract a more open and honest environment can be established according to the professionals involved in this research. However, behaviour in the open and honest environment is, as often mentioned, not only stimulated by a contractual clause, but mostly by the attitude of the involved people. The ancient discussion about being open and honest to each other has to do with mutual trust which is established by intrinsic values of each person (Expert 4, 2020). Outside of the contract, the habits of people have to be adjusted in order to stimulate an open and honest relationship (Expert 2, 2020).

- The NEC contracts originate from an Anglo-Saxon country and is implemented in other Anglo-Saxon countries. The Netherlands, not being an Anglo-Saxon country, has its own habits and values which can sometimes be contrary to the Anglo-Saxon habits and values. Although the NEC contracts are structured in a way that it could serve in different countries including the countries policies, the contract has to be finetuned in order to make it applicable in the Netherlands.

- The NEC contracts are an innovative way of contracting, because it steps away from the transactional way of contracting to a more relational way of contracting. This transition in the way of contracting is relatively new and as seen internationally, parties are more eager to apply a conventional contract (for example FIDIC) instead of innovating the way of contracting through the NEC contracts (Cheung, 2015).

Recommendations for further research

- As an addition to the previous point, not a lot of experience exists in the Netherlands concerning target contracts with pain and gain sharing. More research has to be conducted on

how this mechanism could be implemented in the Dutch construction industry. This can be done by clarifying the concept and highlighting the potentials and implications.

- The clauses from a contract are studied and with the use of interviews, the behaviour in a project is analysed. However, no research is done to how people in a project would actually respond to including the proposed clauses in a contract. The psychological part of behaviour as a response to the contractual clauses still has to be studied.

- During the research, attention is paid to the main contract of a project but the way of procuring, although lightly touched upon, is not included. The way of procurement has a big influence on the way the clauses are applied. Research needs to be conducted on what procurement method is most applicable to reach the fullest potential of the proposed clauses.

- One of the dispute avoidance and resolution options is to assign a dispute board to a project. As mentioned in the strategy, there is still a debate going on about the cost to benefit ratio of such a dispute board. No research has been conducted into the cost to benefit ratio of a dispute board with regard to the projects captured in the scope. Research into that matter can further show the potential of a dispute board or invalidate the potential.

BIBLIOGRAPHY

Acharya, N. K., Dai Lee, Y., & Im, H. M. (2006). Conflicting factors in construction projects: Korean perspective. *Engineering, Construction and Architectural Management*.

Acharya, N. K., Dai Lee, Y., & Kim, J. K. (2006). Critical construction conflicting factors identification using analytical hierarchy process. *KSCE Journal of Civil Engineering, 10*(3), 165-174.

Akintoye, A., McIntosh, G., & Fitzgerald, E. (2000). A survey of supply chain collaboration and management in the UK construction industry. *European journal of purchasing & supply management, 6*(3-4), 159-168.

Arup, O. (2008). Partnering Contract Review. In. London: Office of Government Commerce Norfolk.

Ballard, G., Kim, Y.-W., Azari, R., & Cho, S. (2011). Starting from scratch: A new project delivery Paradigm. *Research Summary, 271*.

Bennett, J., & Baird, A. (2001). *NEC and partnering: The guide to building winning teams*: Thomas Telford.

Bishop, D., Felstead, A., Fuller, A., Jewson, N., Unwin, L., & Kakavelakis, K. (2009). Constructing learning: adversarial and collaborative working in the British construction industry. *Journal of Education and Work, 22*(4), 243-260.

Black, C., Akintoye, A., & Fitzgerald, E. (2000). An analysis of success factors and benefits of partnering in construction. *International Journal of Project Management, 18*(6), 423-434.

Bleeker, M. R. (2014). UAV-GC 2005 (deel 1). *Tijdschrift voor Bouwrecht, 6*(7), 602-612.

Bresnen, M., & Marshall, N. (2000a). Building partnerships: case studies of clientcontractor collaboration in the UK construction industry. *Construction management and economics, 18*(7), 819-832.

