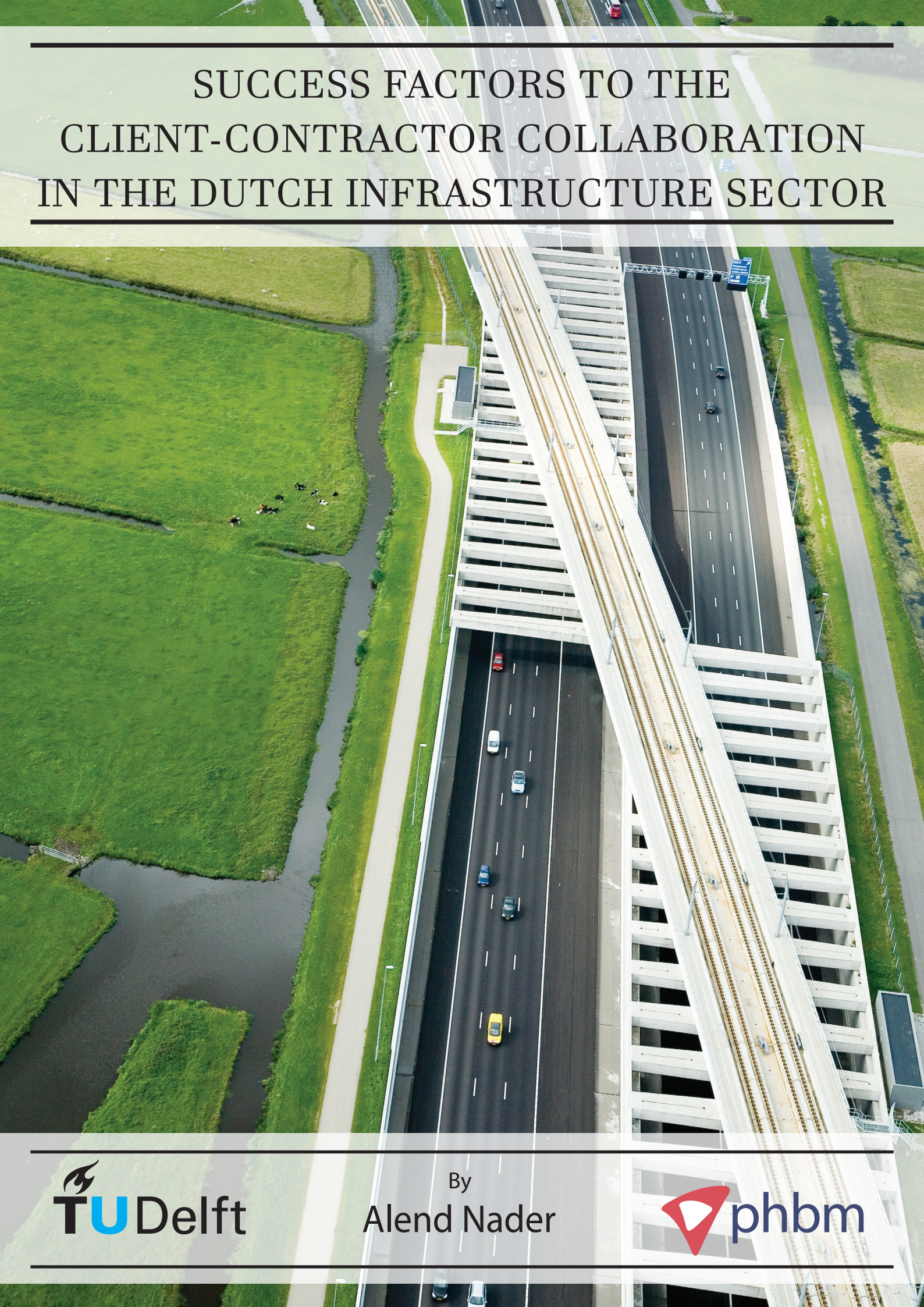
SUCCESS FACTORS TO THE CLIENT-CONTRACTOR COLLABORATION IN THE DUTCH INFRASTRUCTURE SECTOR



TU Delft

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Picture front page: Hoge Snelheidslijn, A4 Hoogmade (Ministerie van Onderwijs, 2016)

Success factors to the client-contractor collaboration in the Dutch infrastructure sector

A comparative study of the client-contractor collaboration within ECI and D&C projects in the Dutch infrastructure sector

By

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Preface

This thesis is written as a graduation thesis for the completion of the MSc Construction Management & Engineering at the University of Technology Delft. The research is conducted at phbm in Amsterdam who provided me with their network and resources that enabled me to conduct this research.

This research is relevant for clients, contractors, consultants, and knowledge platforms in the Dutch infrastructure sector. The results from this research provide insights into possibilities to improve the client-contractor collaboration. The comparison between ECI and D&C projects is rather new, and my own assumption has been that the client-contractor collaboration in ECI projects is better compared to that in D&C projects. As a result of this research, this assumption is proven. Furthermore, I am excited about the development of the RECAP tool in the Dutch infrastructure sector. I hope it will be used regularly in Dutch infrastructure projects.

I would like to express my gratitude to the graduation committee, Monika Chao-Duivis, Marian Bosch-Rekveldt, Leon Hombergen, Marcel Krikke, Roj van Baaren, and Quinten Niekrake, for helping me through this process. They provided the support I needed to complete this research. Special thanks to Marian and Leon who helped me with the thesis through a rough period. Furthermore, I would like to thank my colleagues from phbm for providing support and their network, especially Roel van der Weerd for helping me with developing communication skills. Also, I would like to thank all the interviewees and experts for their time and participation.

Lastly, I want to thank my family and friends for their support during this period. I have to specially express my gratitude to Gores Hamad for supporting me at the end of this research. His support helped me through the last few weeks of the thesis.

Alend Nader

Delft, July 12th, 2019

Samenvatting

In de afgelopen jaren is de relatie tussen opdrachtgever en opdrachtnemer in de Nederlandse GWW-sector verstoord. Er is sprake van wantrouwen en een vechtcultuur, waarin beide partijen lijnrecht tegenover elkaar staan. Mede door de verstoorde relatie tussen opdrachtgever en opdrachtnemer zijn er project overschrijdingen, verliezen en geschillen ontstaan. De spanning tussen opdrachtgever en opdrachtnemer lijkt vaak centraal te staan in plaats van het realiseren van het project. Naar aanleiding van deze ontwikkelingen is in 2016 de Marktvisie ontwikkeld. De Marktvisie is ontwikkeld in een proces waarbij Rijkswaterstaat opdrachtnemers, de kenniswereld en mede-opdrachtgevers heeft uitgenodigd om een dialoog te voeren over de benodigdheden voor een betere samenwerking in de sector.

Probleemstelling en doel

De aanleiding van dit onderzoek is de verstoorde relatie tussen opdrachtgever en opdrachtnemer in de Nederlandse GWW-sector. De sector is op zoek naar mogelijkheden om de samenwerking te verbeteren. Deze masterscriptie heeft als doel om bij te dragen aan de verbetering van de samenwerking tussen opdrachtgever en opdrachtnemer in de Nederlandse GWW-sector. Om dit doel te bereiken is er een vergelijkend onderzoek uitgevoerd naar de verschillen in de samenwerking tussen opdrachtgever en opdrachtnemer in bouwteam projecten en D&C projecten. De keuze voor D&C projecten is vanwege het feit dat het D&C contract op dit moment het meest gangbare en toegepast contract in de sector is. De keuze voor bouwteam projecten is vanwege de opmars van het bouwteam model in de sector. Het bouwteam bestaat al veel langer, maar het werd de afgelopen jaren weinig gebruikt.

Onderzoeksvraag

Om het onderzoek uit te voeren is een onderzoeksvraag opgesteld die beantwoord moet worden om het doel van het onderzoek te bereiken. De onderzoeksvraag van deze scriptie is:

Wat zijn verschillen in de samenwerking tussen opdrachtgever en opdrachtnemer in bouwteam projecten en D&C projecten, en welke mogelijkheden ontstaan er in de vergelijking om de samenwerking in de Nederlandse GWW-sector te verbeteren?

Het is belangrijk om te vermelden dat in dit onderzoek het bouwteam model en het D&C contract niet met elkaar vergeleken worden. Daarnaast wordt het projectresultaat (planning, budget en kwaliteit) van bouwteam projecten en D&C projecten ook niet vergeleken. De conclusies van deze scriptie gaan alleen over de samenwerking in bouwteam projecten en D&C projecten in de Nederlandse GWW-sector.

RECAP tool

Om de onderzoeksvraag te beantwoorden zijn er case studies uitgevoerd. In deze scriptie zijn 3 bouwteam projecten (BT A, B en C) en 2 D&C projecten (D&C 1 en 2) onderzocht, waarbij elf interviews hebben plaatsgevonden. Om de samenwerking in die projecten te meten is er gebruikt van de 'RElational CAPability assessment tool' (RECAP). De RECAP tool is ontwikkeld door Mohammad Suprapto als resultaat van zijn dissertatie in 2016 aan de TU Delft. Deze tool is, ten tijde van dit onderzoek, nog niet gebruikt in de Nederlandse GWW-sector.

Hoofdcriteria	Subcriteria	Definitie
A. Front-end definitie	1. Front-end definitie	In hoeverre zijn de scope, specificaties, uitvoeringsplan, en rolverdelingen duidelijk voor OG en ON?
B. Samenwerkingsverbanden	2. Team integratie	In hoeverre zijn de projectteams van OG en ON geïntegreerd in één team?
	3. Gezamenlijke processen	In hoeverre worden er gezamenlijke processen uitgevoerd door de projectteams van OG en ON?
C. Houding en gedrag	4. Senior management inzet	De inspanning en ondersteuning door de senior management van OG en ON
	5. Senior management vertrouwen	Vertrouwen tussen de senior management van OG en ON
	6. Gevestigde relationele normen	No blame culture, win-win, en open houding
D. Kwaliteit van teamwork	7. Communicatie	In hoeverre wordt er effectief gecommuniceerd met elkaar?
	8. Coördinatie	In hoeverre worden taken gecoördineerd tussen de teams?
	9. Evenwichtige bijdrage	In hoeverre passen de project teams van OG en ON hun specialistische kennis toe
	10. Gelijk georiënteerde inspanning	In hoeverre is de geleverde inspanning van OG en ON evenwichtig?
	11. Wederzijdse ondersteuning	In hoeverre ondersteunen de projectteams van OG en ON elkaar om de projectdoelen te bereiken?
	12. Cohesie	In hoeverre gedragen de projectteams zich als één team?
	13. Onderling vertrouwen	In hoeverre vertrouwen de teamleden elkaar?
E. Projectresultaat	14. Efficiëntie	Is het project geleverd binnen planning en budget?
	15. Kwaliteit	In hoeverre is er voldaan aan de gestelde kwaliteitseisen?
	16. Tevredenheid	In hoeverre zijn OG en ON tevreden over het resultaat?
F. Relatie continuïteit	17. Relatie continuïteit	Zouden OG en ON nogmaals met elkaar willen samenwerken in de toekomst?

Tabel 1: De criteria van de RECAP tool met de definities.

De RECAP tool bestaat uit twee ronden waarbij 72 stellingen ter sprake worden gebracht verdeeld over zes hoofdcriteria, zie Tabel 1. In de eerste ronde van RECAP wordt een formulier met de stellingen ingevuld door respondenten aan de zijde van opdrachtgever en opdrachtnemer. De respondenten beoordelen de stellingen met een score tussen 1 (zeer slecht) en 5 (zeer goed), of niet van toepassing. Het invullen duurt tussen 30 en 45 minuten en het formulier wordt online ingevuld. Hierna worden de scores voor elk criterium geanalyseerd en vergeleken per project. Er wordt gekeken naar opmerkelijke hoge en lage scores, en de verschillen in perceptie tussen opdrachtgever en opdrachtnemer. Elk verschil van 1,0 punt of hoger wordt in de tweede ronde ter sprake gebracht.
De tweede ronde van RECAP bestaat uit een semi-gestructureerde interview met de respondent van de opdrachtgever en opdrachtnemer. Er wordt een interview protocol gebruikt, waarbij de volgende onderwerpen ter sprake komen:

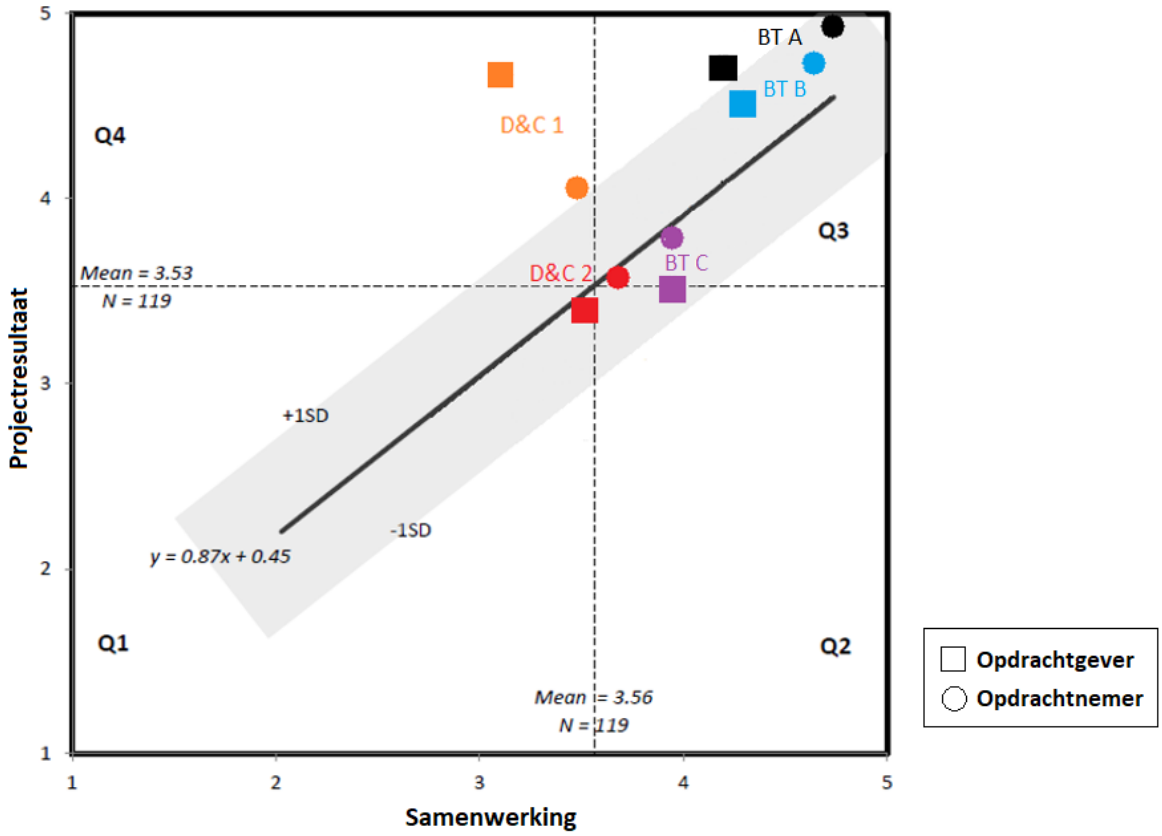
1. **Profielschets:** introductie, toestemming om het gesprek op te nemen, zijn of haar ervaringen, en rol in het project.
2. **Projectbeschrijving:** algemene voortgang, bijzondere aspecten, en resultaat
3. **Het contract/samenwerkingsvorm:** welk contract is gebruikt? Waarom? Aandachtspunten en succesfactoren bij het gebruik ervan.
4. **Samenwerking gedurende het project:** samenwerking over het algemeen, aandacht voor de samenwerking, en eventuele methoden om de samenwerking in stand te houden/ te verbeteren.
5. **RECAP resultaten:** uitleg van RECAP, de scores toelichten, hoge en lage scores, en vragen stellen over de verschillen in perceptie per criterium (1,0 punt of hoger).
6. **RECAP evaluatie:** toepasbaarheid in de sector, bruikbaarheid, en suggesties om de tool te verbeteren.

Resultaten

Voordat de analyse van de resultaten wordt uitgevoerd, worden de vijf projecten in kaart gebracht. Dit wordt gedaan middels een grafiek, zie Figuur 1, waarin de gemiddelde scores op de vier samenwerkingscriteria wordt uitgezet tegen de gemiddelde scores op de twee resultaatcriteria. De grafiek is overgenomen van het onderzoek door Suprapto (2016). In de grafiek zijn de gemiddelden van 119 respondenten in zijn onderzoek overgenomen om de context van de vijf projecten van dit onderzoek te laten zien. Door de gemiddelden van de 119 respondenten te kruisen ontstaan er vier kwadranten:

- Q1: Slechte samenwerking en slechte projectresultaten
- Q2: Goede samenwerking en slechte projectresultaten
- Q3: Goede samenwerking en goede projectresultaten
- Q4: Slechte samenwerking en goede projectresultaten

Alle bouwteam projecten zijn gepositioneerd in Q3. Vooral projecten BT A en B scoren exceptioneel hoog op samenwerking en projectresultaat. Project BT C scoort gemiddeld op projectresultaat en bovengemiddeld op samenwerking. Project D&C 1 is een uitzonderlijk project die buiten de regressielijn+1SD gepositioneerd is in Q4. Project D&C 2 scoort gemiddeld op beide assen.



Figuur 1: Alle projecten in dit onderzoek in kaart gebracht.

Antwoord op de onderzoeksvraag

Nadat de RECAP resultaten binnen zijn en de interviews uitgevoerd zijn, wordt de analyse van de resultaten uitgevoerd. In de analyse worden de verschillen in samenwerking tussen opdrachtgever en opdrachtnemer in de bouwteam projecten en D&C projecten uitgelegd met behulp van de bevindingen in de interviews en het literatuuronderzoek. Om de analyse uit te voeren zijn de scores van de respondenten van opdrachtgever en opdrachtnemer per project gecombineerd. Vervolgens zijn de scores van de bouwteam projecten gecombineerd, hetzelfde is gedaan met de D&C projecten. De resultaten van de analyse zijn te vinden in Tabel 2. Het is belangrijk om te vermelden dat voor de analyse alleen de 13 samenwerkingscriteria gebruikt zijn. Dit is gedaan omdat het projectresultaat niet van belang is voor de beantwoording van de onderzoeksvraag. Daarnaast is het onderzoek alleen gericht op de verschillen in de samenwerking tussen opdrachtgever en opdrachtnemer in bouwteam projecten en D&C projecten.

De resultaten van de analyse zijn overduidelijk. De samenwerking tussen opdrachtgever en opdrachtnemer is over het algemeen beter in bouwteam projecten vergeleken met de samenwerking in D&C projecten. In Tabel 2 is te zien dat de bouwteam projecten op alle samenwerkingscriteria gemiddeld hoger scoren dan de D&C projecten. De bouwteam projecten scoren aanzienlijk hoger dan de D&C projecten voor de volgende criteria: Front-end definitie, Team integratie, en Gezamenlijke processen. Verder scoren de bouwteam projecten gematigd hoger dan de D&C projecten voor de volgende criteria: Gevestigde relationele normen, Communicatie, Evenwichtige bijdrage, Wederzijdse ondersteuning, Cohesie, en Onderling vertrouwen. Voor de volgende criteria was het verschil verwaarloosbaar: Senior management inzet, Senior management vertrouwen, Coördinatie, Gelijk georiënteerde inspanning.

Subcriteria	BT	D&C	Verschil
1. Front-end definitie	4,18	3,13	1,06
2. Team integratie	4,25	2,93	1,32
3. Gezamenlijke processen	4,03	2,83	1,20
4. Senior management inzet	4,22	3,90	0,32
5. Senior management vertrouwen	4,67	4,23	0,44
6. Gevestigde relationele normen	4,38	3,55	0,83
7. Communicatie	4,38	3,63	0,76
8. Coördinatie	4,10	3,80	0,30
9. Evenwichtige bijdrage	4,22	3,68	0,54
10. Wederzijdse ondersteuning	4,57	3,68	0,89
11. Gelijk georiënteerde inspanning	4,27	3,93	0,34
12. Cohesie	4,68	3,80	0,88
13. Onderling vertrouwen	4,55	3,90	0,65

Legenda					
Scores	<3,25	3,25 – 3,74	3,75 – 4,24	4,25 – 4,75	>4,75
Verschillen	Nihil	Gematigd	Aanzienlijk		

Tabel 2: Gemiddelde score per criterium voor bouwteam projecten en D&C projecten met de verschillen.

Bouwteam

De projectteams van opdrachtgever en opdrachtnemer zijn geïntegreerd en gedragen zich als één projectteam in bouwteam projecten. Daarnaast is de front-end definitie in de bouwteam projecten duidelijk voor beide projectteams. De reden hiervoor is te vinden in de bouwteam fase, waarbij de projectteams gezamenlijk processen uitvoeren om tot een geïntegreerd ontwerp te komen. Doordat een bouwteam wordt gevormd in een vroeg stadium van het project, heeft de opdrachtgever meer invloed op het ontwerp vergeleken met D&C projecten. Dit zorgt ervoor dat de kans kleiner is voor veranderingen in de scope en ontwerp later in het project. Daarnaast heeft de inbreng van de expertise en kennis van de opdrachtnemer in een vroeg stadium tot gevolg dat de uitvoeringsfase sneller en gecoördineerd doorlopen kan worden. De opdrachtnemer is gemotiveerd om samen te werken en zijn expertise en kennis in te brengen in de bouwteam fase, omdat hij zeer waarschijnlijk het ontwerp mag ontwerpen. Hij is de eerste en enige die een bod mag doen op het ontwerp waar hij zelf aan heeft gewerkt.
De bouwteam fase geeft een basis voor samenwerkingsgedrag waarin de projectteams gezamenlijk problemen oplossen en risico's identificeren. Er is sprake van een 'no-blame' cultuur, effectieve communicatie, wederzijdse ondersteuning, en onderling vertrouwen tussen de projectteams. Dit is niet het hoofddoel van een bouwteam project, maar door het vormen van een bouwteam worden deze aspecten verwezenlijkt. Het is belangrijk om te vermelden dat het bouwteam eindigt nadat het ontwerp gereed is en opdrachtgever en opdrachtnemer overeenkomst hebben bereikt over de prijs voor de uitvoeringsfase. Echter is de relatie tussen opdrachtgever en opdrachtnemer al opgezet in de bouwteam fase voor de uitvoeringsfase. Dit is geen garantie voor een goede samenwerking, maar het biedt kansen om de bestaande relatie in stand te houden. Dit is ook bevestigd in de meeste interviews. De projectteams hebben een gelijke inspanning in de bouwteam fase en ondersteunen elkaar omdat er een win-win situatie is.

D&C

De relatie tussen opdrachtgever en opdrachtnemer is anders in D&C projecten. Ten eerste zijn de rollen van opdrachtgever en opdrachtnemer anders verdeeld. De opdrachtgever heeft een regisserende rol waarbij hij de opdrachtnemer controleert op bepaalde processen (Vraagspecificatie Proces). De opdrachtgever moet zich hierin wel passief opstellen. De opdrachtnemer is verantwoordelijk voor het opstellen van het ontwerp en de uitvoering. De projectteams in de D&C projecten zijn niet geïntegreerd in één team. Daarnaast worden er geen gezamenlijke processen uitgevoerd. Dat is ook niet het doel van het D&C contract, het is niet de bedoeling dat de projectteams integreren of dat er gezamenlijke processen worden uitgevoerd. Dit heeft tot gevolg dat de samenwerking tussen opdrachtgever en opdrachtnemer niet opgebouwd wordt in een vroeg stadium van het project. De relatie wordt opgebouwd nadat het ontwerp is gegund aan een opdrachtnemer. Dit brengt een risico met zich mee, namelijk de kans op misinterpretatie van de vraagspecificaties. Dit is ook bevestigd in de interviews, het is belangrijk dat de opdrachtgever goed specificeert wat hij wil. In D&C projecten heeft de opdrachtgever minder invloed op het ontwerp, nadat het gegund is. Zijn invloed is voornamelijk gebaseerd op het controleren van de opdrachtnemer. Als de opdrachtgever een verandering doorvoert buiten de scope, dan zijn de consequenties ook voor de opdrachtgever.

Voor de samenwerking in D&C projecten betekent dit dat de scores zeer slecht zijn op de volgende criteria: Front-end definitie, Team integratie, en Gezamenlijke processen. Verder scoren de D&C projecten op alle criteria lager dan de bouwteam projecten. Dit hoeft echter niet te resulteren in een slechte relatie tussen opdrachtgever en opdrachtnemer. Dit blijkt vooral in project D&C 1, waarin de opdrachtgever op afstand bleef en veel vertrouwde toonde in de opdrachtnemer. De senior management van de opdrachtgever ondersteunde de opdrachtnemer in lastige situaties. In dit project was het wel de opdrachtgever die de grondverwerving niet op orde had na gunning. De opdrachtgever had de opdrachtnemer nodig, maar bood ook de benodigde middelen om tot oplossingen te komen. Dit laat zien dat er in D&C projecten mogelijkheden zijn om een goede relatie op te bouwen, door de juiste houding. De samenwerking is niet ideaal, maar het uiteindelijke resultaat kan daardoor wel behaald worden.

Discussie

Gedurende het afstudeeronderzoek werden er een aantal interessante bevindingen gevonden. Allereerst viel het op dat het gebruik van het bouwteam model voornamelijk buiten de Randstad plaatsvond, ten tijde van dit onderzoek. De bouwteam projecten in dit onderzoek bevonden zich in het oosten, zuiden, en midden van Nederland. De reden hiervoor is niet volledig bekend, één van de begeleider stelde dat het cultuurverschil tussen de Randstad (voornamelijk Angelsaksisch) en het oosten/zuiden (voornamelijk Rijnlands) een oorzaak zou kunnen zijn. Verder onderzoek dient te worden verricht om dit uit te zoeken.

In dit onderzoek zijn er een aantal limitaties bij het gebruik van de RECAP tool. Ten eerste is er, vanwege planning en tijdslimiet, voor elk project in dit onderzoek maar één respondent van de opdrachtgever (behalve D&C 2) en één respondent van de opdrachtnemer. Dit zorgt voor minder betrouwbare RECAP resultaten in de eerste ronde. Ten tweede zijn er een beperkt aantal projecten onderzocht, drie bouwteam projecten en twee D&C projecten. In een vervolgonderzoek zouden er meer respondenen van beiden zijden en meer projecten onderzocht kunnen worden.

In dit onderzoek is de RECAP tool gebruikt en geëvalueerd middels drie vragen in de interviews. De tool zou volgens Suprapto (2016) gebruikt kunnen worden voor elk project onder elk contract. Naar aanleiding van de bevindingen in dit onderzoek blijkt dit niet van toepassing

in de Nederlandse GWW-sector. Er is een duidelijke vooroordeel in een aantal stellingen van het RECAP formulier, waarbij de bouwteam projecten op voorhand hoger zouden scoren. In de subcriteria Front-end definitie, Team integratie, en Gezamenlijke processen, zijn er stellingen die niet van toepassing zijn voor D&C projecten. Vooral het criterium Gezamenlijke processen lijkt volledig ongeschikt voor D&C projecten. Voor gebruik in de toekomst zou men een aantal aanpassingen kunnen doorvoeren om dit vooroordeel weg te nemen. Ten eerste zou het criterium Gezamenlijke processen weggelaten kunnen worden bij het gebruik van de RECAP in D&C projecten (geïntegreerde projecten in het geheel). Daarnaast zouden de stellingen waarin wordt gesteld dat bepaalde processen samen worden doorgevoerd, aangepast kunnen worden. Om precies te weten welke aanpassingen nodig zijn voor het geschikte gebruik, is er meer onderzoek nodig. Een vervolgonderzoek met de volledige focus op de evaluatie van RECAP zou meer inzicht kunnen bieden.

Executive summary

In the past decade the relationship between the client and contractor in the construction sector has been disrupted. This disrupted relationship can mainly be characterised as adversarial and distrusting. Additionally, this has resulted in a growing number of disputes between the client and the contractor. As a result of the adversarial relationship and the high expenses to resolve the growing number of disputes, construction projects are more likely to face with time and cost overruns. Currently, the Dutch infrastructure sector is searching for possibilities to improve the client-contractor collaboration. The problem statement of this research is the poor client-contractor collaboration in Dutch infrastructure projects. This problem is derived from the main focus of the Market Vision drafted by RWS, main contractors, co-clients and scholars.

Research question

The main research objective of this research is to contribute to the improvement of the client-contractor collaboration in Dutch infrastructure projects by comparing the collaboration in ECI and D&C projects. This research aims to provide recommendations for managers in the Dutch infrastructure sector to contribute to a more collaborative behaviour. To reach this object a main research question is drafted. The main research question of this thesis is:

What are the differences in the client-contractor collaboration between ECI and D&C infrastructure projects, and what possibilities can be derived from the comparison to improve the collaboration in the Dutch infrastructure sector?

Methodology

To answer the research question several methods are used. Firstly, literature study will be conducted on collaboration, ECI projects, and D&C projects. Secondly, in this research case studies are conducted to identify the differences in the client-contractor collaboration between the ECI and D&C cases in this research. In this research five case studies have been conducted with eleven participants. To conduct the case studies the RECAP tool is used, developed by Suprapto (2016). The RECAP tool is an assessment tool to assess the client-contractor relationship in the construction sector. The tool is quite new in the Netherlands and by using the tool in this research the tool will be evaluated for the Dutch infrastructure sector. The RECAP tool consists of the assessment on six main criteria, which are based on the success factor to the client-contractor collaboration:

1. **Relational attitudes:** includes the sub-criteria of Senior management commitment, Senior management trust and Relational norms
2. **Collaborative practices:** includes the sub-criteria of Team integration and Joint working procedures
3. **Teamworking quality:** includes the sub-criteria of Team communication, Team coordination, Balanced contribution, Aligned effort, Team mutual support, Team cohesion, and Team affective trust
4. **Front-end definition:** includes the sub-criterion of Front-end definition
5. **Project performance:** includes the performance sub-criteria of Efficiency, Quality, and Satisfaction
6. **Relationship continuity:** includes the performance sub-criterion of Relationship continuity

In the first round of the RECAP, the assessment form will be filled in by respondents from the side of the client and the contractor. This will be done separately for each case. The respondents will be asked to assign scores for 72 statements from 1 to 5. Then the score of each sub-criterion will be calculated by averaging the score of each corresponding indicator. The scores by criteria and sub criteria from both the client's side and the contractor's side will be compared side-by-side including the gaps in the scores. These gaps are important for the research, as the gaps can reveal potential dysfunction in the relationship. The second round of the RECAP tool consists of conducting semi-structured interviews. The interview will be done with every respondent separately, to limit the possibility of bias towards the other party. The interviews will be conducted by following an interview protocol. The structure and subjects of the interviews are as following:

- **Respondent's profile:** introduction to the research, permission for voice recording, his or her role and, experiences.
- **Project description:** general progress, remarkable aspects, and project performance.
- **Used contract/form of collaboration:** which is used, why, and pitfalls and success factors of using the contract/form of collaboration.
- **Collaboration in the case:** general collaboration, attention to collaboration, and used methods and process to improve collaboration in the project.
- **RECAP results:** explanation of RECAP, scores of the case, questions about the gaps of 1,0 points and higher in the scores, high scores, and low scores.
- **RECAP evaluation:** practicality, usefulness of the RECAP tool, and suggestions to improve RECAP.

Answer to the research question

After the interviews, the analysis of the results is conducted. In the analysis the scores for each collaborative sub-criterion are assessed and compared. The results from the analysis are shown in **Error! Reference source not found.**. As a result of the analysis the main research question can be answered.

Sub-criteria	ECI	D&C	Gap	
Front-end definition	4,18	3,13	substantial	1,06
Team integration	4,25	2,93	substantial	1,33
Joint working	4,03	2,83	substantial	1,21
SM commitment	4,22	3,90	negligible	0,32
SM trust	4,67	4,23	negligible	0,44
Relational norms	4,38	3,55	moderate	0,83
Team communication	4,38	3,63	moderate	0,76
Team coordination	4,10	3,80	negligible	0,30
Balanced contribution	4,22	3,68	moderate	0,54
Team mutual support	4,57	3,68	moderate	0,89
Alignment of effort	4,27	3,93	negligible	0,34
Team cohesion	4,68	3,80	moderate	0,88
Team affective trust	4,55	3,90	moderate	0,65

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 1: Average scores of the clients and contractors combined for the ECI and D&C cases for each sub-criterion, including the gaps. (own ill.)

The ECI cases scored higher than the D&C cases on all collaborative criteria. From the results of the analysis it was observed that the ECI cases scored substantially higher than the D&C cases for the sub-criteria of Front-end definition, Team integration, and Joint working processes. Furthermore, it was observed that the ECI cases scored moderately higher than the D&C cases for the sub-criteria of Relation norms, Team communication, Balanced contribution, Team mutual support, Team cohesion, and Team affective trust

In ECI projects the project teams of the client and contractor are integrated and behave as one project team actively collaborating together. The main cause for this, is the design team. By forming the design team, the client has more influence on the design, and higher certainty in costs and planning. The contractor's expertise and knowledge of technical aspects, preparation, and costing enables the construction phase to be executed quicker and to be coordinated more effectively. This results in an integrated design and also a better comprehension of the front-end definition by the members of the design team. The contractor is motivated to collaborate into drafting a feasible design, as he has a better position to be award the building contract compared to the traditional process of Design-Bid-Build. He is the first and only to bid on the final design, on which he had worked on himself. Furthermore, the design team feeds a collaborative behaviour, in which the parties jointly solve problems and jointly identify potential risks and pitfalls. The project teams of the client and contractor are integrated as one project team. In the ECI cases there is a collaborative behaviour with 'no blame' culture, effective communication, mutual support and trust between the project teams, and the projects teams behave as one project team. These effects may not be the goal of the ECI model, it is a result from forming the design team in the design phase. By forming a design team, the members do not become formal partners. The members all enter into separate contracts with the client, so each member has his own role and responsibility. It is important to note that the design team ends after the final design is drafted, and therefore also the collaboration ends. However, as the client-contractor relationship has been set up in the design team, this provides opportunities for a collaborative relationship between the client and contractor for the construction phase. From the case studies it became clear that by forming the design team, there are positive effects on the client-contractor relationship. The forming of the design team feeds a collaborative behaviour, in which the parties jointly solve problems and jointly identify potential risks and pitfalls. There is a balance in the contribution from all the members of the design team. The teams support each other, because they know that by supporting each other they themselves will benefit from it also. Furthermore, the teams communicate more open towards each other as this is needed to integrate the final design. Especially, the participating contractors were highly satisfied with the team communication in the ECI cases. Also, the cohesion within the ECI cases was perceived as highly satisfying by the clients and contractors.

In D&C projects, the client-contractor relationship is different. The roles of the client and contractor in D&C projects is clearly separated and there is an imbalance in the involvement during the process of D&C projects. The contractor is responsible for the design and construction of the project, based on the Employer's Requirements submitted to the tender phase by the client. The client has a directing role, in which he has a passive attitude and checks the contractors processes and works. The project teams of the client and contractor are not integrated into one project team. Furthermore, the jointly working processes is not stimulated by the D&C contract. Contractor B stated that the UAC-IC 2005 does not feed a 'no-blame' culture, the parties could be pointing to each other instead of jointly working on issues.

Also, from the case studies it also became clear that it is not intended to integrate the project teams of the client and contractor and to behave as one project team. The separation between the client and contractor is known and is set. In D&C projects, the relationship starts after the tender phase. The transition from the tender phase to the design and construct phase could affect the relationship, and therefore the communication. During the interviews, participants stated that the probability of misinterpretation of the Employer's Requirements in D&C projects is higher because of the use of functional specification. This misinterpretation has the consequence that the relationship starts off on the wrong foot, and it could affect the team communication and cohesion. For the overall collaboration in the D&C cases, the low scores on Front-end definition, Team integration, and Joint working processes do not have to mean that there is an adversarial relationship between the client and contractor. In D&C projects there is room for a good understanding between the client and contractor. This was clearly observed in case D&C 1, in which the contractor had the trust and support from the client. This shows that remotely collaborating, with a passive attitude from the client could work. It may not have positive effects on the client-contractor collaboration in general, however the project performance could benefit from it.

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1. Introduction to the research topic

sector will be described. In addition to this the importance of improving the client-contractor collaboration in the future will be covered. The need for new forms of collaboration is also suggested by the main public clients and contractors in the Dutch infrastructure sector. Furthermore, a brief introduction will be provided on integrated contracts and a form of collaboration which is recently increased used in the Dutch infrastructure sector. This chapter ends with the problem statement of this research and a brief overview of the report.

1.2. Poor collaboration in the construction sector

In the past decade the relationship between the client and contractor in the construction sector has been disrupted (Rijkswaterstaat, 2016, p. 3). This disrupted relationship can mainly be characterised as adversarial and distrusting (Laan, Noorderhaven, Voordijk, & Dewulf, 2011; Rietdijk, Noorderhaven, Molier, & van Oijen, 2006). Additionally, this has resulted in a growing number of disputes between the client and the contractor. As a result of the adversarial relationship and the high expenses to resolve the growing number of disputes, construction projects are more likely to cope with time and cost overruns (Chan et al., 2004; Lloyd-walker, Mills, & Walker, 2014).

Although there are several factors causing the poor project performance, the collaboration between the client and contractor seems to be an important factor to the project performance. One research into the collaboration between the client and contractor in capital projects concludes that the aspect of teamworking quality between the client and contractor significantly affects project performance (Suprapto, 2016, p. 214). Another research into success factors in large infrastructure projects, conducted by Adelback and Johansson (2013, p. 40), suggests that one of the success factors is to establish a trust-based relationship between the client and contractor and to solve issues as a joint team.

Research conducted by Cantarelli and Van Wee (2012) covering 78 infrastructure projects in the Netherlands reports that road, railway and bridge/tunnel projects have respectively 62%, 50% and 47% cost overruns on average. The research is composed of projects within a period of 20 years until 2012. Cantarelli and Van Wee (2012) state that the main phases from which the problems occur are the pre-construction phase and the preparation phase, so in the early phase of a project. Due to this recurrent budget overruns, time overruns and maldistribution of risks and responsibilities within projects, doubts have arisen about the current contracts and forms of collaboration (Rijkswaterstaat, 2016).

The public client in the Netherlands, during the last decades, has been outsourcing specialist knowledge towards the market (Rijkswaterstaat, 2016, p. 4). On the other hand, construction projects are getting more complex due to increased uncertainty, technical complexity and time pressure (Rijkswaterstaat, 2016; Stark, Bierly, & R. Harper, 2014; Wisse & Arends, 2017). With less expertise at the public clients and more complex projects this results in an increasing need for good collaboration between the client and the contractor (Spang & Riemann, 2011). However, as mentioned before, that relationship is adversarial and distrusting (Chan et al., 2004; Rietdijk et al., 2006).

Currently, integrated contracts are used frequently in the Netherlands (Rijksvastgoedbedrijf, 2018; van den Heuvel, 2012, p. 22). Observing the aforementioned challenges and the increasing amount of projects with high uncertainty and complexity, contracts or forms of

collaboration in which the client and contractor are collaborating in an early phase seem to be favourable (Rijkswaterstaat, 2016). Such forms of collaboration are known as 'bouwteam' (in English: Early contractor involvement) and project alliances (Chao-Duivis, 2012). The integrated contracts and the early contractor involvement will be elaborated on later in the report.

1.3. The Market Vision

The relevance and need for the improvement of the collaboration and relationship between the client and contractor is confirmed by the development of 'De Marktvisie' (in English: The Market Vision). The Market Vision is a set of generic guidelines drafted by Rijkswaterstaat (RWS) along with contractors, co-clients and scientists. The goal of the Market Vision is to tackle the blame culture and adversarial relationship between the client and contractor in the Dutch construction sector (Rijkswaterstaat, 2016).

1.4. Integrated contracts

In the Netherlands integrated contracts are used more often as a project delivery method since the early 2000's with the introduction of the Uniform Administrative Conditions for Integrated Contracts in 2005 (UAC-IC 2005) (Rijkswaterstaat, 2019). There are several types of integrated contracts, from Design & Construct (D&C or D&B) to Design-Build-Finance-Maintain-Operate (DBFMO) (Lenferink et al., 2013, p. 616; Pianoo, 2018b). An overview of the different types of integrated contracts can be seen in Figure 1.