Bresnen, M., & Marshall, N. (2000b). Partnering in construction: a critical review of issues, problems and dilemmas. *Construction management & economics, 18*(2), 229-237.

Chan, A. P., Chan, D. W., Chiang, Y. H., Tang, B.-S., Chan, E. H., & Ho, K. S. (2004). Exploring critical success factors for partnering in construction projects. *Journal of Construction Engineering and management, 130*(2), 188-198.

Chao, A. (2016). INTRODUCING THE NEW ENGINEERING CONTRACT: ENGINEERING AND CONSTRUCTION CONTRACT (NEC3 ECC) FROM A DUTCH LAW PERSPECTIVE. *Van het gebaande pad, 1*, 26.

Chao, A. (2019). De verdere evolutie van deNew Engineering Contract:Engineering and Construction Contract (NEC4 ECC). *Verwant met verband: Ruimte, Recht en Wetenschap, 1*, 291-298.

Chao-Duivis, M. (2019). *De zaak van de smeltende dinosaurus*. Delft: Chao-Duivis, Monika.

Cheng, E. W., & Li, H. (2002). Construction partnering process and associated critical success factors: quantitative investigation. *Journal of management in engineering, 18*(4), 194-202.

Cheung, L. (2015). *Research into the influence of mutual trust between the Client and the Contractor on the efficiency and the effectiveness of the change management process for complex D&B infrastructure projects using the UAC-IC 2005: Lessons learned from a comparison between the UAC-IC 2005 and the NEC3 ECC and the FIDIC Yellow Book*.

Retrieved from Delft Repository: https://repository.tudelft.nl/islandora/object/uuid:48872d15-6bf4-4330-99df-0dc0ef8d519b/?collection=research

Cohen, J. (2010). Integrated project delivery: Case studies. *AIA National, AIA California Council, AGC California and McGraw-Hill*.

CROW. (2013). Toelichting bij Model Basisovereenkomst en UAV-GC. Retrieved from http://kennisbank.crow.nl/Kennismodule/

Drexler Jr, J. A., & Larson, E. W. (2000). Partnering: Why project owner-contractor relationships change. *Journal of Construction Engineering and management, 126*(4), 293-297.

Egan, J. (1998). *Rethinking construction*: Department of Environment, Transport and the Region.

Eggleston, B. (2019). *The NEC4 Engineering and Construction Contract: A Commentary*: John Wiley & Sons.

Expert 1 (2020, 21-08-2020). [Expert panel validation interview with expert 1].

Expert 2 (2020, 20-08-2020). [Expert validation interview with expert 2].

Expert 3 (2020, 13-08-2020). [Expert panel validation interview with Malcolm Aalstein].

Expert 4 (2020, 19-08-2020). [Expert validation interview with expert 4].

Expert 5 (2020, 17-08-2020). [Expert panel validation interview with expert 5].

Expert 6. (2020, 18-09-2020) *Expert panel validation interview with expert 6*. Rotterdam.

Gao, Y. (2017). *Early Warning of NEC3 ECC, A Solution for Dutch Design and Build Construction Problem Solving?* Retrieved from Delft: https://repository.tudelft.nl/islandora/object/uuid%3Acec53164-52d8-4f97-ad41-2bf929735add

Garrett, A. (2017). NEC4 - What's new in the resolution of disputes? Retrieved from https://www.mills-reeve.com/insights/publications/nec4-what-s-new-in-the-resolution-of-disputes

Geertsma, L. (2016). *Evaluating the relevance of NEC3 contracts on the collaboration between stakeholders in the Dutch building industry*. Retrieved from Eindhoven: https://research.tue.nl/en/studentTheses/evaluating-the-relevance-of-nec3-contracts-on-the-collaboration-b

Gerrard, R., & Waterhouse, P. (2019). *NEC4 Resolving and Avoiding Disputes*. London: Institute of Civil Engineers.