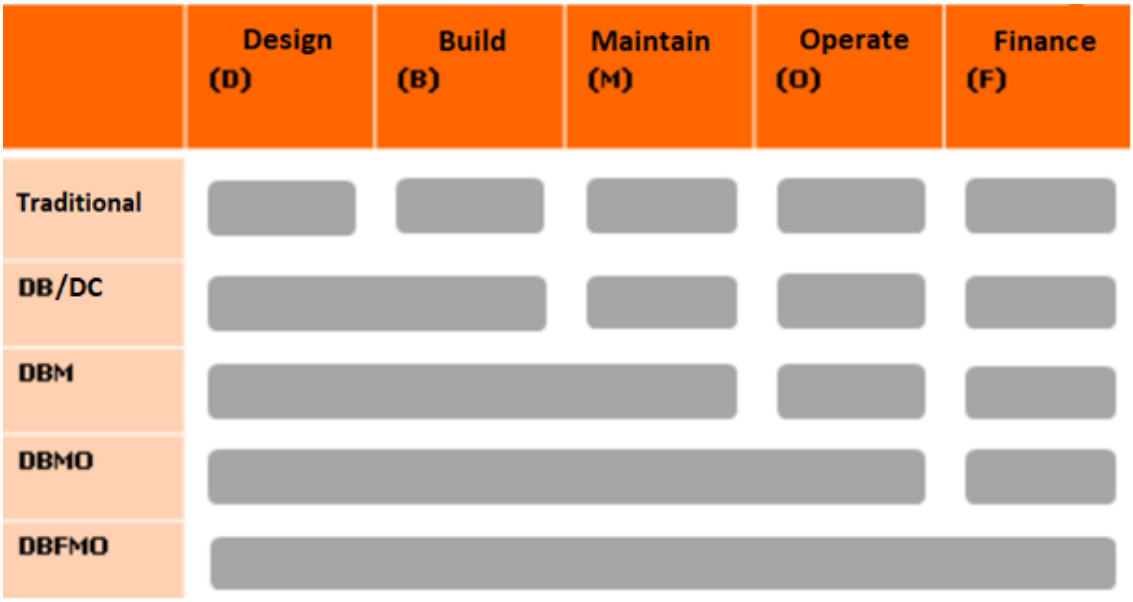

Figure 1: Different types of contracts and their corresponding phases (Pianoo, 2018b).

Within the integrated contracts, the D&C contract is used most often (Lenferink et al., 2013, p. 617; Pianoo, 2018a). The use of traditional contracts such as Design-Bid-Build (DBB) has been reduced (van den Heuvel, 2012, p. 22). D&C is a project delivery system in which the contractor is responsible for both the design and the construction of a project whereas in DBB the client enters into separate contracts with separate contractors for the design and execution (Plusquellec, Cimon, & Lehoux, 2016). The change from a traditional way of working to working in an integrated way is mostly noticeable at the two main public bodies, RWS and ProRail,

changing their policy into transferring more tasks and risks to the market since the market has more expertise on design and construction (Rijkswaterstaat, 2018b).

1.5. Early contractor involvement

ECI is a form of collaboration which is in between traditional contracts and integrated contracts (Chao-Duivis, 2012, p. 22). In ECI the client, contractor, and consultants collaborate in the design phase of the project (Pianoo, 2018c). They form a design team and all members of the design team sign a coordination agreement. The contractor has an advisory role and his task in the design phase is mainly to provide his expertise on costs and the execution of the project (Chao-Duivis, 2012, p. 1; Jansen, 2009, p. 59).

The goal of ECI is to set up a design team using the experience and expertise of the participants, mainly the contractor, and to set up a design (de Koning, 2018). The contractor has the advantage that he is the first and only one to make a bid on the design to execute. If the client and contractor cannot come to an agreement on the price for the execution, the normal tender procedure is followed (de Koning, 2018; Jansen, 2009, pp. 59 - 61). According to Boijens (2008, p. 47) using ECI time could be saved as the design is drafted with the execution knowledge of the contractor at hand. This is in line with Chao-Duivis (2012, p. 1&2), who suggests that a cause for failure costs is the lack of attention to the execution of a design in the preparation phase, resulting in a design which is not feasible to construct. A result of an infeasible design could complicate the relationship from the start.

In recent years, Early Contractor Involvement (ECI) is used more often as a project delivery method in the Dutch infrastructure sector (Koenen, 2019). This trend can be seen looking at number of tenders of ECI. In 2017 there were 16 tenders awarded for ECI projects, in 2018 that number increased to 55 tenders. Furthermore, in only the first four months of 2019 there 27 tenders awarded for ECI projects (Koenen, 2019).

It is important to note that when ECI is mentioned in this thesis, this refers to the whole project from the initiation phase till completion It refers to a project in which the ECI model is used. The term ‘design team’ or ‘design team phase’ is a part of an ECI project. When design team or design team phase is mentioned, it refers only to the design phase of an ECI project in which the client, contractor, and consultant(s) form a design team.

1.6. Assessment tool for collaboration

An extensive research into the collaboration between the client and contractor has already successfully been done by Suprapto (2016). The research was conducted in four stages combining qualitative and quantitative studies in the execution of capital projects (oil platforms, LNG plants, chemical plants, or mass transportation systems) within the process industry competence network. As a result of this research, Suprapto (2016, p. v) developed and validated the RElational CAPability assessment tool (RECAP) to measure the state of collaborative working. RECAP could be applied to measure the soft and relational aspects of collaboration in projects at different stages. The RECAP tool will be used in this research to measure the collaboration between the client and the contractor. An elaboration on RECAP will be given in the literature study later in this thesis.

1.7. Problem statement

All in all, the Dutch infrastructure sector is searching for possibilities to improve the client-contractor collaboration. The problem statement of this research is the poor client-contractor collaboration in Dutch infrastructure projects. This problem is derived from the main focus of the Market Vision drafted by RWS, main contractors, co-clients and scholars.

1.8. Research context

The author of this research is a student of the master program Construction Management and Engineering at the University of Technology Delft. The author is conducting this research as a graduate intern at phbm. Phbm is a consultancy firm with around 20 consultants providing advice in the Dutch construction sector for contractors and public clients. They provide different types of services, such as contract management, project management, process management and risk management. These services can be in different phases of a project, from the tender to the execution of a project. The reason for conducting the research at phbm is their interest in the collaboration within projects. Phbm provided guidance during the research and connections in their network for the cases in the case study. Also, the conclusions of this thesis are validated by experts from phbm.

1.9. Report overview

In this chapter the research topic was introduced. Furthermore, the problem statement of this research was drafted. In the next chapter the research approach of this thesis will be described, by providing the research objective, research questions, research scope and the research design. This thesis consists of a theoretical part and an empirical part. In the theoretical part the literature study on collaboration, ECI and the D&C contract will be conducted. In the empirical part of this research cases studies will be conducted, using the aforementioned RECAP tool. Thereafter, the analysis of the case studies will be provided followed by a discussion on the results of that analysis. Lastly, the final conclusions and recommendations of this research will be provided.

2. Research Approach

2.1. Introduction

In this chapter the research approach of this thesis will be explained. First, the research objective will be provided. Next the research question will be presented. Furthermore, the research scope of this thesis will be provided. The main topics of this research and the problem owners are laid down. The scientific relevance of this research will be explained by reviewing prior studies covering the similar area of knowledge as this research. Lastly, an overview of the research design and the structure of this thesis will be provided.

2.2. Research objective

The main research objective of this research is to contribute to the improvement of the client-contractor collaboration in Dutch infrastructure projects by comparing the collaboration in ECI and D&C projects. This research aims to provide recommendations for managers in the Dutch infrastructure sector to contribute to a more collaborative behaviour. Secondly, this research aims to evaluate the RECAP tool for the Dutch infrastructure sector.

2.3. Research question

The research objective and problem statement are put together to provide a main research question that this thesis aims to answer. The main research question of this thesis is:

What are the differences in the client-contractor collaboration between ECI and D&C infrastructure projects, and what possibilities can be derived from the comparison to improve the collaboration in the Dutch infrastructure sector?

To answer this research question, sub questions have been drafted. The sub questions are as following:

1. What does the client-contractor collaboration entail and what are the success factors to the client-contractor collaboration according to literature?

2. What are the characteristics of ECI and D&C infrastructure projects in the Netherlands?

3. To what extent do the success factors to the client-contractor collaboration apply to the case studies?

4. To what extent is the RECAP tool practical and useful to assess the state of the client-contractor collaboration in Dutch infrastructure projects?

5. What are the differences in the client-contractor collaboration between the ECI and D&C cases?

2.4. Research scope

The scope of this research is limited to the improvement of the client-contractor collaboration in the Dutch infrastructure sector. Projects from abroad and other sectors are out of the scope of this research. Also, other parties than clients and contractors are out of the scope of this research. That is because the addition of other parties in the research would increase the complexity and size of the research. An overview of the scope of this research is shown in Figure 2.

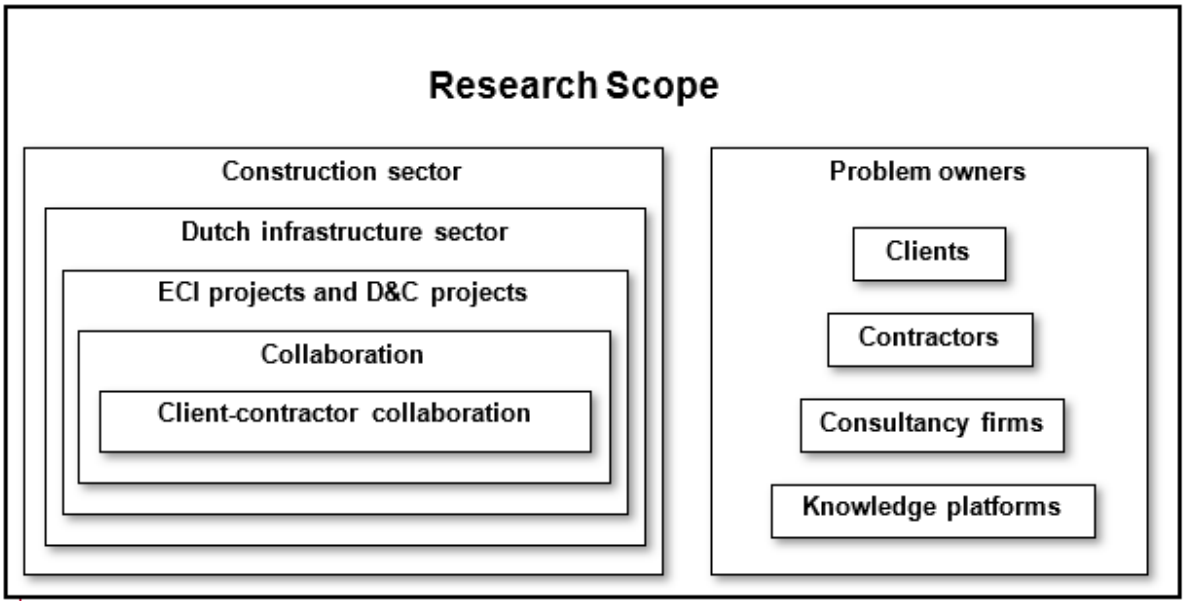

Figure 2: Scope of this research and the problem owners (own ill.)

It is important to state that the researcher does not aim to provide recommendations to improve the project performance. While project performance is important, this research will be solely focused on the aspect of collaboration. The author understands that aspects such as the project performance are also important in a project. However, the current challenge in the Dutch infrastructure sector is mostly on the improvement of the client-contractor collaboration. Firstly, this challenge can be found in the Market Vision (Rijkswaterstaat, 2016, p. 3).

Furthermore, the scope of this research is within ECI and D&C projects. The choice for ECI is because of the recently increasing popularity of this form of collaboration (de Koning, 2018; Koenen, 2017, 2018). Also, the collaborative characteristics of ECI are interesting to investigate. The preparation phase in which the client and contractor are collaborating to draft a design might contain insights which can positively influence the collaboration. The D&C contract is chosen because it is used increasingly more often in the Dutch infrastructure sector (Lenferink et al., 2013, p. 617). Within the integrated contracts, the D&C contract is used the most (Lenferink et al., 2013, p. 617; Pianoo, 2018a).

This research has several problem owners in the construction sector. The research is focused on both the clients' and contractors' perspective. Firstly, the results of this thesis are useful for public clients in Dutch infrastructure projects such as RWS, ProRail, Dutch waterboards and municipalities. Secondly, this research is also useful for contractors involved in Dutch infrastructure projects. Furthermore, problem owners of this research are consultancy firms, such as phbm, specialised in contracting in Dutch infrastructure projects. Lastly, the research

could be useful for knowledge platforms specialised in contracting such as the IBR (Instituut voor Bouwrecht) and CROW.

2.5. Scientific relevance

To show the scientific relevance of this research, prior studies conducted into the main topics of this research will be reviewed. Firstly, multiple studies are conducted over time into success factors for collaboration in the construction sector (Groenewegen, 2013; Meng et al., 2011; Suprapto, Bakker, & Mooi, 2015; Suprapto, Bakker, Mooi, et al., 2015). Some studies aim to provide success factors for collaboration by investigating forms of collaboration, such as project partnering (Adnan, Shamsuddin, Supardi, & Ahmad, 2012; Black, Akintoye, & Fitzgerald, 2000; Bygballe, Jahre, & Swärd, 2010; Chan et al., 2004; Chan, Chan, & Ho, 2003; Larson, 1995; Wattjes, 2010) and alliancing (Laan, Voordijk, & Dewulf, 2011; Lloyd-walker et al., 2014; Officer, 2008). Furthermore, there have also been studies into specific elements of collaboration, such as trust (Kadefors, 2004; Peterson & Behfar, 2003), communication (Doloi, 2009; Hoezen, Reymen, & Dewulf, 2006; Müller & Turner, 2005) and contractual effects on collaboration (Boukendour & Hughes, 2014; Cheung, 2015; Moree, 2013; M. M. Rahman & Kumaraswamy, 2008; Suprapto, Bakker, Mooi, & Hertogh, 2016). Many of these studies will also provide the basis of this research, mainly in the literature study.

Furthermore, there have also been studies into ECI (Lenferink, Arts, Tillema, van Valkenburg, & Nijsten, 2012; van Wijck, 2018; Wondimu et al., 2016), integrated contracts (Chan, Ho, & Tam, 2001; de Schipper, 2007; Plusquellec et al., 2016) and Project DOEN (ten Hoeve, 2018). A gap in the scientific knowledge is the effect of ECI on the collaboration, there are only a few sources covering that aspect. The sources merely cover the potential opportunities. This thesis aims to contribute to the scientific knowledge on the effects of ECI on the client-contractor collaboration(M. Rahman & Alhassan, 2012).

Recently, a master thesis by ten Hoeve (2018) has been published with some similarities to this research. However, that study is different as it is more focused on the methods and clauses of NEC4 ECC and Project DOEN that may improve the collaboration. His research focuses on Project DOEN. This research is not focused on Project DOEN. The main focus is on ECI projects and D&C projects. Also, with the use of the RECAP tool and the comparison of the collaboration between ECI projects and D&C projects this research should provide different perspectives.

Lastly, one of the main elements of this research is the use of the RECAP tool, developed by Suprapto (2016), to assess the state of the client-contractor collaboration. This study aims to further develop that tool in a different sector. The RECAP tool has not been used in the context in which it is used in this research, the Dutch infrastructure sector.

2.6. Research overview

In this research, several research methods will be applied to answer the sub questions and the main research question. An overview of the complete research design is shown in Figure 3.

Firstly, a literature study will be conducted into collaboration and the contracts which form the theoretical background of this research. This will be done in chapter 3 and 4. In the introduction of chapters 3 and 4 the methodology of the literature study will be provided. As a result of the literature study, the elements and success factors for a collaborative relationship are provided. This will give an insight into the current knowledge of those topics and in chapter 3 sub question 1 will be answered. Also, the RECAP tool will be elaborated on in chapter 3. The RECAP tool is used later in the research for the case studies. In chapter 4, the different model of contracts covered in this research will be elaborated on. By conducting literature study in-depth insights will be gained into the ECI model and the D&C contract. As a result of this, sub question 2 will be answered.

Secondly, the case studies will be conducted regarding the ECI and D&C cases. The methodology, selection criteria, overview and the results of the case studies will be provided in chapter 5. The case studies will provide an insight into the state of the client-contractor collaboration in the ECI and D&C cases. In chapter 5 sub questions 3 and 4 will be answered.

In chapter 6 the analysis of the case studies from chapter 5 will be conducted and described. The client-contractor collaboration in the ECI cases will be compared to that of the D&C cases. This is done to show the differences in collaboration between ECI projects and D&C projects. Furthermore, the differences observed in the case studies will be linked to the literature study. In chapter 6 sub question 5 will be answered.

The findings observed in chapters 5 and 6 provide the input for the expert validation in chapter 7. The expert validation gives an insight into the validity of the findings. When for instance the experts on average agree with a statement, that statement is more likely to be true in practice. This process strengthens or weakens the findings as it indicates if the identified statements holds in projects according to industry experts.

In chapters 8 of this thesis the discussion will be provided. In the discussion of this research remarkable aspects in this research will be provided. Furthermore, the limitations of this research will be described.

Lastly, chapter 9 consists of the answers to all the sub questions. These answers will be connected to provide an answer to the main research question. Furthermore, in this chapter recommendations regarding possibilities to improve the client-contractor collaboration in the Dutch infrastructure sector will be provided. These recommendations are aimed at the parties involved in the Dutch infrastructure sector: public clients, contractors and consultancy firms. Also, recommendations for future research will be provided.

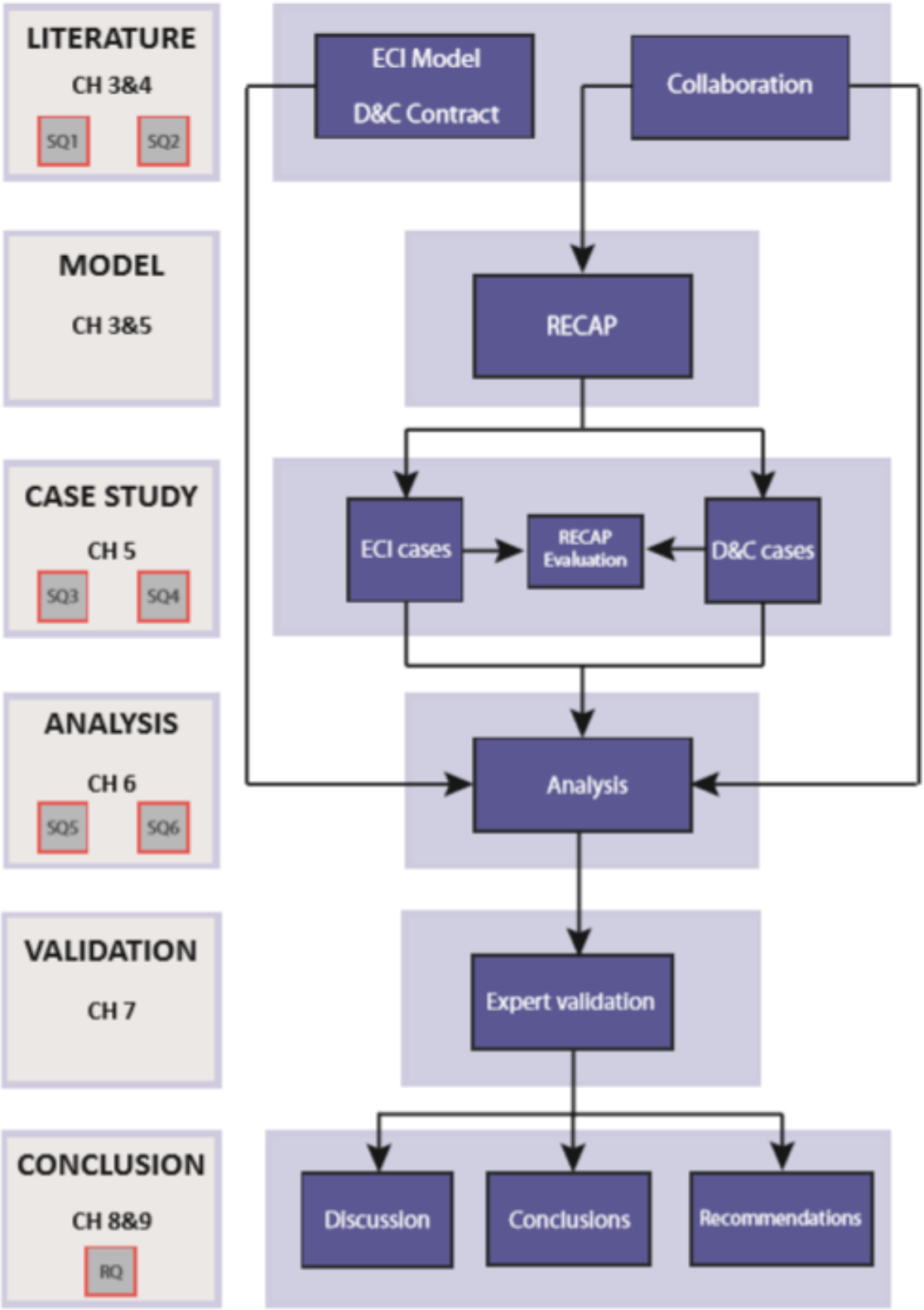

Figure 3: Overview of the research design. (own ill.)