Ghassemi, R., & Becerik-Gerber, B. (2011). Transitioning to Integrated Project Delivery: Potential barriers and lessons learned. *Lean construction journal*.

Gil, N. (2009). Developing cooperative project client-supplier relationships: How much to expect from relational contracts? *California Management Review, 51*(2), 144-169.

Harper, C. M., Molenaar, K. R., & Cannon, J. P. (2016). Measuring constructs of relational contracting in construction projects: The owner's perspective. *Journal of Construction Engineering and management, 142*(10), 04016053.

Hayford, O. (2020). *Collaborative Contracting and Procurement*. Retrieved from https://media-exp1.licdn.com/dms/document/C561FAQHAt8-gdHH4gg/feedshare-document-pdf-analyzed/0?e=1597410000&v=beta&t=oCp70qAJJLL_W-_tkbZTsxz5Cg50Pp00YcKahi85wPw

Heaphy, I., & Birch, M. (2018). *How to avoid and resolve disputes under NEC4 webinar*. Retrieved from https://www.neccontract.com/getmedia/ef27d298-6424-4dbb-bfe6-

0f32989e1ceb/How-to-avoid-and-resolve-disputes-under-NEC4-webinar-Slides.pdf.aspx
Hellard, R. B. (1995). *Project partnering: principle and practice*. London: Thomas Telford.
Hertogh, M., & Westerveld, E. (2010). Playing with Complexity. Management and organisation of large infrastructure projects. Retrieved from https://repub.eur.nl/pub/18456/
Hofstede, G. H., Hofstede, G. J., & Minkov, M. (2005). *Cultures and organizations: Software of the mind* (Vol. 2): Mcgraw-hill New York.
Hosseini, A., Windimu, P., Klakegg, O. J., Andersen, B., & Laedre, O. (2018). Project partnering in the construction industry: Theory vs. practice. *Engineering Project Organization Journal, 8*(1), 2-24.
Hughes, D., Williams, T., & Ren, Z. (2012). Differing perspectives on collaboration in construction. *Construction Innovation 12(3):355-368*.
Hunter, D. (2019). Engaging Suppliers Early with NEC4. Retrieved from https://www.neccontract.com/About-NEC/News-and-Media/Engaging-suppliers-early-with-NEC4
Jefferies, M., Brewer, G. J., & Gajendran, T. (2014). Using a case study approach to identify critical success factors for alliance contracting. *Engineering, Construction and Architectural Management 21(5)*.
Kamminga, Y. P. (2008). Towards effective governance structures for contractual relations. *Tilburg University*.
Koenen, I. (2015). Reportage: 'Veel Britse collega's waren jaloers op ons'. *Cobouw*. Retrieved from https://www.cobouw.nl/utiliteitsbouw/nieuws/2015/06/reportage-veel-britse-collega-s-waren-jaloers-op-ons-101222284
Kumaraswamy, M. M. (1997). Conflicts, claims and disputes in construction. *Engineering Construction and Architectural Management, 4*(2), 95-111.
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.
Larson, E. (1995). Project partnering: results of study of 280 construction projects. *Journal of management in engineering, 11*(2), 30-35.
Latham, S. M. (1994). Constructing the team. Retrieved from https://constructingexcellence.org.uk/wp-content/uploads/2014/10/Constructing-the-team-The-Latham-Report.pdf
Lousberg, L. H. M. J. (2012). Sturen op haalbaarheid en relatie: Interventies om disfunctionele conflicten bij Publiek Private Samenwerking in ruimtelijke ontwikkelingsprojecten te voorkomen. Retrieved from https://www.researchgate.net/publication/241859595_Sturen_op_haalbaarheid_en_relatie_Interventies_om_disfunctionele_conflicten_bij_Publiek_Private_Samenwerking_in_ruimtelijke_ontwikkelingsprojecten_te_voorkomen
Ltd, T. T. (2017a). *Engineering and Construction contract, C: Target contract with activity schedule*. London: Institute of Civil Engineers.
Ltd, T. T. (2017b). *Establishing a procurement and contract strategy*. London: Institution of Civil Engineers.
Ltd., T. T. (2014). History of NEC. Retrieved from https://www.neccontract.com/About-NEC/History-Of-NEC
Macaulay, S. (1963). Non-contractual relations in business: A preliminary study. *American sociological review*, 55-67.

Marktvisie, K. (2016). *Marktvisie*. Retrieved from https://www.marktvisie.nu/downloads/
Masons, P. (2011). Standard Form Contracts: NEC. Retrieved from https://www.pinsentmasons.com/out-law/guides/standard-form-contracts-nec
Mitchell, B., & Trebes, B. (2005). *NEC Managing Reality*: Thomas Telford.
NEC. (2020). NEC in action - Design and Build. Retrieved from https://www.neccontract.com/NEC-in-Action/Design-Build
Norris, T. (Producer). (2017). NEC Option Z. [Powerpoint slides] Retrieved from https://www.cewales.org.uk/files/4915/0530/4887/Presentation.pdf
Nyström, J. (2005). The definition of partnering as a Wittgenstein family-resemblance concept. *Construction management and economics, 23*(5), 473-481.
Patterson, R. (2009). Using NEC contracts to manage risk and avoid disputes. *Proceedings of the Institution of Civil Engineers-Management, Procurement and Law, 162*(4), 157-167.
Patterson, R., Anders, M., Siljehah, P., & Macdonald, M. (2017). NEC: how to require something is done by a certain date. Retrieved from https://www.neccontract.com/About-NEC/News-and-Media/NEC-how-to-require-something-is-done-by-a-certain
Pianoo. (2020). Uniforme administratieve voorwaarden (UAV en UAV-GC). Retrieved from https://www.pianoo.nl/nl/markten/gww/inkopen-gww/gww-contractvormen/uniforme-administratieve-voorwaarden-uav-uav-gc
Prorail. (2016). *De ProRail alliantie* Retrieved from https://www.prorail.nl/sites/default/files/brochure_de_prorail-alliantie_0_0.pdf
Rahman, M. M., & Kumaraswamy, M. M. (2004). Contracting relationship trends and transitions. *Journal of management in engineering, 20*(4), 147-161.
Rijkswaterstaat. (2019). *Toekomstige Opgave Rijkswaterstaat: Perspectief op de uitdagingen en verbetermogelijkheden in de GWW-sector*. Retrieved from Utrecht: https://www.rijksoverheid.nl/documenten/rapporten/2019/06/11/toekomstige-opgave-rijkswaterstaat
Siu, M.-F. F., Leung, W.-Y. J., & Chan, W.-M. D. (2018). A data-driven approach to identify-quantify-analyse construction risk for Hong Kong NEC projects. *Journal of Civil Engineering and Management, 24*(8), 592-606.
Skeggs, C. (2003). Project partnering in the international construction industry. *International Construction Law Review, 20*(4), 456-482.
Stam, R. (2016). Relationship contracting arrangements: A study of relationship contracting arrangements and their ability to foster best-for-project behavior in infrastructure projects in the Netherlands. Retrieved from https://repository.tudelft.nl/islandora/object/uuid:84ab5b51-daf1-49f5-ae9a-4a35290c7246/datastream/OBJ
Strang, M. H. P. C. W. (2017). Aangeschaft door het IBR: NEC4; lees hier het artikel van mr. Hugo Strang. Retrieved from https://www.linkedin.com/pulse/aangeschaft-door-het-ibr-nec4-lees-hier-artikel-van-mr-chao-duivis/
Suprapto, M. (2016). Collaborative contracting in projects. Retrieved from https://repository.tudelft.nl/islandora/object/uuid%3A8081fd15-7e16-4a05-bd6a-152c8fee2f94
ten Hoeve, G. (2018). *Improving collaboration between client and contractor in integrated contracts in the Dutch construction sector*. Retrieved from Delft: https://repository.tudelft.nl/islandora/object/uuid%3A7fbe5a20-53b7-4237-be67-67a6ea793502

Thompson, R. M., Vorster, M. C., & Groton, J. P. (2000). Innovations to manage disputes: DRB and NEC. *Journal of management in engineering, 16*(5), 51-59.