3. Collaboration

3.1. Introduction

In this chapter the literature study on collaboration between the client and contractor is provided. The chapter starts with a description of the used methodology for conducting the literature study. Next, the definition of the term 'collaboration' within the context of this research is described. Subsequently, a collaborative relationship is defined in the context of this research. Lastly, literature on the success factors of the client-contractor collaboration is researched. An overview of the structure of this chapter is depicted in Figure 4. Also, in this chapter the required theoretical background is provided for the empirical research in chapter 5 and 6 of this thesis. This will be done by explaining the RECAP tool at the end of this chapter. In this chapter sub question 1 will be addressed:

1. What does the client-contractor collaboration entail and what are the success factors to the client-contractor collaboration according to literature?

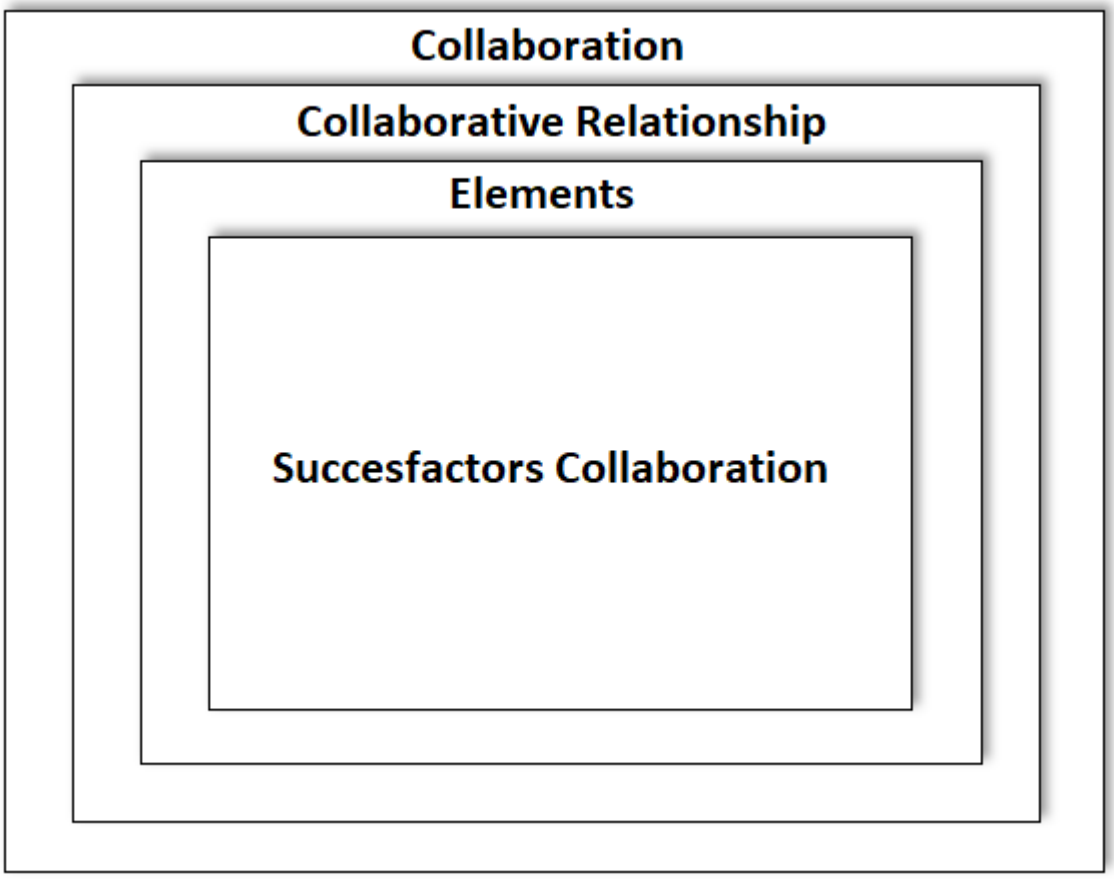

Figure 4: Overview of the chapter. (own ill.)

3.2. Methodology

By researching relevant literature about collaboration, the researcher provides the theoretical background of this research as collaboration is the main subject of this research. To gather articles mostly internet databases are used, such as: ASCE Library, Emeraldinsight, Google Scholar, Science Direct, Scopus and WorldCat. To find articles relevant for sub questions 1 and 2, the author searched the databases using the following key words: collaboration definition, collaboration, collaboration elements, collaboration factors, collaboration success factors, construction sector collaboration, infrastructure collaboration, client contractor

collaboration, client contractor collaboration construction sector, client contractor collaboration infrastructure sector, collaborative relationship, definition collaborative relationship, partnering, partnering in construction, relational contracting and collaborative relationship client contractor. Besides these databases the author also used several journals to search for relevant articles, such as: Journal of purchasing and supply management, Journal of Management in Engineering, Journal of Construction Engineering and Management, Construction Management and Economics and International Journal of Project Management. Furthermore, the TU Delft library was also used to obtain relevant books and e-books.

It is important to note that while these databases and journals are used to obtain relevant articles and books, not all mentioned databases and journals provided relevant articles that are actually used in the literature study. There were some articles and books found which were relevant, but not recent anymore. While the author aims to obtain only recent articles and books, in some cases there was no recent literature available. In those cases, older relevant literature is used in the literature study.

Lastly, it is important to note that even though the scope of this research is on the Dutch infrastructure sector, in this chapter articles from around the world will be used. This is done because of two reasons. Firstly, the available articles for collaboration in the Dutch sector is limited. Secondly, the different definitions and element for collaboration is internationally regarded as comparable. This will also be shown in paragraph 4.4 with the comparison of the success factors for collaboration in different countries.

3.3. Definitions

In this paragraph the commonly used definitions of collaboration and collaborative relationships will be described and reviewed for the context of this research. This is done to show the reader that the topic of collaboration is broad and to show the reader that to investigate collaboration, the definition used in the research is necessary and important (Eriksson, 2010, p. 906). The definition of a collaborative relationship within the context of this research will be described at the end of this paragraph.

3.3.1. Collaboration

The Oxford (2018) dictionary defines “collaboration” as: “the action of working with someone to produce something”. This definition is generic and not specifically aimed at a particular sector. Another definition by Chan et al. (2003), in the context of a project, is: “the simple process of establishing good working relations between project parties”. In this definition the description of “the simple process” seems to be contradicting because collaboration is seen as a challenging and highly complex task, not a simple process (Xue, Shen, & Ren, 2010, p. 197). In that sense, a more specific definition of collaboration in construction projects is stated by Kalay (2001, p. 741) as: “the agreement among specialists to share their abilities in a particular process, to achieve the larger objectives of the project as a whole, as defined by the client”. The latter is used as the definition of collaboration within the context of this research.

3.3.2. Collaborative relationship

There has been extensive research conducted into collaborative relationships. Suprapto, Bakker, Mooi, et al. (2015) state that there are two types of relationships in projects: adversarial and collaborative. An adversarial relationship is not desired as it is assumed that it leads to opportunistic behaviour and confrontations between the client and the contractor (Suprapto, Bakker, Mooi, et al., 2015, p. 665). Collaborative relationship is more desirable. Collaborative relationship is a term used interchangeably to define contractual agreements such as project alliances, project partnering, relational contracting and Public-Private Partnerships (PPP) (Eriksson, 2010; Suprapto, 2016, p. 18). These terms define a 'positive' collaborative relationship with characteristics such as: aligned goals and interests, open and honest communication, mutual trust, joint problem solving and dispute handling among parties (Suprapto, 2016, pp. 18, 19). In those practices and agreements, collaboration is mostly in a formal setting and in some cases the collaborative agreement is legally binding (Kamminga, 2009, p. 6).

Xue et al. (2010) provides a clear definition of collaborative working, also a term used interchangeably for collaborative relationships. The research presents an extensive review of 94 papers published in seven well-known construction management journals to analyse the state of the art and trends of collaborative working in construction projects. Xue et al. (2010, pp. 196, 197) defines collaborative working as: "the joint working or working together of project stakeholders or different organizations to effectively and efficiently accomplish a product". Here, "joint working" or "working together" means that stakeholders work with others with shared goals for which the team attempts to find solutions that are satisfying to all concerned (Xue et al., 2010, p. 197). The part of "to effectively and efficiently accomplish a product" refers to the project performance. While this definition is commonly used and cited, the definition will only be party used. As mentioned before the research is scoped on the improvement of collaboration and not on the project performance.

In the academic literature a commonly cited and more specific definition for construction partnering is that by Bygballe et al. (2010, p. 239): "…a long-term commitment between two or more organisations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organisational boundaries. The relationship is based on trust, dedication to common goals, and understanding of each other's individual expectations and values." This definition is quite specific and does consist some overlapping characteristics mentioned in the definition of Xue et al. (2010). However, there are two remarks to be made of that definition regarding the Dutch infrastructure sector and the context of this research. Firstly, "a long-term commitment" is out of the scope of this research, as the relationships in ECI and D&C projects are purely the length of one project. Secondly, the definition suggests changing traditional relationships to a shared culture without regard to organisational boundaries. While this seems obvious, traditional relationships maintain a certain power distance between the client and the contractor (Rahat, 2014, p. 52). In his research into potential barriers for adopting project alliancing, which is a form of relational contracting, in the Netherlands Rahat (2014, p. 108) concludes that organizational change is of the main barriers as the senior management prefers control over trust.

Suprapto, Bakker, Mooi, et al. (2015, p. 665) define an owner-contractor collaborative relationship in a project as: "the behavioural interaction between owner 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." This definition is characterized by commitment, cooperation and connectedness of the client and contractor towards a common goal (Suprapto, Bakker, Mooi, et al., 2015, p. 665). The definition is based on a review of related literature on alliances, partnering, supply chain management, relational contracting and integrated teamwork.

In a research into supply chain relationships in construction, conducted by Meng et al. (2011), a Maturity Model was developed as result of reviewing existing models. This model is used in this section for the purpose of placing the term 'collaborative relationships' into context compared to other levels of collaboration. While that research does not define the owner-contractor relationship in a sentence, Meng et al. (2011, p. 101) does define four maturity levels of that relationship, shown in Figure 5 below. In summary the four maturity levels are explained as following:

- At Level 1, called price competition, the relationship between the client and contractor(s) characterized as adversarial and based on a win-lose situation. Parties take extreme positions for self-interest and mistrust towards other parties. There are no mutual objectives at all, parties are focused to achieve their own objectives and profit margins. The relationship is based on price competition with the trust between parties limited to their commitment to the formal contract (Meng et al., 2011, pp. 101 - 103).
- At the second Level, quality competition, the parties are mostly focused on achieving their own objectives and interests. While mutual objectives are not set up beforehand, a win for both parties enables a limited degree of collaboration. The trust between parties is based on the mutual understanding of the other's capabilities to carry out the assigned tasks. The difference with Level 1 is that the competition is based on quality, instead of price (Meng et al., 2011, pp. 101 - 103).
- At Level 3, project partnering, objectives of parties are aligned in a single project. The parties become partners trying to achieve the aligned objectives by collaborating as an integrated project team. There is goodwill trust between the partners and the relationship is established on a win-win philosophy (Meng et al., 2011, pp. 101 - 103).
- The relationship at Level 4, strategic partnering/alliance, is somewhat comparable with Level 3 with the difference being that at Level 4 the collaboration is focused on the long-term relationship. The relationship is based on full, but fair, sharing gains and risks and trust is at the highest degree because all parties try to achieve the best value (Meng et al., 2011, pp. 101 - 103).

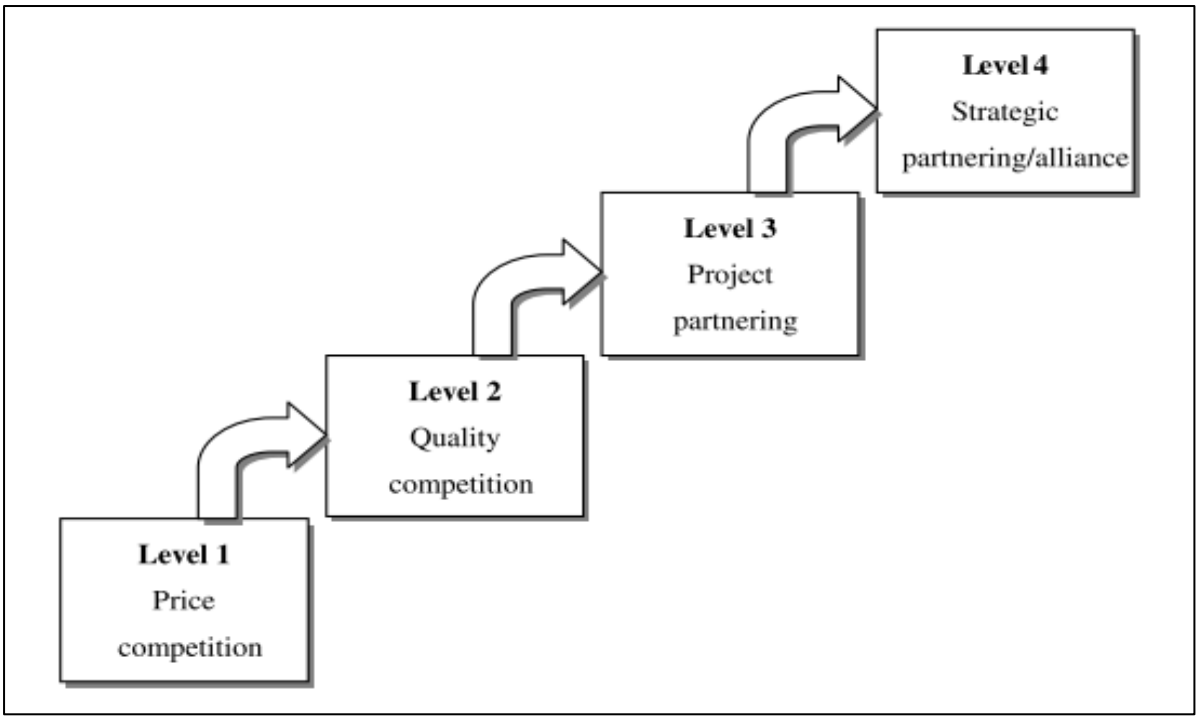

Figure 5: Construction supply chain maturity levels. (Meng, Sun, & Jones, 2011, pp. Fig.1 ,p101)

3.3.3. Collaborative relationship in the context of this research

Now that several definitions of a 'collaborative relationship' are described and reviewed, the used definition in the context of this research can be drafted. Furthermore, collaborative relationship in the context of this research will be placed within the Maturity Model of Meng et al. (2011). The mentioned definitions are shown in Table 2 Based on the definitions of 'collaboration' and 'collaborative relationships' that have been provided and reviewed, the definition of a collaborative relationship in the context of this thesis is as following:

"The joint working and behavioural interaction between the client and contractor(s) based on mutual values and norms for the purpose of achieving the larger objectives of the project, as defined by the client, by maximising the effectiveness of each participant's resources and sharing their abilities."

Regarding the maturity levels of Meng et al. (2011) the definition of collaborative relationships in the context of this research can be placed at Level 3. Level 4 of the Maturity Model suggests a more collaborative relationship based on full, but fair, sharing gains and risks and trust is at the highest degree because all parties try to achieve the best value (Meng et al., 2011, pp. 101 - 103). However, Level 4 is also characterized as: "the alignment of objectives over a series of projects, which focuses on the long-term relationship"(Meng et al., 2011, p. 101). This aspect is outside of the scope of this research, as this research is focused on the client-contractor collaboration within a single project.

Author(s)	Term	Definition
Oxford (2018)	Collaboration	The action of working with someone to produce something
Chan et al. (2003)	Collaboration in the context of a project	The simple process of establishing good working relations between project parties
Kalay (2001)	Collaboration in construction projects	The agreement among specialists to share their abilities in a particular process, to achieve the larger objectives of the project as a whole, as defined by the client
Xue et al. (2010)	Collaborative working	The joint working or working together of project stakeholders or different organizations to effectively and efficiently accomplish a product
Bygballe et al. (2010)	Construction partnering	…a long-term commitment between two or more organisations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organisational boundaries. The relationship is based on trust, dedication to common goals, and understanding of each other's individual expectations and values
Suprapto, Bakker, Mooi, et al. (2015)	Collaborative relationship	the behavioural interaction between owner 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

Table 2: Definitions of collaboration and collaborative relationship. (own ill.)

3.4. Elements of a collaborative relationship

While there have been many existing studies conducted on collaboration within the construction sector, this research will focus on the RECAP assessment tool by Suprapto (2016, pp. 179 - 206). It is important to clarify that the RECAP tool is based on chapters 2 to 6 of Suprapto's dissertation, but not all chapters will be reviewed in this section. Chapter 2 will be discussed, as in that chapter the elements of a collaborative relationship are identified.

To identify the different elements of collaborative relationships in projects, Suprapto (2016, p. 19) conducted an in-depth literature review of 11 articles which are based on empirical studies. These articles and the elements are shown in Appendix C. The elements of collaborative relationships are shown in Table 3, and can be categorized as following (Suprapto, 2016, pp. 19 - 23):

- Owner and contractor capabilities (CAP);
- Relationship indicators (RI);
- Relationship practices (RP);
- Relational attitudes (RA).

The category, owner and contractor capabilities, consists of elements concerned with capabilities of the involved parties. Firstly, it recognizes the capabilities of the contractor, which is the basic requirement in current procurement procedures. Secondly, the owner's knowledge and skills in specific areas are also important elements because of the increasing complex projects. This category furthermore contains the element of commitment and support from the top management of both the client and contractor. Also, the parties involved in the relationship should have sufficient financial capacity and prior relationship experience (Suprapto, 2016, pp. 19, 20).

The second category, relationship indicators, is mainly about elements concerned with the jointly alignment of objectives, vision and trust. These elements are often mentioned in literature on collaboration. Furthermore, this category consists of an open and two-way communication with sharing information. Lastly, all parties are treated equal, with 'no blame' attitude and clear responsibilities (Suprapto, 2016, p. 23).

The third category, relationship practices, is about the practices and processes intended to enable the relationship indicators of collaborative relationship. The parties work together as an integrated team by sharing knowledge, solving problems together and constant monitoring. This category also contains the element of involving the contractor as early as possible to establish a positive relationship during the front-end phase (Suprapto, 2016, p. 23). For this element a remark should be made concerning the European procurement laws, as there are strict laws for involving a contractor during the front-end phase.

The last category, relational attitudes, is about the orientation and willingness of the parties towards added values, sharing knowledge and information and different corporate values. Also, elements of awareness of opportunistic behaviour and of other's roles and responsibilities are within this category Suprapto (2016, p. 23).

Category	Elements
Owner and contractor capabilities	Owner's technical capability
	Top/senior management commitment and support
	Financial strength
	Prior relationship experience
Relationship indicators	Goal aligning, shared vision, and mutual objectives
	Mutual trust and trust-based arrangement
	Open and honest communication
	"No blame" culture attitudes
	Balance or equitable participation
	Clear definitions of responsibilities
Relationship practices	Joint problem solving and active dispute resolution
	Knowledge sharing
	Integrated team working
	Continuous improvement
	Contractor's early involvement
	Performance measurement and benchmarking
	Risk-reward or gain-pain sharing scheme
	Joint risk management
Relational attitudes	Long-term orientation/commitment
	Adequate resources or willingness to share resources
	Organizational cultural compatibility
	Owner's commitment and support
	Expectation of future work
	Reflection and self-assessment

Table 3: Categorization of the 24 elements. Self-made illustration based on Suprapto (2016, pp. 21 - 22).