Van den Berg, M. (2015). *Barriers and the success factors for the implementation of the NEC within the civil engineering industry of South Africa.* Stellenbosch: Stellenbosch University,

Van den Berg, M., & Kamminga, P. (2006). Optimising contracting for alliances in infrastructure projects. *International Construction Law Review, 23*(1).

van der Veen, M., & Altes, W. K. K. (2011). Urban development agreements: Do they meet guiding principles for a better deal? *Cities, 28*(4), 310-319.

van Dijk, E. (2013). Kroniek rechtspraak UAV-gc. *Tijdschrift voor Bouwrecht, 1*(7).

Van Loo, M. (2012). Organisational Culture and Project Partnering Performance. Retrieved from https://repository.tudelft.nl/islandora/object/uuid:0f0ba235-997e-4943-9a38-ec0bd0a366aa

van Riggelen, R. (2019). Bouwteam: For more collaboration in the construction industry. Retrieved from https://repository.tudelft.nl/islandora/object/uuid%3A961d11cf-aea7-4201-a6a7-e15da55a399d

Verschuren, P., Doorewaard, H., & Mellion, M. (2010). *Designing a research project* (Vol. 2): Eleven International Publishing The Hague.

Walker, D. H., Hampson, K., & Peters, R. (2002). Project alliancing vs project partnering: a case study of the Australian National Museum Project. *Supply Chain Management: An International Journal*.

Yeung, J. F., Chan, A. P., & Chan, D. W. (2012). Defining relational contracting from the Wittgenstein family-resemblance philosophy. *International Journal of Project Management, 30*(2), 225-239.

APPENDICES

APPENDIX A, PROJECT PARTNERING LITERATURE

Author and year	Title	Content
(Kamminga, 2008)	Toward effective governance structures for contractual relations	The goal of this study is to provide a systematic approach to improve collaboration to achieve project success.
(Nyström, 2005)	The definition of partnering as a Wittgenstein family-resemblance concept	We develop recommendations that can be used to improve the interaction between clients and contractors and their representatives.
(Drexler Jr & Larson, 2000)	Partnering: why project owner-contractor relationships change	This study utilized data collected from 276 construction projects to examine the stability in the owner-contractor relationship.
(Chan et al., 2004)	Exploring Critical Success Factors for Partnering in Construction Projects	This paper presents a review of the development of the partnering concept in general and identifies critical success factors for partnering projects from the Hong Kong perspective in particular.
(Stam, 2016)	Relationship contracting arrangements	This research investigates which behaviour is beneficial to project performance, which governing mechanisms should be part of a contract in order to foster this behaviour, and which categories of relationship contracting arrangements are capable of fostering this behaviour
(Suprapto, 2016)	Collaborative Contracting in Projects	This research is a systematic research to understand the essence (factors, mechanisms, and attributes) of collaborative relationships and their specific effects upon project outcomes.
(Bresnen & Marshall, 2000a)	Building partnerships: case studies of client–contractor collaboration in the UK construction industry	The aim of this paper is to help bridge this gap between existing research and useful practical recommendations by exploring issues in some empirical depth. What follows are the findings from a research project designed to investigate the use of collaborative approaches, such as partnering and alliancing, across a range of project circumstances in construction.
(Bresnen & Marshall, 2000b)	Partnering in Construction: A Critical Review of Issues, Problems and Dilemmas	This paper attempts to contribute towards this debate by exploring the presumed link between partnering and cultural change within the industry, at both organisational and inter-organisational levels of analysis
(Black et al., 2000)	An analysis of success factors and benefits of partnering in construction	Using a UK-wide postal questionnaire survey, the opinions of different types of organization consultants, contractors, and clients were assessed in relation to the success factors and benefits of partnering.
(Hughes et al., 2012)	Differing perspectives on collaboration in construction	Purpose to identify the key aspects present in collaborative projects with the objective of producing a clear definition for collaboration within the UK construction industry

(Hosseini et al., 2018)	Project Partnering in the Construction Industry: Theory vs. Practice	The purpose of this study is to shed more light on how the partnering concept as practiced in real-life projects compares with the way partnering is described in the literature by exploring the hard (formal/contractual) elements of this concept. By this, we aim to identify discrepancies between theory and practice and help clear up the confusion that results from conflicting definitions of partnering. This investigation is based on a literature study and 39 interviews with respondents from 44 construction projects classified as partnering projects.
(Larson, 1995)	Project partnering: results of study of 280 construction projects	Based on empirical research on 280 projects, this study aims to show the results of project partnering in practice.
(Yeung et al., 2012)	The definition of alliancing in construction as a Wittgenstein family-resemblance concept	This study focusses on developing the definition of alliancing by comparing it to project partnering. To do so, the researcher first provides a clear definition and purpose of project partnering.

APPENDIX B, NEC4 ECC CLAUSES

1	**General**
10	Actions
11	Identified and defined terms
12	Interpretation and the law
13	Communication
14	The project manager and the supervisor
15	Early warning
16	Contractor's proposals
17	Requirements for instructions
18	Corrupt act
19	Prevention
2	**The contractor's main responsibilities**
21	The contractor's design
22	Using the contractor's design
23	Design of equipment
24	People
25	Working with the client and others
26	Subcontracting
27	Other responsibilities
28	Assignment
29	Disclosure
3	**Time**
30	Starting, completion and key dates
31	The programme
32	Revising the programme
33	Access to and use the site
34	Instructions to stop or not to start work
35	Take over
36	Acceleration
4	**Quality management**
40	Quality management system
41	Tests and inspections
42	Testing and inspection before delivery
43	Searching for and notifying defects
44	Correcting defects
45	Accepting defects
46	Uncorrected defects
5	**Payment**
50	Assessing the amount due
51	Payment

52	Defined cost
53	Final assessment
54	The contractor's share
55	The activity schedule
6	**Compensation events**
60	Compensation events
61	Notifying compensation events
62	Quotations for compensation events
63	Assessing compensation events
64	The project manager's assessments
65	Proposed instructions
66	Implementing compensation events
7	**Title**
70	The client's title to plant and materials
71	Marking equipment, plant and materials outside the working areas
72	Removing equipment
73	Objects and materials within the site
74	The contractor's use of material
8	**Liabilities and insurance**
80	Client's liabilities
81	Contractor's liabilities
82	Recovery of costs
83	Insurance cover
84	Insurance policies
85	If the contractor does not insure
86	Insurance by the client
9	**Termination**
90	Termination
91	Reasons for termination
92	Procecures on termination
93	Payment on termination

APPENDIX C, INTERVIEW SETUP

Interview – Semi structured

Introductie	Doel
-Voorstellen aan elkaar -Toestemming opnemen interview -Anonimiteit benadrukken -Achtergrondinformatie icm doel onderzoek -Rol van geïnterviewde benadrukken -Kort doornemen hoofdonderwerpen vragen	Kennismaken om een vertrouwde sfeer te creëren waar ervaringen gedeeld kunnen worden.

Samenwerking op het project	Doel
Hoe is de samenwerking tussen de opdrachtgever en opdrachtnemer verlopen op het project? - Welke (extremen) positieve en negatieve ervaring heeft u overgehouden aan de samenwerking? - Had de samenwerking beter gekund? - Werd er voldoende aandacht aan samenwerking besteed? - Wat had er volgens u beter gekund?	Beeld creëren van de verhoudingen tussen de opdrachtgever en opdrachtnemer en de prioriteit van samenwerking binnen het project. Dit kan gebruikt worden om vervolgvragen toe te spitsen op specifieke situaties.
Is de dynamiek van de samenwerking veranderd door de loop van het project? **Zo ja, op welke manier?**	Bekijken wat voor effect de verschillende fases binnen een project hebben op de algehele verstandshouding.
Wat is er aan gedaan om de samenwerking te stimuleren en hoe is dit opgepakt?	Eerste indruk met betrekking tot de toegepaste principes/methodes om samenwerking te stimuleren. Dit wordt gebruikt om een beeld te schetsen van de toegepaste methodes als reflectie op de beschreven methodes in de NEC.