3.5. Success factors for client-contractor collaboration

In this section the success factors for client-contractor collaboration are identified. As mentioned before, the RECAP is based the success factors identified by Suprapto, Bakker, Mooi, et al. (2015). In this section that research by Suprapto, Bakker, Mooi, et al. (2015) will be elaborated on.

Based on the results of the review of the aforementioned empirical studies, Suprapto, Bakker, Mooi, et al. (2015) conducted a Q-factor analysis with 30 project practitioners from both the side of the client and the contractor in the Netherlands. The fact that the research is conducted in the Netherlands is an important reason to choose for the RECAP tool. The RECAP is based on the elements (in the previous paragraph) and the success factors described below. The respondents have experience with different types of contracts. The respondents were asked to rank 55 statements in a scale from -5 (most disagree) to 5 (most agree), with the main question: "in order to improve owner-contractor relationship it is important that..."(Suprapto, 2016, p. 82). The 55 statements were collected from 10 interviews with project directors and senior project managers, popular literature, journal articles and popular articles from websites and blogs (Suprapto, 2016, p. 81).

The research resulted into an overall rank of the statements across four perspectives: shared team responsibility, execution focused team, joint capability and structure and senior leadership pair (Suprapto, 2016, pp. 84 - 91). The ranking was highlighted by the top 15 statements (most positive) and the bottom 15 statements (most negative) according to the mean Z-scores. The ranking is shown in Figure 6 below.

The first perspective of shared team responsibility is built on the view that the client-contractor relationship can be improved by focusing on a common vision, collectively feel responsible, support and trust in each other (Suprapto, 2016, p. 96). Moreover, the pre-established Relational attitudes (no blame culture, open and honest communication, and mutual respect) are more effective to improve the working relationship. It is notable that the factor of a contract is seen as not effective for managing the relationship (Suprapto, 2016, p. 96). This is important in the context of this thesis, as in this thesis the collaboration will be compared between ECI, D&C and Project DOEN. Furthermore, Suprapto (2016, p. 96) states that performance management, joint risk management, and recognition and rewards program are regarded as positive practices to improve the Teamworking quality. Lastly, the elements of technical capabilities, owner's and contractor's capabilities and personnel competencies are regarded as requirements, but not factors improving teamworking (Suprapto, 2016, p. 96).

The perspective of execution focused team is built on the view that the client-contractor relationship can be improved by focusing on trust and common vision, this is also partly mentioned in the perspective of shared team responsibility (Suprapto, 2016, p. 96). Different to the first perspective, this perspective regards the role of senior management and support as important. Also, the client should acknowledge contractor's trust and interest (Suprapto, 2016, p. 96). It is notable that this perspective considers the contract of importance to teamworking to set performance targets. Also, interesting for this thesis, early contractor involvement in the front-end phase is considered unnecessary and might complicate the relationship in the execution phase (Suprapto, 2016, p. 96).

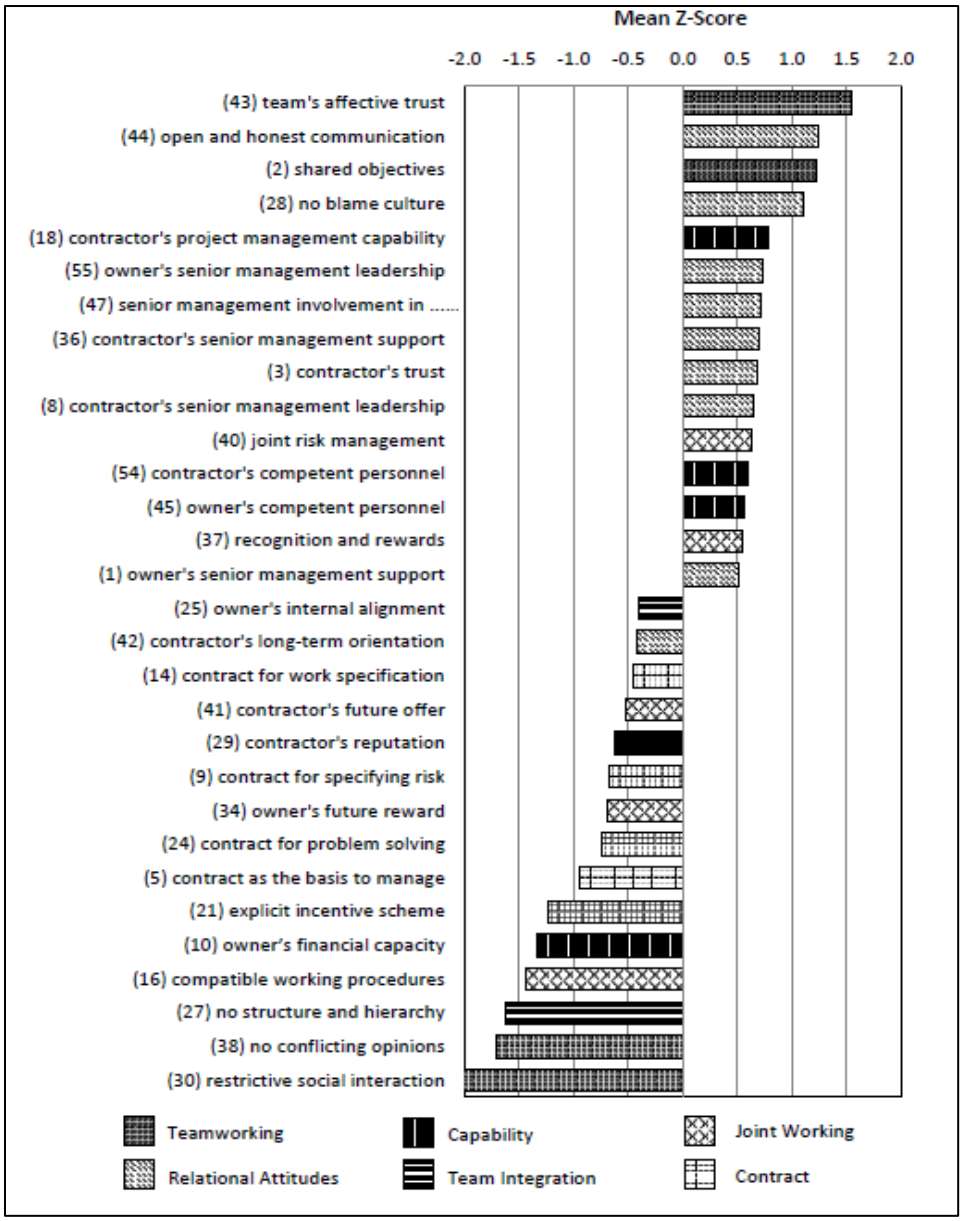

Figure 6: Top 15 and bottom 15 statements across perspectives. (Suprapto, 2016, p. 92)

The third perspective of joint capability and structure is built on the view that the formation of the client-contractor relationship lies in the front-end phase of the project. This perspective also regards trust in each other and a common vision as important for teamworking (Suprapto, 2016, pp. 96, 97). In contrast to the perspective of shared team responsibility, this perspective regards the client's and contractor's capability as critical to a successful relationship. Also, the Relational attitudes such as no blame culture, open and honest communication, and the role of senior management and its support are regarded as useful but not necessary (Suprapto, 2016, p. 97). The element of the contract is regarded as only important to structure the responsibilities and not important for improving the relationship (Suprapto, 2016, p. 97).

The last perspective of senior leadership pair is built on the view that full alignment at senior management level is key to the client-contractor relationship (Suprapto, 2016, p. 97). The elements of trusting each other, respect of differences, no blame culture and open and honest communication should characterize the client-contractor collaboration. Practices such as early

contractor involvement and the client's and contractor's capabilities are also regarded as important for the collaboration (Suprapto, 2016, p. 97). The contract is also considered as the least important element for the relationship, just like the perspective of shared team responsibility (Suprapto, 2016, p. 97).

In summary the research resulted in the following success factors for client-contractor collaboration, categorised into 5 general factors (Suprapto, 2016, p. 98):

1. **Relational attitudes:** includes senior management commitment and relational norms
2. **Collaborative practices:** includes team integration and joint working procedures
3. **Teamworking quality:** includes inter-team communication, coordination, balanced contribution, aligned effort, mutual support, cohesion, and affective trust
4. **Front-end definition:** includes the ability to comprehend the scope, design, plan and responsibilities
5. **Joint teams' capabilities:** includes the client's project team capability and contractor's project team capability

In Appendix E these success factors are compared to other comparable studies into the success factors for collaboration.

3.6. Relational capability assessment tool (RECAP)

Simply put, the RECAP tool is based on the empirical and literature studies conducted by Suprapto (2016) for the purpose of his dissertation. The RECAP tool is based on the study into the success factors mentioned in paragraph 3.5. Not all success factors are adapted in the RECAP tool, that will be explained later in this section. Furthermore, in Appendix D the RECAP tool is compared to the Maturity Model developed by Meng et al. (2011).

After an empirical study in chapter 4 six factors were tested and five of the factors were perceived as most important to improve client-contractor relationship. Contractual aspects in a project setting were perceived relatively less important according to the practitioners in that empirical study (Suprapto, Bakker, Mooi, et al., 2015, p. 678). Later in chapter 5 and 6 (Suprapto, Bakker, & Mooi, 2015; Suprapto et al., 2016), the general factors were restructured after a survey study. Those general factors are (Suprapto, 2016):

1. Relational attitudes which include senior management commitment and relational norms
2. Collaborative practices which include team integration and joint working procedures
3. Teamworking quality which consists of inter-team communication, coordination, balanced contribution, aligned effort, mutual support, cohesion, and affective trust
4. Front-end definition
5. Joint teams' capabilities which consist of owner's team capability and contractor's team capability

As a result, factors 3 and 4 (Teamworking quality and front-end definition) were perceived as direct predictors to project performance. Factors 1,2 and 5 were perceived as indirect predictors to the performance, through Teamworking quality (Suprapto, 2016, p. 183).

The RECAP tool does not directly assess all criteria mentioned above. It consists of six main criteria: Front-end definition, Collaborative practices, relational attitudes, Teamworking quality, Project performance, and Relationship continuity (Suprapto, 2016, p. 183). The factor of the teams' capabilities is not included in the RECAP tool as a criterion, as the purpose of the tool is to measure relational capabilities in the relationship rather than the individual capabilities of each member of the team (Suprapto, 2016, p. 183). The six criteria are further categorized into two groups: relational capability and project performance. The criteria included in the category of relational capability are: Relational attitudes, Teamworking quality, Collaborative practices, and Front-end definition. Project performance and Relationship continuity are included in category of project performance (Suprapto, 2016, p. 183).

The main criteria of front-end definition and Relationship continuity are assessed directly and not further broken down into sub-criteria. The other criteria are assessed indirectly by breaking them down into sub-criteria. In total, the RECAP tool consists of 17 sub-criteria and 72 indicators (Suprapto, 2016, p. 184). The main criteria and sub-criteria, and their definitions are shown in Table 4. The assessment form and procedure with steps and all indicators can be found in Appendix A.

Criteria	Sub-criteria	Definition
A. Front-end definition	1. Front-end definition	The ability to comprehend the project scope, basic design, execution plan, and roles and responsibilities (5 indicators).
B. Collaborative practices	2. Team integration	The extent to which the owner and the contractor teams are structured and integrated as a single team with no apparent boundaries (5 indicators).
	3. Joint working processes	The extent to which the owner and the contractor teams perform joint working processes (7 indicators).
C. Relational attitudes	4. Senior management commitment	How well the senior management of the owner and the contractor commit to support the collaboration (5 indicators).
	5. Senior management trust	The extent of mutual trust between firms (4 indicators).
	6. Established relational norms	Norms of no blame culture, win-win, and communication openness (7 indicators).
D. Teamworking quality	7. Communication	The extent of to which the teams communicate with each other effectively (4 indicators).
	8. Coordination	The extent to which the teams achieve synergies in coordinating interdependent activities (3 indicators).
	9. Balanced contribution	The extent to which the teams contribute their specific knowledge and expertise (3 indicators).
	10. Aligned effort	The extent to which the teams align their effort (3 indicators).
	11. Mutual support	The extent to which the teams help each other in achieving project goals (3 indicators).
	12. Cohesion	The extent to which the teams behave as one team (4 indicators).
	13. Affective trust	The extent to which the teams' members personally trust each other (6 indicators).
E. Project performance	14. Efficiency	The extent to which the project meet the planned budget and schedule (2 indicators).
	15. Quality	The extent to which the project progressed or completed safely, meeting the targeted quality, reliability, operability (4 indicators).
	16. Satisfaction	The perceived overall satisfaction and business or commercial success (3 indicators).
F. Relationship continuity	17. Relationship continuity	The perceived intention to continue the relationship in future (4 indicators).

Table 4: Criteria and sub-criteria of the relational capability assessment tool (RECAP) (Suprapto, 2016, p. Table 7.1)

3.6.1. Applying the RECAP tool in this research

As mentioned before, for the case studies in this research RECAP will be used to assess the state client-contractor collaboration. RECAP will be used in the exact same format, with the same criteria and indicators. This is done to further validate the applicability of RECAP, as Suprapto (2016, p. 198) states:

"RECAP could be used for any projects with any contracts because the assessment criteria/sub-criteria were generic and independent of any prescription models of collaboration as long as the senior management and project managers of both sides are willing to engage in a collaborative relationship" (Suprapto, 2016, p. 198).

The author aims to further develop the RECAP tool in the Dutch infrastructure sector. This means that some aspects of the RECAP tool might be changed. The RECAP tool in this research is translated to Dutch, as that would ease the communication with the respondents in the case studies. Also, the English terms used in the RECAP tool may cause confusion. The translated version of the RECAP tool can be found in Appendix B. During the course of this research, the RECAP tool, its layout and translation of terms may have changed. However, the changes in translating the terms will be done after receiving all the forms from the respondents. This is done afterwards because changing the translated terms could influence the results.

In the first round of the RECAP, the assessment form will be filled in by the respondents. The respondents will form a set consisting of respondents of the side of the client and respondents of the side of the contractor. This will be done separately for each case. The respondents will be asked to assign scores for all 72 indicators from 1 to 5 (from very poor to very good), NA (not applicable) or DK (do not know). These scores will then be entered into a spreadsheet containing all sub-criteria and main criteria. Then the score of each sub-criterion will be calculated by averaging the score of each corresponding indicator. The score of the sub-criteria will then be averaged to calculate the score of the corresponding main criterion (Suprapto, 2016, p. 185). The scores by criteria and sub criteria from both the client's side and the contractor's side will be compared side-by-side including the gaps in the scores. These gaps are important for the research, as the gaps can reveal potential dysfunction in the relationship. The gaps could indicate specific aspects of the collaboration which can be improved (Suprapto, 2016, p. 185. In order to further develop the tool each interviewee will be asked to provide suggestions regarding the practicality, usefulness and improvements on RECAP. These suggestions will be described in the conclusion of this thesis.

The second round of the RECAP tool consists of a semi-structured interview. By conducting semi-structured interviews all questions and answers within the interview are not predetermined, questions for introduction purposes are predetermined. However, in semi-structured interviews the subjects of the interviews are predetermined. A topic-list will be set up of all the topics that will be discussed during the interviews (Baarda, de Goede, & Teunissen, 1995, pp. 133, 134). Using semi-structured interviews, the interviewees have the opportunity to provide more input for the research instead of using fully-structured interviews with predetermined questions (Baarda et al., 1995, pp. 130, 131). The interview will be done with every respondent separately, to limit the possibility of bias towards the other party. The interview protocol can be found in Appendix G. It is important to note that it could occur that

not all questions of interview protocol will be asked. The reason for this is that the interviews will be based on the gaps of 1,0 in the scores and notable scores.

Thereafter, the scores of each project will be mapped in a capability-performance matrix with two axes: relational capability on the x-axis and project performance on the y-axis. An example of this matrix is shown in Figure 7. Furthermore, four quadrants can be identified. In the first quadrant, low capability and low performance, both the collaboration and performance are below average (Suprapto, 2016, p. 197).. The participants will likely be dissatisfied with the results and the collaboration. The second quadrant, high capability and low performance, means that the participants paid attention to team working and Relational attitudes and practices (Suprapto, 2016, p. 197). However, the project results or the Relationship continuity were below average. Quadrant three is the most ideal position, high capability and high performance, with above average scores for both relational capability and project performance (Suprapto, 2016, p. 197). The last quadrant, low capability and high performance, shows lack of attention to Relational attitudes and practices but with an above average score for performance. This quadrant suggests a position in which other aspects than relational capability factors might have affected the project results (Suprapto, 2016, p. 197).

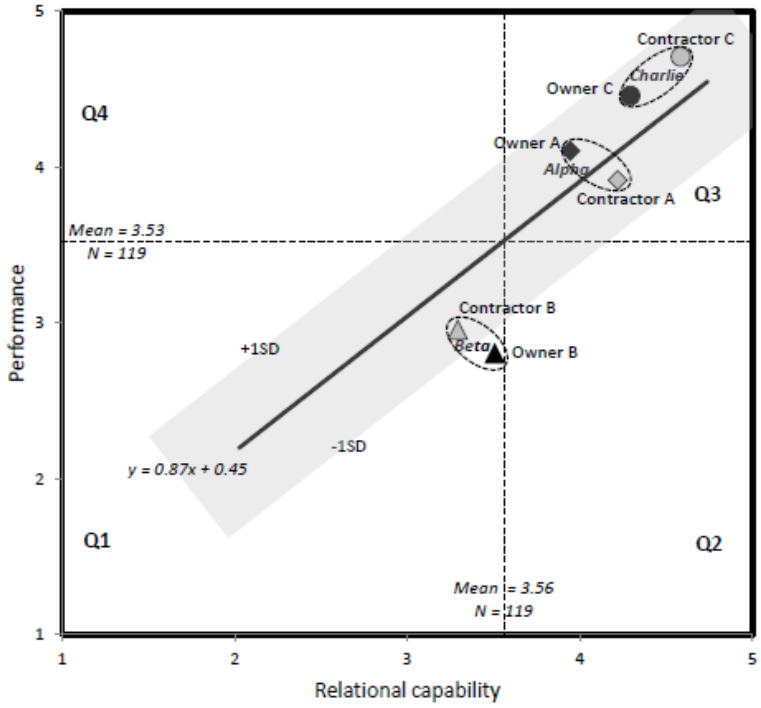

Figure 7: Example of mapping projects into the capability-performance matrix (Suprapto, 2016, pp. Figure 7-9)

3.6.2. Link to the case study

As described in chapter 2 of this thesis, the effects of the client-contractor collaboration within ECI and D&C projects on the project performance are outside of the research scope of this study. Because the relation between the client-contractor collaboration and the project performance is outside of this research, some adjustments are needed to analyse the results. The analysis of the case studies (chapter 6 of this thesis) will only be on the collaborative criteria of RECAP. The project performance will be shown in the results, but this is only used to provide the context of each case in relation to the other cases in this research.

The same RECAP assessment form will be used, as it is used in the study conducted by Suprapto (2016). The collaborative criteria in RECAP which are used for the analysis of the cases are shown in Table 5. These criteria are used to assess the success factors to the client-contractor collaboration, as provided in chapter 3.5. In the Table 5 the main criteria are shown with the corresponding sub-criteria. Furthermore, the average scores of the contractor and the average scores of the client are shown for each sub-criterion. In chapter 6 of this thesis, this table is modified to show the steps of the analysis.

		Case number	
Main-criteria	**Sub-criteria**	**Scores contractor**	**Scores client**
Front-end definition	Front-end definition		
Collaborative practices	Team integration		
	Joint working		
Relational Attitudes	SM commitment		
	SM trust		
	Relational norms		
Teamworking quality	Team communication		
	Team coordination		
	Balanced contribution		
	Team mutual support		
	Alignment of effort		
	Team cohesion		
	Team affective trust		

Table 5: The collaborative criteria which are used for the analysis of the case studies (Own ill.)

3.7. Conclusion

In this chapter the literature study on collaboration is conducted. Firstly, the definitions of 'collaboration' and 'collaborative relationship' were drafted in the context of this research. Thereafter, the elements of a collaborative relationship were described and the success factors for a collaborative relationship were provided. Based on the literature study in this chapter, sub question 1 of this thesis can now be answered:

What does client-contractor collaboration entail and what are the success factors to the client-contractor collaboration according to literature?