NEC introduceren	Doel
-Uitleggen wat de NEC precies is en waar de potentie ligt ten opzichte van de huidige traditionele contracten. Daarnaast ook benoemen waarom het nog niet in Nederland is toegepast (jurdisch).	De geïnterviewde duidelijk maken waar de potenties en uitdagingen van de NEC liggen. Dit vormt voor de geïnterviewde een beeld van de doelstelling van de NEC in het algemeen en verklaard de benadering van verschillende clausules

Methodes voor samenwerking in UAV-GC	Doel
In welke fase is de aannemer voor het eerst betrokken bij het project?	Identificeren of er sprake is van 'early contractor involvement' en of dit een negatieve of positieve werking heeft gehad op de samenwerking tussen OG en ON.
Op welke manier is er invulling gegeven aan het risicoregister en heeft dit bijgedragen aan het beter verdelen en opvangen van de risico's? - Zo ja, heeft dit de samenwerking gestimuleerd?	Identificeren of er sprake is van 'early warning/risico register' en of dit een negatieve of positieve werking heeft gehad op de samenwerking tussen OG en ON.
Zijn er van tevoren duidelijke afspraken gemaakt ten opzichte van de samenwerking en zijn deze afspraken nageleefd?	Identificeren of er sprake is van duidelijke afspraken mbt samenwerking en of dit een negatieve of positieve werking heeft gehad op de samenwerking tussen OG en ON.
Heeft het planningsmanagement en eventuele mijlpalen bijgedragen aan het bevorderen van de samenwerking?	Identificeren of dit een negatieve of positieve werking heeft gehad op de samenwerking tussen OG en ON.
Is er gebruik gemaakt van een gedeeltelijke oplevering en heeft dit samenwerking bevorderd?	Identificeren of er sprake is van 'Sectional completion' en of dit een negatieve of positieve werking heeft gehad op de samenwerking tussen OG en ON.
Is er gebruik gemaakt van bonussen voor vroegtijdige voltooiing? - Zo ja, heeft dit de samenwerking gestimuleerd? - Zo nee, zou dit stimulerend kunnen werken?	Identificeren of er sprake is van 'Bonus for early completion' en of dit een negatieve of positieve werking heeft gehad op de samenwerking tussen OG en ON.
Is er gebruik gemaakt van boetes voor vertraging van mijlpalen? - Zo ja, heeft dit de samenwerking gestimuleerd? - Zo nee, zou dit stimulerend kunnen werken?	Identificeren of er sprake is van 'Delay damages' en of dit een negatieve of positieve werking heeft gehad op de samenwerking tussen OG en ON.
Zijn er KPI's toegepast? - Zo ja, heeft dit de samenwerking gestimuleerd? - Zo nee, zou dit stimulerend kunnen werken?	Identificeren of er gebuik gemaakt is van 'KPIs' en of dit een negatieve of positieve werking heeft gehad op de samenwerking tussen OG en ON.
Zijn er van tevoren afspraken gemaakt over het escaleren of voorkomen van een conflict? - Zo ja, heeft dit de samenwerking gestimuleerd? - Zo nee, zou dit stimulerend kunnen werken?	Identificeren of er gebuik gemaakt is van 'dispute resolving options' en of dit een negatieve of positieve werking heeft gehad op de samenwerking tussen OG en ON.
Is er in het contract opgenomen dat een persoon of partij binnen het project vervangen kan worden? - Zo ja, heeft dit de samenwerking gestimuleerd?	Identificeren of 'termination' is opgenomen in het contract en of dit een negatieve of positieve werking heeft gehad op de samenwerking tussen OG en ON.