A collaborative relationship in the context of this research is defined as: *"the joint working and behavioural interaction between the client and contractor(s) based on mutual values and norms for the purpose of achieving the larger objectives of the project, as defined by the client, by maximising the effectiveness of each participant's resources and sharing their abilities."*

Furthermore, the elements of such a collaborative relationship are divided into the following four categories:

- **Owner and contractor capabilities:** consists of elements concerned with capabilities and financial strength of the client and the contractor, their prior relationship, and senior management support.

- **Relationship indicators:** consists of elements such as open communication, clear definition of the parties' responsibilities, and the jointly alignment of objectives, vision and trust.

- **Relationship practices:** consists of elements regarding practices and processes to enable a collaborative relationship such as knowledge sharing, joint risk management, and joint problem solving.

- **Relational attitudes:** consists of elements concerned with the orientation and willingness of both parties towards added values, sharing knowledge and information, and different corporate values

Finally, the success factors to the client-contractor collaboration are categorised as following:

7. **Relational attitudes:** includes senior management commitment and relational norms
8. **Collaborative practices:** includes team integration and joint working procedures
9. **Teamworking quality:** includes inter-team communication, coordination, balanced contribution, aligned effort, mutual support, cohesion, and affective trust
10. **Front-end definition:** includes the ability to comprehend the scope, design, plan and responsibilities
11. **Joint teams' capabilities:** includes the client's project team capability and contractor's project team capability

4. ECI and D&C projects

4.1. Introduction

In this chapter the literature study on Early Contractor Involvement and the D&C contract is conducted. The goal of this chapter is to provide the answer to sub question 2 by describing the main characteristics of ECI and the D&C contract. In the conclusion of this chapter sub question 2 of this thesis will be addressed:

What are the characteristics of ECI and D&C infrastructure projects in the Netherlands?

The chapter consist of a description of the used methodology for conducting the literature study. Next, ECI will be covered by providing the definition for ECI used in the context of this research, the process of an ECI infrastructure project, the relationship between the client and contractor, the roles and responsibilities of the client and contractor within an ECI project, and the advantages and disadvantages of using ECI. Thereafter, the same approach will be used to cover the D&C contract in Dutch infrastructure projects. Lastly, the link between the literature study and the case study is described.

4.2. Methodology

By researching relevant literature about ECI, D&C and Project DOEN, the researcher provides the theoretical background on the other main subject of this research: the contracts. To gather relevant literature mostly internet databases are used, such as: ASCE Library, Emeraldinsight, Google Scholar, Science Direct, Scopus and WorldCat. To find articles the author searched the databases using the following key words: construction process, construction phases, early contractor involvement, early contractor involvement in the Netherlands, early contractor involvement process, early contractor involvement liabilities, bouwteam (Dutch for ECI), bouwteam definition, bouwteam UAV-GC 2005, integrated contracts, integrated contracts in the Netherlands, geïntegreerde contracten, UAV-GC 2005, Design & Construct contract, Design & Construct process, Design & Construct liabilities, Design & Build process, Design & Build contract, and Design & Build liabilities. Note that some of these key words are in Dutch because of the context in this research. Dutch literature is used in this chapter, but it is translated into English. Furthermore, some Dutch webpages are used to obtain information about the contracts. This is done because the contracts covered in this research is within the context of the Dutch construction sector. The webpages of the following institutes are searched: Pianoo, CROW, Cobouw and Rijksvastgoedbedrijf.

Besides these databases the author also used several journals to search for relevant articles, such as: Journal of purchasing and supply management, Journal of Management in Engineering, Journal of Construction Engineering and Management, Construction Management and Economics and International Journal of Project Management. Furthermore, the TU Delft library was also used to obtain relevant books and e-books.

Once more, it is important to note that while these databases and journals are used to obtain relevant articles and books, not all mentioned databases and journals provided relevant articles that are actually used in the literature study. There were some articles found which were relevant, but not recent anymore. While the author aims to obtain mostly recent articles and books, in some cases there was no recent literature available. In those cases, older relevant literature is used.

4.3. Traditional contracts

The traditional model is governed by the Uniform Administrative Conditions for the Execution of Works and Technical Installation Works 2012 (UAC 2012 or in Dutch UAV 2012). The UAC 2012 is a revised version of the 1989 set of general terms and conditions and are based on the legal relationship between the client and the contractor (Chao-Duivis et al., 2013, p. 51).

In Figure 8 the phases of a construction project are shown: initiation, project definition, design and preparation, pricing and tendering, construction, project delivery, operation, and maintenance. The process shown in Figure 8 is that of a construction project using the Design-Bid-Build contract. The process starts with the project definition, which is drawn up by the client (Boijens, 2008). Thereafter, in the next phase, the design is drafted. First, a preliminary design is drafted followed by a detailed final design. The design is often drafted by a designer (architect) and/or a constructer. Note that the design is still the responsibility of the client in relation to the contractor (Jansen, 2009, p. 57). After the design is approved by the client, the client will price the design into a design which can be tendered (Wentzel & Eekelen van, 2005). The award criteria for the tender is mostly on the lowest price, as the client already knows what he wants. The contractor who bids the lowest price, wins the tender and the construction phase starts. After the construction phase is finished, the contractor hands over the built object to the client. The built object will then be operated, often by the client, and during its life cycle the object will also need maintenance (Boijens, 2008). The legend in Figure 8 applies for all figures in chapter 4.

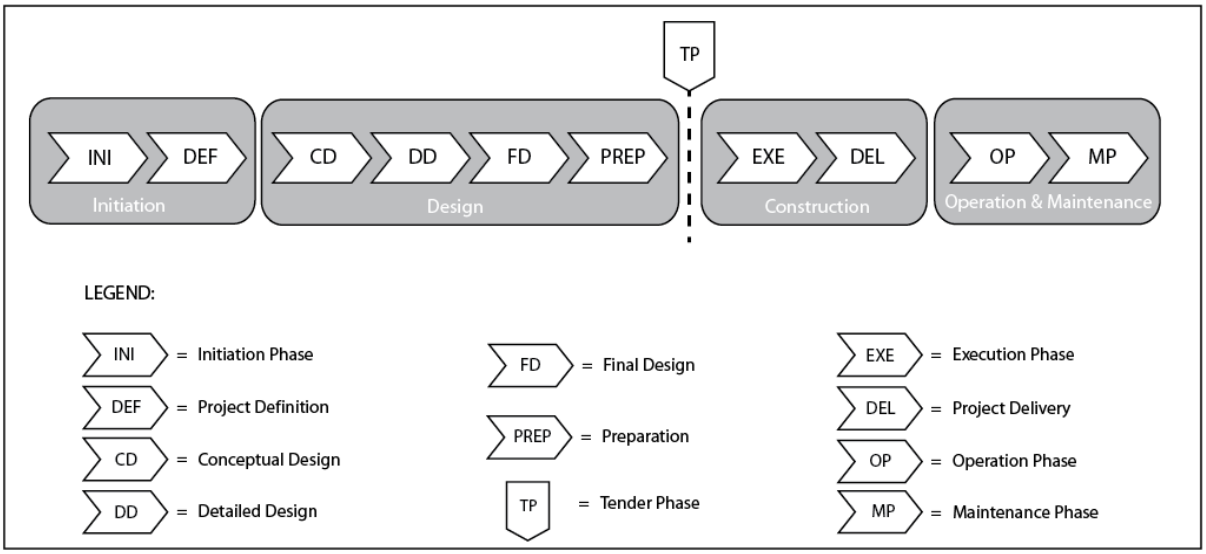

Figure 8: Traditional building process. Own illustration based on (Pianoo, 2018c); Wentzel and Eekelen van (2005)

The traditional contract model has three different variants (Jansen, 2009, p. 57). These variants differ in the phases that the client wants to outsource and are as following:

- All phases are carried out by the client, except for the construction phase. The construction phase is outsourced.
- The design, construction and maintenance phase are outsourced to different parties. The client carries out the finance and operation phase.
- Early contractor involvement.

The first and second variants are described in general, in Appendix F. The third variant will be elaborated on in paragraph 4.4, as ECI is one of the main subjects in this thesis.

4.4. Early Contractor Involvement

While Jansen (2009, p. 58) states that ECI is a variant of the traditional model, Chao-Duivis (2012, p. 22) suggests that ECI is more in between the traditional model and the integrated model. ECI could be part of both model, it depends on the chosen tender procedure for ECI (Chao-Duivis, 2012, pp. 21 - 22). As of 2019 there have been development in the use of ECI in the Dutch infrastructure sector. Koenen (2019) states that ECI is being used more often in recent years compared to 2009 and 2012, in those years the books of Chao-Duivis (2012) and Jansen (2009) were published. Nowadays, in the Dutch infrastructure sector two different types of ECI are being used. One is the traditional model of ECI (in Dutch: Bouwteam traditioneel), the other is the integrated model of ECI (in Dutch: Bouwteam onder UAV-gc). The integrated model is being used recently and there is no standard model for it. Furthermore, there is no relevant literature about the integrated model. Therefore, in this section only the traditional model of ECI will be covered. The traditional model of ECI will be referred to as 'ECI'.

4.4.1. Definition of ECI

Firstly, it is important to note that there are multiple definitions of ECI in different countries. It is therefore relevant to define ECI in the context of this research, which is the application of ECI in the Dutch infrastructure sector. In the Netherlands, the commonly used term for ECI is "bouwteam" (translated into English: building team). ECI is also referred as "design team", by Chao-Duivis et al. (2013). In the context of this research, ECI is the same as "bouwteam" and "design team". Three (translated) definitions of ECI will be covered:

"Article 1 of the VGBouw Standard Design Team Contract 1992 defines the purpose of design team as: "The design team is a partnership in which the participants – each retaining his independence and responsibility – work together to prepare the project. To this end each of the participants is required to make the best possible use of his particular experience and expertise".

"A temporary partnership on an equal footing between representatives of the roles in the building process of initiation, design and execution, where the participants in a coordinated manner perform the tasks arising from their particular roles and on top of this, where possible, assist their fellow participants to perform their tasks by giving advice". (van den Berg, 2007).

"The building team agreement is a temporary form of collaboration between the client, the designer, and the contractor. The building team drafts the design, with each member preserving its own responsibility and independency. For this, each member should use its own expertise and knowledge. The building team ends after the design is drafted. After the design

phase, the client and the contractor will sign a new contract for the construction of the design. This contractor does not necessarily have to be the same contractor as the one in the building team."(SBR, 2003)

The definition by van den Berg (2007) is quite general and does not define the process in which the contractor is involved. The definition is mainly about attitude and division of responsibilities. On the other hand, the definition by SBR (2003) is clearer. It should be clear in the definition that the members of the design team will not design together but that the design is drafted by a designer/consultant with the advice of the other members, which includes the contractor (Jansen, 2009, p. 59). This advice is mainly based on the members' knowledge and expertise. In the case of the contractor his knowledge and expertise on technical aspects, preparation and costing of the execution of the design will be used. In the context of this research ECI is defined as:

"A form of collaboration in which the client, contractor and consultant(s) form a design team and collaborate to draft the best possible and feasible design by using the expertise and knowledge of all members and each preserving their own responsibility and liability. The design team phase and the collaboration between the members of the design team formally ends after the final design is drafted. Thereafter, the client enters into a new contract with the contractor for the construction phase."

4.4.2. Process of an ECI infrastructure project

Compared to the other variants of the traditional model ECI is different in the fact that it is all about involving the contractor in an early phase of the project, to benefit from his expertise and knowledge on constructing and preparing the construction of the project (Wondimu et al., 2016). The process of an ECI project is shown in Figure 9. The collaboration in the design team is temporary and ends after the design phase (Chao-Duivis, 2012).

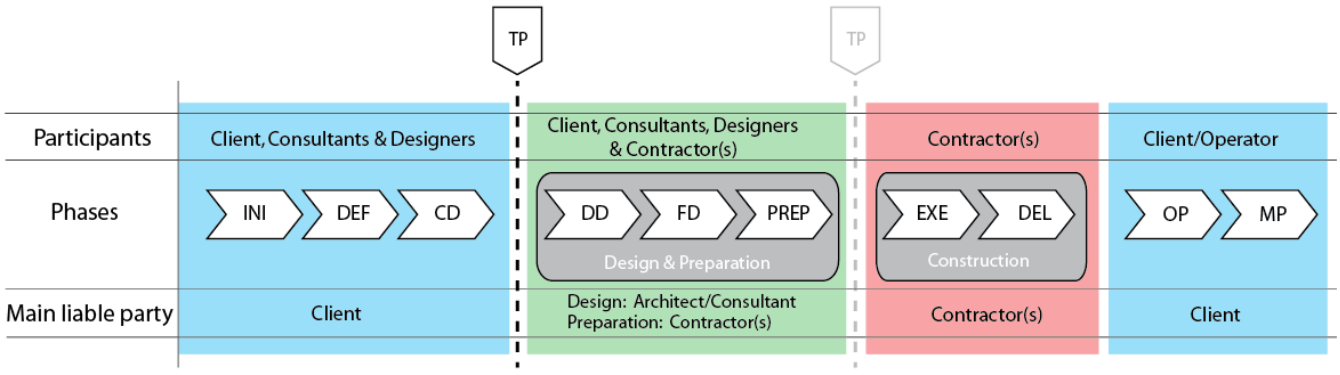

Figure 9: The ECI process of an infrastructure project. Own illustration based on Wentzel and Eekelen van (2005).

4.4.2.1. Design team phase

The design team phase consists of several parties, the client puts together a design team by different tenders (Nielen, 2010). All members of the design team sign a coordination agreement, the coordination agreement will be covered in the next paragraph. The tender to select the contractor could be different than the traditional process, in that the tender to select the contractor for a design team could also be a tender for service instead of a tender for works (Jansen, 2009, p. 59). This is uncommon, usually the tender to select the contractor is a tender

for works. It is important to note that when a contractor is selected by a tender for service, that contractor cannot bid for the design (Jansen, 2009, p. 59). The contractor will be bidding for the design phase only, as the price for the whole project is not set yet. The design phase, cost estimations and preparation will be done in parallel. By using the expertise and knowledge of the contractor during the design team phase the final design should be a more integrated and feasible design, compared to the Design-Bid-Build contract (Boijens, 2008). As a result of the design team phase, a final design is drafted including the preparation of the works. The design team, including the coordination agreement, and the collaboration between the parties is formally ended (Boijens, 2008).

4.4.2.2. Construction phase

After the design phase is completed, the contractor has the advantage that he is the first and only one to make a bid on the design to execute. The client and contractor will negotiate to a price which satisfies both parties (de Koning, 2018, pp. 58 - 61; Jansen, 2009). In Figure 9 the tender phase is coloured grey, as that tender phase may not happen at all. The tender for the design will only happen when the client and contractor cannot come to an agreement on the price for the execution of the design (Chao-Duivis, 2012, p. 12; Jansen, 2009; Nielen, 2010). When the client and the contract have agreed on the final price for the works, the client enters into a contract with the contractor. Thereafter, the construction phase of the project will be executed by the contractor. The contract for the construction phase is subject to the UAC 1989, however Chao-Duivis et al. (2013, p. 97) states that it would make sense to refer to the revised and more recent UAC 2012.

4.4.3. Client-contractor relationship

As mentioned in the previous paragraph the members of the design team sign a coordination agreement covering the willingness to collaborate and consult with one another, the purpose of the partnership, the roles within the design and the enforcement of the roles by the member responsible for coordination (Chao-Duivis, 2012, p. 17; Chao-Duivis et al., 2013, p. 86). This agreement allows the enforcement by the coordinator of the obligation of the members to collaborate (Chao-Duivis et al., 2013, p. 86).

In addition to the coordination agreement the client also enters into separate contracts with each member of the design team. With the architect, consultants and engineers the client usually enters into a contract based on The New Rules 2011 (DNR 2011). With the contractor, the client usually enters in to the Standard Design Team Contract 1992 (Chao-Duivis et al., 2013, p. 86). In this paragraph only the contract between the client and the contractor will be covered, as that is in the research scope of this thesis. An illustration of the coordination agreement and the contractual relationships within the design team, and the research scope is shown in Figure 10.

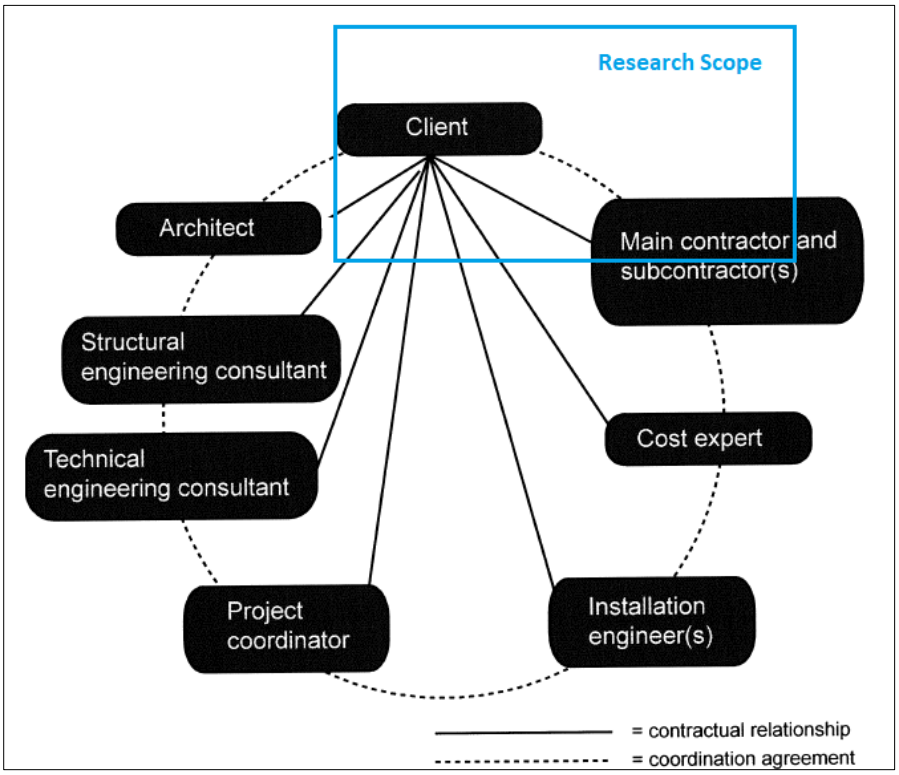

Figure 10: Schematic representation of the design team model (Chao-Duivis et al., 2013, p. 85).

While a partnership is formed, it is important to note that the relationships between all the members of the design team is not based on equality. The equality within the team is mainly on the members other than the client, even though he is a member of the design team (Chao-Duivis, 2012, p. 12; Chao-Duivis et al., 2013, p. 84). The dotted line in Figure 10 shows that all the members of the design team work together. The solid line shows the hierarchical position of the client compared to the other members.

4.4.4. Roles

The role of the client is laid down in Article 5(1) of the Standard Design Team Contract 1992, stating that the he has a leadership role within the design team. His main responsibilities include: chairing the meetings, checking and coordinating the work of all members, assessment of the proposed plans and budget, and to timely take all the decisions necessary for the progress of the project (Chao-Duivis et al., 2013, p. 88). Article 5(2) states that the client may have assistance or be represented by a participant in the team or a third party. The client's representative shall represent him in all matters relating to the project except if the contract indicates otherwise of where the client has indicated to the contrary sufficiently (Chao-Duivis et al., 2013, p. 88).

The role of the contractor is laid down in Article 6(1) of the Standard Design Team Contract 1992, stating that the contractor should make his particular experience and expertise of construction and the associated costs available to the design team (Chao-Duivis et al., 2013, p. 89). The contractor's work is listed in Appendix 1 of the Standard Design Team Contract 1992. His work includes advising on the technical and financial feasibility of the project as a whole and the design, and the optimisation of the project in terms of costs. Furthermore, the

contractor's work includes drawing up a design of the alternatives put forward by the contractor and a timetable for the preparation and execution of the project (Chao-Duivis et al., 2013, p. 89). Furthermore, the members of the design team have the duty to warn when one party provides advice on the design and that advice entails risks or contain errors (Chao-Duivis et al., 2013, p. 90).

4.4.5. Responsibilities

Even though the members of the design team form a partnership, there is no collective responsibility for the design. Within the design team each party has his own particular responsibility (Chao-Duivis et al., 2013, p. 91 & 93). Each member is liable for damages caused as a result of fulfilling his responsibility. Also, a member can be held liable when he adopts erroneous advice from another member that lies in his area of responsibility (Chao-Duivis et al., 2013, p. 91). That member is not liable if he states that he does not accept liability for a particular advice or if he had warned of the risks associated with a particular advice (Chao-Duivis et al., 2013, pp. 91 - 92). For the contractor this means that he can be held responsible for a part of the design on which he provided advice for. This is different compared to the Design-Bid-Build contract. In those variants the contractor is not liable for errors in the design, except if the contractor fails to warn for any errors in the design, construction methods and building materials that are of such a nature that execution without warning would not be fair or reasonable (Jansen, 2009, p. 57)

4.4.6. Advantages of using ECI

Before covering the advantages of the use of ECI, the following is important. In a report to the Dutch parliament, Rijkswaterstaat (2019, p. 31) states that cost and time overruns are mainly caused in the design phase and construction phase. During the design phase it is caused by the lack of attention to the uncertainties and risks in the preparation. During the construction phase it is caused by time pressure, inadequate preparation, mistakes in the planning, and mistakes in the design (Rijkswaterstaat, 2019, p. 31). Figure 11 is used in addition to describe the advantages of ECI, the figure shows the flexibility and the cost of changes in the design throughout the different phases a construction project. The phases are not entirely the same compared to the ECI process, for example the tendering is in a different phase when using ECI. However, the goal of this figure is to show the flexibility and the cost of changes in the design throughout a construction project. In Figure 11 it is shown that in the early stages of a construction project the flexibility to apply changes in the design is the highest, and the costs of those design changes are the lowest (Davies, 2016; Sødal, 2014). During the construction phase the flexibility to apply changes in the design is the lowest, and the costs of those design changes are the highest (Davies, 2016; Sødal, 2014).

From Figure 11, among other characteristics of ECI described in the previous paragraphs, it can be derived that the main advantage of using ECI is the involvement of contractor in the early phases of the project. The final design consists of advice from the contractor based on his experience. His expertise and knowledge of technical aspects, preparation and costing enables the construction phase to be executed quicker and to be coordinated more effectively (Chao-Duivis et al., 2013; Lenferink et al., 2012; Sødal, 2014; Van Valkenburg, Lenferink, Nijsten, & Arts, 2008).

For the client the use of ECI is advantageous as he has higher certainty in the costs and planning (Bundgaard, Klazinga, & Visser, 2011; Rahmani, Khalfan, & Maqsood, 2013). By having the contractor involved in the preparation phase the chances of errors in the design are reduced. This aspect provides another advantage for the client, namely: risk distribution. The identification of risks is improved and also some of the responsibilities of the design is transferred to the contractor (Bundgaard et al., 2011; Koning, 2018; Rijkswaterstaat, 2019). Furthermore, the client has influence on the proposed design during the design team. As shown in Figure 11 the blue arrow indicates the moment in the construction process when the design team is formed. The flexibility to apply changes in the design is high during the design phase and the cost of changes is low (Davies, 2016).

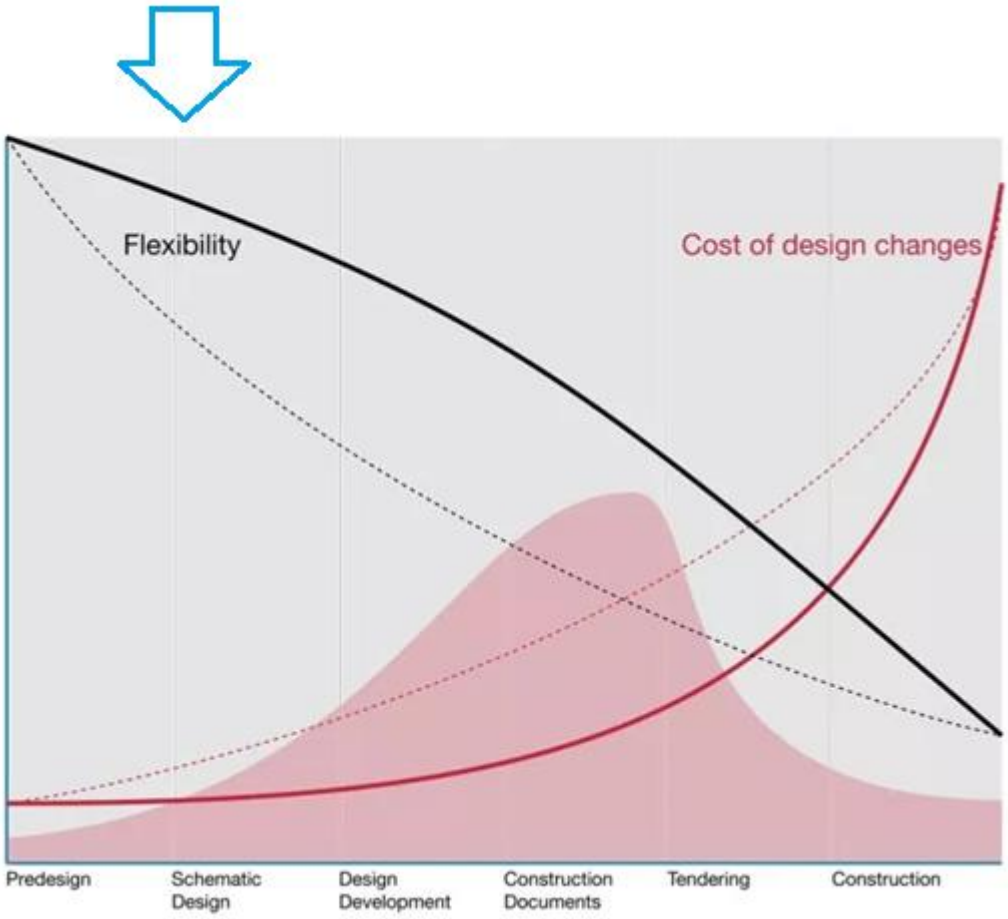

Figure 11: The MacLeamy curve. Flexibility and cost of design changes throughout a construction project (Davies, 2016). The blue arrow indicates the moment in the process when the design team is formed.

For the contractor participating in the design team the main advantage is that he is the first and only one to bid on the final design (Chao-Duivis et al., 2013, p. 95). Even though he is not certain of being awarded the contract for the construction phase, he has a better position to be awarded the building contract compared to the first and second variant of the traditional model (Chao-Duivis et al., 2013, p. 85). For the contractor this could mean that he gives himself more work (Chao-Duivis et al., 2013, p. 85).

Regarding the effects of ECI on the collaboration, there are only a few sources covering that aspect. The sources merely cover the potential opportunities. While the design team ends after

the final design is drafted, the collaboration during the design phase between client and the contractor provides opportunity for a better relationship going into the construction phase (Koenen, 2017; M. Rahman & Alhassan, 2012; Suprapto, 2016). The collaboration between the client and contractor during the design team phase could lead to a better understanding of each other during the construction phase (Kamminga, 2009; M. Rahman & Alhassan, 2012). However, the early involvement of the contractor could also be seen as a disadvantage if the relationship between the client and the contractor is disrupted in the early phases of a construction project (Suprapto, 2016, p. 96).

4.4.7. Disadvantages of using ECI

The coverage of disadvantages of using ECI in literature is limited. Some sources do cover the challenges that arise using ECI. The first challenge in implementing ECI is the tendering aspect (Chao-Duivis, 2012, p. 3; Jansen, 2009, p. 59; Song, Mohamed, & AbouRizk, 2009, pp. 13-14). The reason for this is because there is no standard for tendering ECI in the Netherlands (Jansen, 2009, p. 59). In addition to this, the Standard Design Team Contract dates back to 1992. This standard contract is outdated and as of 2019 there has been a lot development in contracting and tendering in the Netherlands (de Koning, 2018). For example, the Standard Contract refers to the UAC 1989 while that set has been revised in 2012. Also, the Standard Contract also refers to an out-of-date set of general terms and conditions for consultancy work, the Regulations governing the Relationship between the Client and Consulting Engineers (RVOI) (Chao-Duivis et al., 2013, p. 87).

Secondly, in the Dutch infrastructure sector the use of ECI is rather new (Koenen, 2019). This means that there is inexperience of using ECI in the sector. In addition to this, Sødal (2014); Song et al. (2009) state that a different culture and attitude is needed to successfully implement ECI. This change of culture and attitude is also suggested in the Market Vision (Rijkswaterstaat, 2016). The latter is not specifically aimed at implementing ECI but rather for implementing new forms of collaboration.

4.5. Integrated contracts

Since the year 2000 RWS, in consultation with parties in the Dutch infrastructure sector, developed guidelines for the use of integrated contracts. These guidelines enabled clients to outsource multiple phases to a contractor or a consortium of multiple contractors, instead of outsourcing one or more phases to different parties using the traditional model (Jansen, 2009; Lenferink et al., 2013; Rijkswaterstaat, 2019, p. 12). The D&C contract is a variant of integrated contracts.

As integrated contracts were used more often, a set of general terms and conditions was developed: the Uniform Administrative Conditions for Integrated Contracts 2005 (UAC-IC 2005) (Chao-Duivis et al., 2013, p. 100). The UAC-IC 2005 lays down the legal relationship between the client and the contractor. The set consists of a Basic Contract with annexes, the Employer's Requirements and other contract documents, and the general terms and conditions (Chao-Duivis et al., 2013, pp. 99 - 102). As mentioned in paragraph 4.3, larger clients usually had their own design and maintenance departments. As the use of integrated contracts became common, the technical and specialist expertise transferred from clients towards contractors and consultant firms (Rijkswaterstaat, 2019, p. 29).

The integrated model consists of several different types of contracts. These contracts differ in the number of phases and tasks that are outsourced. The common types of integrated contracts are as following, sorted from least integrated to most integrated (Jansen, 2009; Lenferink et al., 2013; Rijkswaterstaat, 2019):

- Engineering-Construction (E&C)
- Design-Construct/Build (D&C/D&B).
- Design-Construct/Build-Maintain (DCM/DBM)
- Design-Construct/Build-Maintain-Operate (DCMO/DBMO)
- Design-Construct/Build-Finance-Maintain (DCFM/DBFM)
- Design-Construct/Build-Finance-Maintain-Operate (DCFMO/DBFMO).

The D&C variant will be elaborated on in the section, as that is one of the main subjects in this research. In Appendix F the other different types of variants of the integrated contracts are covered in general.

4.6. Design and Construct

Since 2008, the D&C contract is the standard form of contracting within RWS and it is also the most used integrated contract in the Dutch infrastructure sector (Lenferink et al., 2013; Rijkswaterstaat, 2019). In Table 6 it is shown that of the integrated contracts between 2010 and 2018 tendered by RWS, the D&C contract is used the most often comprising 41% of the total value (Rijkswaterstaat, 2019, p. 12). While there are other clients in the Dutch infrastructure sector, these statistics are the only reliable that can be found. Furthermore, of all the tendered Dutch infrastructure projects, RWS tenders about 65% of the projects (Rijkswaterstaat, 2019, p. 11).

Contract type	Number of tendered projects	Percentage of total contract value covering the types shown in the first column
D&C	180	41%
DBFM	16	38%
Prestatiecontract (Operation and Maintenance)	116	6%
DBM	2	6%
E&C	80	3%
Plan Design Construct	1	3%
Maintenance E&C	76	3%

Table 6: Used contract types by RWS from 2010 to 2018 by amount and value in the Dutch infrastructure sector (Rijkswaterstaat, 2019, p. 12).

4.6.1. Definition of the D&C contract

In contrast to ECI, the definition of the D&C contract is more evident. The reason for this is that the use of D&C is internationally almost the same. ECI on the other hand is more general and is used in a different way in different countries. The definition of the D&C contract is: *"a contract between the client and contractor, in which the contractor is responsible for the design phase and construction phase of an infrastructure project"* (Lenferink et al., 2013; Rijkswaterstaat,

2018a, 2019). Note that D&C can also be referred to as D&B which stands for Design and Build, but the definition is the same for both.

4.6.2. Process of a D&C infrastructure project

The essence of the D&C contract, in fact that of most integrated contracts, is the integration of multiple phases of a project. The number of interfaces between the phases is reduced, as the traditional approach has interfaces between each phase (initiation phase, design phase, construction phase, and maintenance phase) (Lenferink et al., 2013). In the case of D&C, short for Design and Construct, the design and construction phase of a project are integrated.

The process of a D&C project is different compared to the traditional model of contracts, as the tender phase is taking place in an earlier stage. The D&C process of an infrastructure project is shown in Figure 12. After the initiation and project definition phase of an infrastructure project the client drafts the Employer's Requirements to be put to a tender process, this could be conducted with the assistance of consultants. The Employer's Requirements is one of the most important contract documents, as it is defined in the UAC-IC 2005 (§1 (q)) as the document on the basis of which the contractor submits his tender (Chao-Duivis et al., 2013, p. 101). These requirements consist of at least the Schedule of Requirements (in Dutch: Programma van Eisen). The client usually uses functional specifications in these requirements to specify his wishes (de Haan, Degenkamp, Schotanus, & Mulder, 2017). This is different compared to the Design-Bid-Build contract, in which the client submits the final design to the tender phase using technical specification (in Dutch: RAW-bestek). In the UAC-IC 2005 the client is allowed to include a conceptual design or a final design using technical specification (Chao-Duivis et al., 2013; de Haan et al., 2017). Note that by submitting a detailed or final design the contract would be more an E&C contract than a D&C contract (de Haan et al., 2017). The process of an E&C infrastructure project is shown and described in Appendix F.

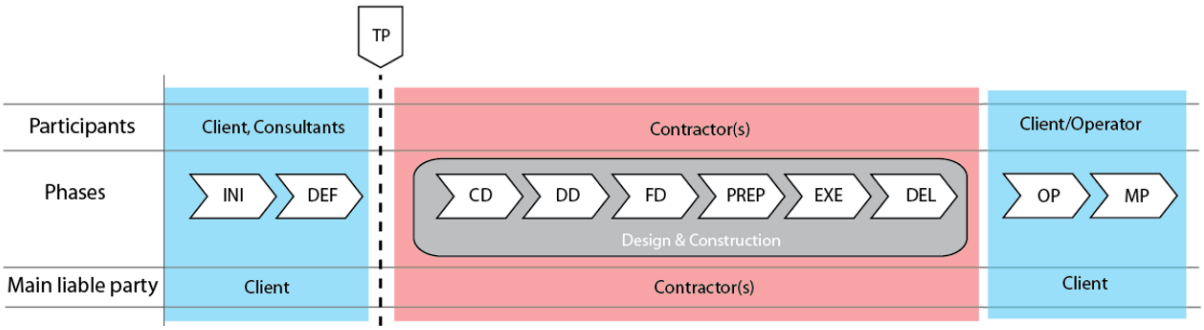

Figure 12 : The D&C process of an infrastructure project. Own illustration based on (Lenferink et al., 2013)

4.6.3. Client-contractor relationship

After the tender phase is completed, the design and construction of the works is awarded to a contractor or a consortium of contractors. In this thesis both situations of one contractor and a consortium of contractors will be referred to as 'the contractor' or 'a contractor'. The client enters into a contract with the contractor, which is governed by the UAC-IC 2005. An illustration of the contractual relationships of UAC-IC 2005 is shown in Figure 13. The contractor commits to deliver the works in accordance with the specifications, on time and within the promised budget (Chao-Duivis et al., 2013, p. 110). The contractor can choose to bring in an architect/consultant if he does not possess the expertise. In that case the contractor goes into a contract with the architect/consultant, usually DNR 2011 will be used. If the contractor brings

in a building (sub)contractor, usually the UAC 2012 will be applied (Chao-Duivis et al., 2013). The situations in which the contractor brings in an architect/consultant or a (sub)contractor will not be covered as this is out of the research scope of this thesis, as shown in Figure 13.

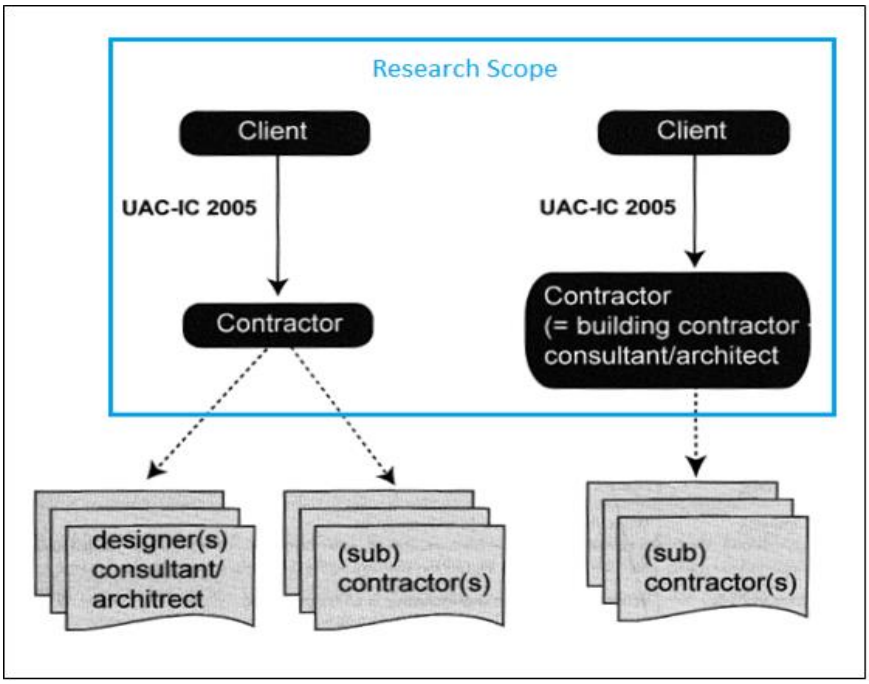

Figure 13: Schematic representation of UAC-IC 2005 (Chao-Duivis, Koning, & Ubink, 2013)

4.6.4. Roles and responsibilities

The role of the client is different compared to the traditional model of contracts and ECI. Even though the design and construction are the responsibility of the contractor, this does not mean that the client has no role in the design and construction phase (Chao-Duivis et al., 2013, p. 102). The UAC-IC 2005 provide the opportunity for the client to check the contractor's work, by verification and acceptance points. Through verification and acceptance, the client can order to make variation in the design (Chao-Duivis et al., 2013, pp. 102 - 103). It is important to note that it is not intended for the client to help himself with the power of verification and acceptance to vary to such an extent that he is substantially involved. By being involved substantially the client transfers part of the responsibility to himself (Chao-Duivis et al., 2013, pp. 102 - 103). In addition to his involvement, the client has the duty to cooperation. The client's cooperation obligations are set out in the UAC-IC 2005 §3(1) (Chao-Duivis et al., 2013, p. 102):

- The client must make available the necessary information to the contractor for the execution of he works.
- The contractor has to have access to land and/or water as specified in the Employer's Requirements to carry out the works.
- The client must provide the goods as specified in the basic contract.

The contractor has a primary and secondary obligation according to the Explanatory Notes to §4 of the UAC-IC 2005 (Chao-Duivis et al., 2013, p. 110) The primary obligation is to deliver the works in accordance with the requirements, on time and within the promised budget. There is an exception to this if the client interferes with the works, as mentioned above. The secondary obligation is the duty to warn and is laid down in §4 (7) of the UAC-IC 2005 stating that the contractor should warn the client immediately in writing if the Employer's

Requirements, appended annexes, the basic contract, the information, land/water or goods provided by the client, or a measure taken by the client, contain errors or defects that are clearly inconsistent with the reasonableness and fairness for the contractor to proceed with the exertion of the works (Chao-Duivis et al., 2013, p. 114). Failing to do so means that the contractor is liable for the consequences (Chao-Duivis et al., 2013, p. 114).

4.6.5. Advantages of the D&C contract

The main advantage for both the client and contractor of using the D&C contract lies in its essence. Using the D&C contract the number of interfaces between the phases in a project is reduced, as the traditional approach consists of interfaces between each phase (Lenferink et al., 2013). This results in an integrated process of the design and construction of the works. Because the design and construction are both executed by one party, the design could be more feasible compared to the Design-Bid-Build contract (Lenferink et al., 2013). Furthermore, this could provide the opportunity for more innovation in a project. The contractor has the knowledge and experience to construct a more innovative project compared to the traditional approach (Jansen, 2009). However, to benefit of this opportunity of more innovation the award criteria during the tender process should contain criteria on innovation (Rijkswaterstaat, 2019).