- Zo nee, zou dit stimulerend kunnen werken?	

NEC specifieke clausules	**Doel**
Pain/gain sharing, wat vindt u daarvan? - Op wat voor manier zou dit mechanisme toegepast kunnen worden (voorbeeld) en zou dit tot bevordering van samenwerking kunnen leiden in het project?	Achterhalen of 'Pain/gain sharing' toepasbaar is op projecten binnen de scope en of dit een positief effect heeft op de samenwerking tussen OG en ON
Revising the programme, wat vindt u daarvan? - Op wat voor manier zou dit mechanisme toegepast kunnen worden (voorbeeld) en zou dit tot bevordering van samenwerking kunnen leiden in het project?	Achterhalen of 'Revising the programme toepasbaar is op projecten binnen de scope en of dit een positief effect heeft op de samenwerking tussen OG en ON
Open book economy, wat vindt u daarvan? - Op wat voor manier zou dit mechanisme toegepast kunnen worden (voorbeeld) en zou dit tot bevordering van samenwerking kunnen leiden in het project?	Achterhalen of 'open book economy' toepasbaar is op projecten binnen de scope en of dit een positief effect heeft op de samenwerking tussen OG en ON

Concluderen	**Doel**
Zijn er naast de zojuist doorgenomen methodes, nog andere methodes die in het project toegepast zijn om samenwerking te stimuleren? - Zo ja, hoe hebben deze uitgepakt?	Laatste moment om de toegepaste methodes na te lopen. Wellicht heeft de geïnterviewde na de genoemde clausules nog nieuwe ideeën gekregen.

Afsluiten	**Doel**
- Bedanken voor het delen van de informatie - Vragen naar een eventueel project plan - Aangeven dat de uitwerking ter validatie wordt opgestuurd. - Mogelijkheid tot vervolgvragen per mail	

APPENDIX D, CASE STUDY INTERVIEWS

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APPENDIX E, OVERVIEW RESULTS INTERVIEWS

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APPENDIX F, EXPERT PANEL

Experts:

- **Expert 1**
  Years of experience: 28 years
  Job description: Senior consultant
  Expertise: Contract management of Dutch and international projects
  Input thesis: Validate UAV-GC opportunities and application of NEC4 ECC clauses

- **Expert 2**
  Years of experience: 12 years
  Job description: Lawyer (head of projects and construction NL)
  Expertise: Development and contract management of innovative and complex-large-scale projects
  Input thesis: Validate UAV-GC opportunities and application of NEC4 ECC clauses

- **Expert 3**
  Years of experience: 25 years
  Job description: Advisor market and procurement
  Expertise: Revision of the UAV-GC
  Active in projects as well as overall strategies for the company
  Input thesis: Experience in projects and especially the UAV-GC
  Validate UAV-GC opportunities and application of NEC4 ECC clauses

- **Expert 4**
  Years of experience: 22 years
  Job description: Mediator and researcher
  Input thesis: Validate on relational contracting clauses as a way to stimulate client-contractor collaboration
  Validate the dispute avoidance/resolving mechanism

- **Expert 5**
  Years of experience: 34 years
  Job description: Manager energy, industry and water
  Expertise: Involved in acquisition and tenders for integrated projects
  Input thesis: Experience with financial mechanism (target cost contract)
  Validate UAV-GC opportunities and application of NEC4 ECC clauses

- **Expert 6**
  Years of experience: 21 years
  Job description: Senior project manager and contract manager
  Expertise: Contract management (UAV-GC) of complex projects
  Input thesis: Validate UAV-GC opportunities and application of NEC4 ECC clauses

APPENDIX G, INTERVIEWS EXPERT PANEL

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APPENDIX H, RESULTS INTERVIEWS EXPERT PANEL

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APPENDIX I, INTERVIEWS STRATEGIC PARTNERING

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