For the client an additional advantage of integrating multiple phases together is that the risks and responsibilities of the design are (partly) transferred to the contractor. The transfer of the risks and responsibilities to the contractor could also be a pitfall of the D&C contract. Rijkswaterstaat (2019, p. 21) states that a consequence of transferring too much risk to the contractor is the fact that contractors do not submit to tenders for large projects.

Furthermore, the client has a directing role in which he can review and make variations if the contractor does not abide to the tendered design (Chao-Duivis et al., 2013; Jansen, 2009). This provides the client the ability to make sure the contractor is abiding by the awarded design. With the power of verification and acceptance the client can order changes, if the contractor is not abiding by the requirements.

4.6.6. Disadvantages of the D&C contract

The main disadvantage of the D&C contract for the client is his limited influence on applying changes in the design, after the tender phase. In Figure 14 the same curve is used as in paragraph 4.4.6 to show this disadvantage. Note that the phases are not entirely the same compared to the D&C process, for example the tendering is in a different phase when using the D&C contract. However, the goal of this figure is to show the flexibility and the cost of changes in the design throughout a construction project. The client has to submit the Employer's Requirements at the moment of the red arrow in Figure 14, that is when the tender process starts in a D&C project. As the project continues, the flexibility to apply changes to the design reduces and the cost of changes increases significantly. As mentioned before, the cost of changes outside of the tendered design will be on the client. Therefore, it is important for the client to know his wishes clearly in an early stage and draft his wishes correctly. In a project in which the client has a lot of uncertainties in the early phases, the D&C contract is not preferable (Jansen, 2009).

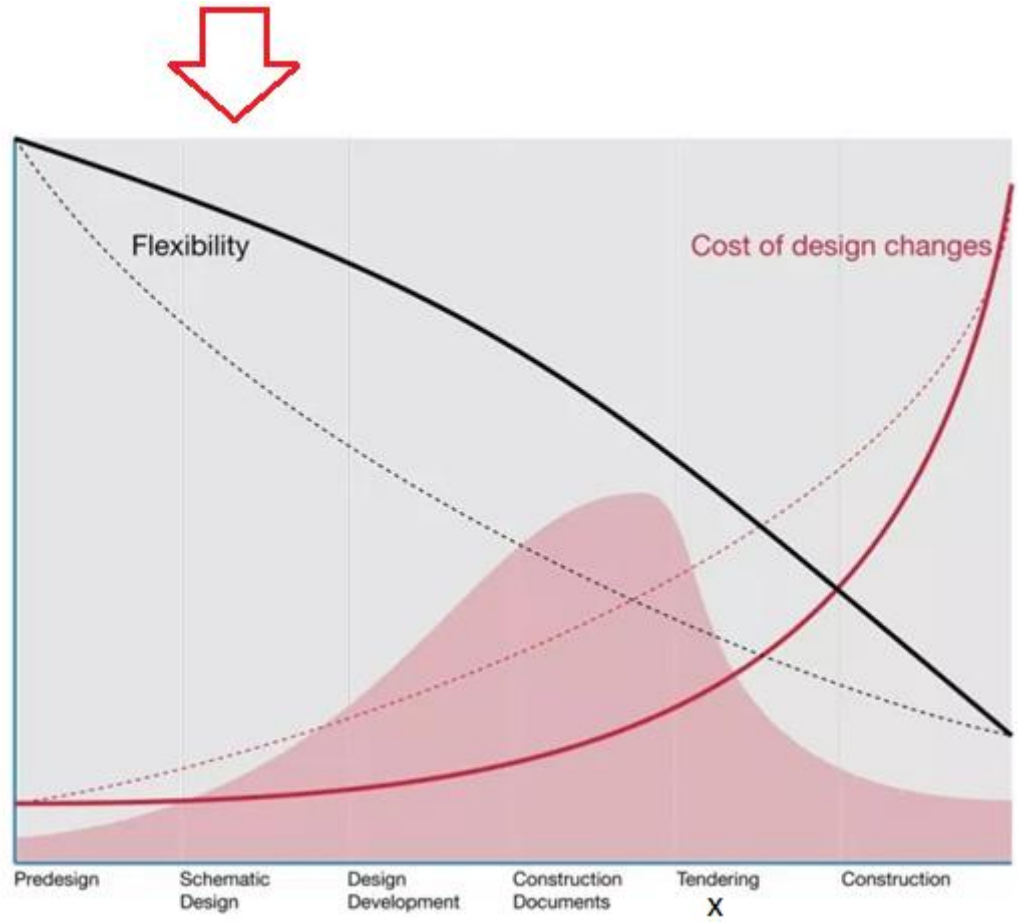

Figure 14: The MacLeamy curve (Davies, 2016). The red arrow indicates the moment of the tender process.

As the Employer's Requirement is usually in the form of functional specifications, the client could end up with a solution which he may not prefer. The importance of the Employer's Requirement is therefore very high for the client (Pianoo, 2018a). Using functional specifications requires specific competences. The UAC-IC 2005 does allow for the client to submit a final design to the tender process. However, by doing this the client is held liable for errors in that design (Chao-Duivis et al., 2013). In addition to this, the opportunity for innovation and the contractor's freedom in the design will be limited.

4.7. Link to the case study

The literature study on ECI and D&C infrastructure projects in the Netherlands, and the ECI model and the D&C contract are relevant for the analysis in chapter 6. In chapter 6 the results from the case studies and the literature study, from this chapter, will be synthesised to find the differences in the client-contractor collaboration between the ECI and D&C cases. The input from this chapter will be mainly on the characteristics of ECI and D&C infrastructure projects in the Netherlands. By providing this input, the observations from chapter 5 and 6 will be explained.

4.8. Conclusion

In this chapter the literature study on ECI and D&C infrastructure projects in the Netherlands is conducted. The main focus of this chapter has been on the ECI model and the D&C contract. Based on the literature study, sub question 2 of this research can be answered:

What are the characteristics of ECI and D&C infrastructure projects in the Netherlands?

ECI

During the design phase of an ECI infrastructure project a design team is formed consisting of the client, contractor and consultant(s). In the design team phase the members collaborate to draft an integrated and feasible design by using the members' expertise and knowledge. The members sign a coordination agreement together and all members enter into a separate contract with the client. Even though the members of the design team form a partnership, there is no collective responsibility for the design. Each member is liable for his own particular area of responsibility. A final design is drafted including the preparation of the works. Thereafter the design team, including the coordination agreement, and the collaboration between the parties is formally ended. Thereafter, the contractor has the advantage that he is the first and only one to make a bid on the design to execute. The client and contractor will negotiate to a price which satisfies both parties. After that, the client enters into a contract with the contractor, and the construction phase of the project will be executed by the contractor. If the client and contractor do not come to an agreement for the price of the execution of the design, the client is allowed to put the design to a tender.

The main advantage of using ECI is that the final design is more integrated, more feasible and to coordinated more effectively compared to the traditional approach of the Design-Bid-Build contract. The design is drafted mainly using the contractor's expertise and knowledge of technical aspects, preparation and costing involvement of contractor in the early phases of the project. Furthermore, the collaboration in the design team provides opportunity for a better client-contractor relationship going into the construction phase and it could also lead to a better understanding of each other.

The challenges for implementing ECI in the Dutch infrastructure are the tendering of ECI projects, as there is no standard for tendering ECI projects, and the risk of the inexperience in the sector, as the use of ECI in the sector is rather new.

D&C

The D&C (or D&B) contract is a contract between the client and contractor governed by the UAC-IC 2005, in which the contractor is responsible for the design and construction phase of an infrastructure project. The essence of the D&C contract is the integration of these phases which reduces the chance of misinterpretations of the design by the contractor. After the initiation and project definition phase of an infrastructure project the client drafts the Employer's Requirements to be put to a tender process. In contrast to ECI and the Design-Bid-Build contract, the Employer's Requirements are drafted by means of functional specifications instead of technical specifications. In the UAC-IC 2005, the client is allowed to include a conceptual or even final design. During the design and construction phase the client has a directing role to check, and order changes when necessary, if the contractor abides by the

requirements. The contractor has the obligations to deliver the works in accordance with the requirements, on time and within the promised budget, and the duty to warn the client if the client's documents contains errors.

As a result of integrating the phases and therefore reducing the number of interfaces between the design and construction phase, the design and construction of the works could be more feasible and executed quicker compared to the Design-Bid-Build contract. Furthermore, the integration provides the opportunity for more innovation, as the contractor has more flexibility to design using his expertise. The Employer's Requirements are drafted using functional specifications and thus contractors can come up with different solutions compared to Design-Bid-Build, in which the design is specified in technical details. An additional advantage for the client is that the risks and responsibilities of the design are (partly) transferred to the contractor. On the other hand, the main disadvantage of the D&C contract for the client is his limited influence after the tender phase. As the project progresses, the flexibility to apply changes to the design reduces and the cost of changes increases significantly. The cost of changes outside of the tendered design will be on the client. The client should know his wishes clearly in an early stage and draft the Employer's Requirements correctly. In addition to this, as the Employer's Requirement is usually in the form of functional specifications, the client could end up with a solution which he may not prefer.

5. Case Study Results

5.1. Introduction

In this chapter the case study of this research is designed and conducted. Firstly, the case study methodology and the reason for conducting case studies is provided. Furthermore, the criteria for the selection of the cases are provided. An overview of the cases will be shown, including the participants within the cases. The results of the case studies are provided and mapped onto a relational capability- performance matrix. Lastly, in this chapter the RECAP tool will be evaluated, based on the responses from the participants. The goals of this chapter are to provide the answers to sub questions 3 and 4:

3. To what extent do the success factors to the client-contractor collaboration apply to the case studies?

4. To what extent is the RECAP tool practical and useful to assess the state of the client-contractor collaboration in Dutch infrastructure projects?

5.2. Case study methodology

The multiple case study is used in this research to investigate the client-contractor collaboration in ECI and D&C projects. The case study is used when there is little control over the cases and when the focus of the research is on a real-life phenomenon (Yin, 2015, p. 32). In this research, the researcher has no control over the ECI and D&C cases and the focus of this research is on a real life phenomenon, which is the client-contractor collaboration. Yin (2015, p. 82) provides four types of case study designs: single-case holistic designs, single-case embedded designs, multiple-case holistic designs and multiple-case embedded designs. The four types differ in the number of case studies, and the number of units of analysis within each case. In this research the embedded multiple-case design is used. This research is embedded of nature and consists of multiple units of analysis: ECI cases and D&C cases and the extent to which the success factors for collaboration is present in those cases. In this research multiple case studies are conducted and compared by analysing the results.

As mentioned before, the RECAP tool by Suprapto (2016) is used to collect and assess the information on the client-contractor collaboration within the cases. In the first round of the RECAP tool, the assessment form is filled in by the participants within the cases. This data is then analysed and used for the second round of the RECAP tool. Furthermore, the data of the first round is used to analyse the client-contractor collaboration within the ECI and D&C cases chapter 6.

The second round of the RECAP tool consists of semi-structured interviews. Using semi-structured interviews, the interviewees have the opportunity to provide more input for the research instead of using fully-structured interviews with predetermined questions (Baarda et al., 1995, pp. 130, 131). In this research, the researcher can identify if characteristics or aspects within the ECI and D&C cases enable the client-contractor collaboration (Easterby-Smith & Thorpe, 2002). By conducting semi-structured interviews all questions and answers within the interviews are not predetermined, questions for introduction purposes are predetermined. However, in semi-structured interviews the subjects of the interviews are predetermined. A topic-list will be set up of all the topics that will be discussed during the interviews (Baarda et al., 1995, pp. 133, 134).

The interview protocol for conducting the semi-structured interviews can be found in Appendix G. In short, the interview protocol consists of the following six parts including a brief description of the subjects covered:

- **Respondent's profile:** introduction to the research, permission for voice recording, his or her role and, experiences.
- **Project description:** general progress, remarkable aspects, and project performance.
- **Used contract/form of collaboration:** which is used, why, and pitfalls and success factors of using the contract/form of collaboration.
- **Collaboration in the case:** general collaboration, attention to collaboration, and used methods and process to improve collaboration in the project.
- **RECAP results:** explanation of RECAP, scores of the case, questions about the gaps in the scores, high scores, and low scores.
- **RECAP evaluation:** practicality, usefulness of the RECAP tool, and suggestions to improve RECAP.

Lastly, the respondents in the case studies should be project-, contract-, environmental- or technical managers within the chosen case. These are the roles in the IPM model, used by many public clients in the Dutch infrastructure sector (Rijkswaterstaat, n.d.). This is because of the fact that these managers are actively involved during the course of the project and are mostly aware of relevant information about the project. For example, if people from the senior management were interviews the data about the projects would be on a higher, more general, level. In this research the focus is on the collaboration between the project teams of the client and the contractor. Certainly, the senior management is also relevant for this collaboration, but it is on a higher level. Also, the participating respondents from the side of the client and the contractor had to be collaborating during the course of the project. So, for each case both the respondents of the client and contractor had to be collaborating with each other.

5.3. Case study selection

The cases investigated in this research are selected by specific criteria. These criteria are mainly derived from the scope of this research. In this section the criteria for the selection of cases are presented, and an overview of the selected cases and its participants is provided.

5.3.1. Case study criteria

The first criterion is that the cases must be public projects tendered by a public client, such as RWS, municipalities, provinces, and waterboards. In addition, the cases must be carried out in the Netherlands, specifically in the Dutch infrastructure sector (in Dutch: GWW sector).

Furthermore, it is important for this research that the client cannot choose a preferred contractor. That would influence the results of the case studies, as the client and contractor would already have a relationship before. This results in the third criterion: the cases must be tendered according to European procurement law. While the European procurement law is elaborated, for this criterion only the thresholds are relevant. The budget of the works in the cases must be at least €5,548 million, which is the threshold for works contracts (EU, 2018). As regards to the other aspects of the European procurement law, there are no criteria for the cases in this research. So, the award criteria for the tender and the procurement procedure may differ between the cases. While the award criteria and the procurement procedure may

affect the client-contractor collaboration, this research is not focused on those aspects. There are other theses about the procurement and its effects on the client-contractor collaboration (de Jager, 2016; Korvinus, 2017).

The fourth criterion is the used contract or form of collaboration for the project. As mentioned in the research design, this research is scoped on Dutch infrastructure projects using D&C contracts or using ECI as the form of collaboration.

The fifth criterion for the case selection is that the cases must be completed or at least in the construction phase. This is relevant because then the client and contractor have collaborated during the design phase and the construction phase. If a project would only be in the design phase, thee experiences are only on the design of the project. It would be more interesting for the research to see what the experiences are in both the design and construction phase, as in the construction phase most unforeseen risk arise.

Lastly, it is crucial for this research that both the client and the contractor(s) are willing to participate in the research, as the RECAP tool requires input from both the client and the contractor.

In summary, the criteria for the case selection are shown in Figure 15.

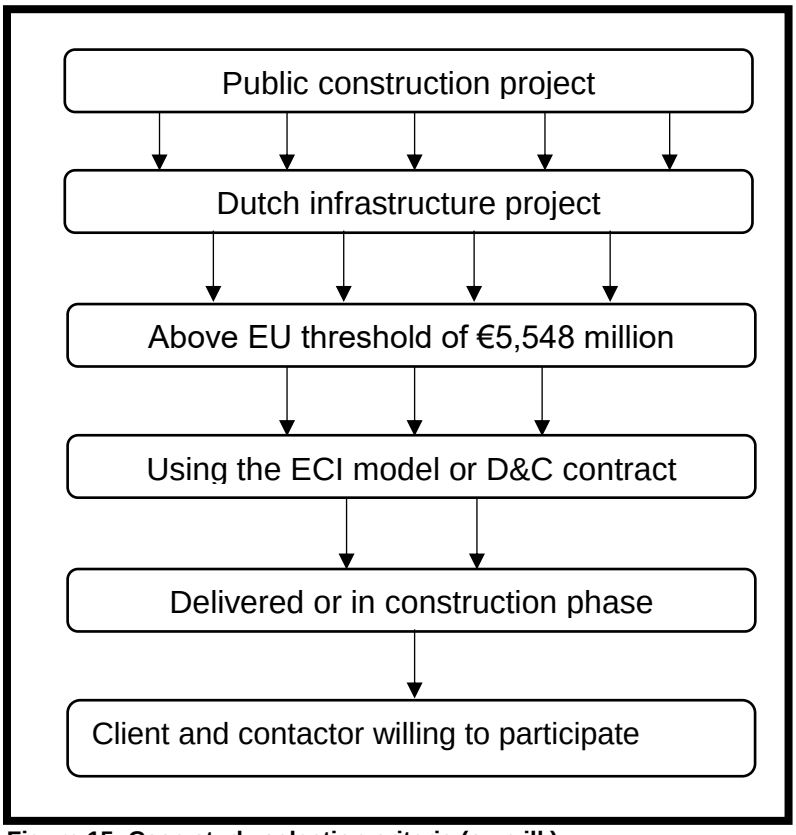

Figure 15: Case study selection criteria (own ill.)

5.3.2. Overview of the cases

In this section, an overview of the cases will be provided. All the cases meet the criteria for the case selection. Participation in this research is anonymous, meaning the names of the participants and projects are hidden. While this may not be common in some researches, in this research it seemed to be necessary. The search for suitable cases for this research has been a challenge, this will be elaborated on in chapter 8 of this thesis. An overview of the participants and cases is shown in Table 7.

Case code	Type of project	Participant code	Role	Type of organisation
ECI A	Construction of a pumping station	Contractor A	Projectmanager	Medium contractor company
		Client A	Projectmanager	Waterboard
ECI B	Major maintenance of two city districts	Contractor B	Projectmanager	Medium contractor company
		Client B	Projectmanager	Municipality
ECI C	Construction of several roads, pipelines and a bridge	Contractor C	Projectmanager	Medium to large contractor company
		Client C	Projectmanager	Municipality
D&C 1	Dike reinforcement	Contractor 1	Projectmanager	Large contractor company
		Client 1	Environmental manager	Waterboard
D&C 2	Major road maintenance of a main road	Client 2,1	Contract manager	Province
		Client 2,2	Technical manager	Province
		Contractor 2	Projectmanager	Large contractor company

Table 7: Overview of cases and participants. (own ill.)

5.4. RECAP results

In this section the results and findings of the case studies are provided. The structure of this section is mainly based on the structure of the interview protocol, described in paragraph 5.2. Results from each case study will be covered separately.

Firstly, the case will be described, and the participants' roles and type of organisation will be provided. Secondly, the results from the first round of the RECAP tool will be provided. The overall collaboration according to the RECAP, the gaps in scores between the client and contractor, and the high and low scores per criterion will be covered. This is done before conducting the interviews. Thereafter, the RECAP results from the second round, which is a part of the interviews, will be provided. This will be done by describing the statements from the client and contractor during the interviews about the RECAP results. Fourthly, the RECAP evaluation will be provided by covering the statements regarding the practicality, usefulness of the RECAP tool, and suggestion to improve the tool. Lastly, additional interview findings are described, which are not in the research scope of this thesis. However, these findings are considered as relevant for the application of ECI, D&C or collaboration in general. These findings will not be analysed, further elaboration on these findings are discussed in chapter 8 of this thesis.

For this section it is important to note that when the terms ‘overall collaboration’, ‘collaborative criteria’, or ‘collaborative main criteria’ are used, this refers to the four main collaborative criteria of RECAP: Front-end definition, Collaborative practices, Relational attitudes, and Teamworking quality. Also, the term ‘collaborative sub-criteria’ is used for the corresponding thirteen sub-criteria of the four main collaborative criteria of RECAP. These can be found in Table 5 on page 48 of this thesis.

5.4.1. Case ECI A

Case ECI A is the construction of a pumping station in the east region of the Netherlands. The project was awarded to the contractor in 2016 and was fully completed at the end of 2018 and is in use. It is important to note that after the design phase the project had a standstill of a year because of issues with land acquisition. The budget for the project is around seven million euros.

The client (Client A) of this project is project manager for a Dutch water board, which is a regional government entity in charge for managing water barriers, waterways, water levels, water quality and sewage treatment of their respective region. The contractor (Contractor A) is a project manager for a contractor company specialised in the Dutch water infrastructure sector.

Results from round one of RECAP for case ECI A

The assessment forms filled in by Contractor A and Client A are used for this section. The average scores of both parties on the main criteria are shown in Figure 16, and the average scores of both parties on the sub-criteria are shown in Figure 17.

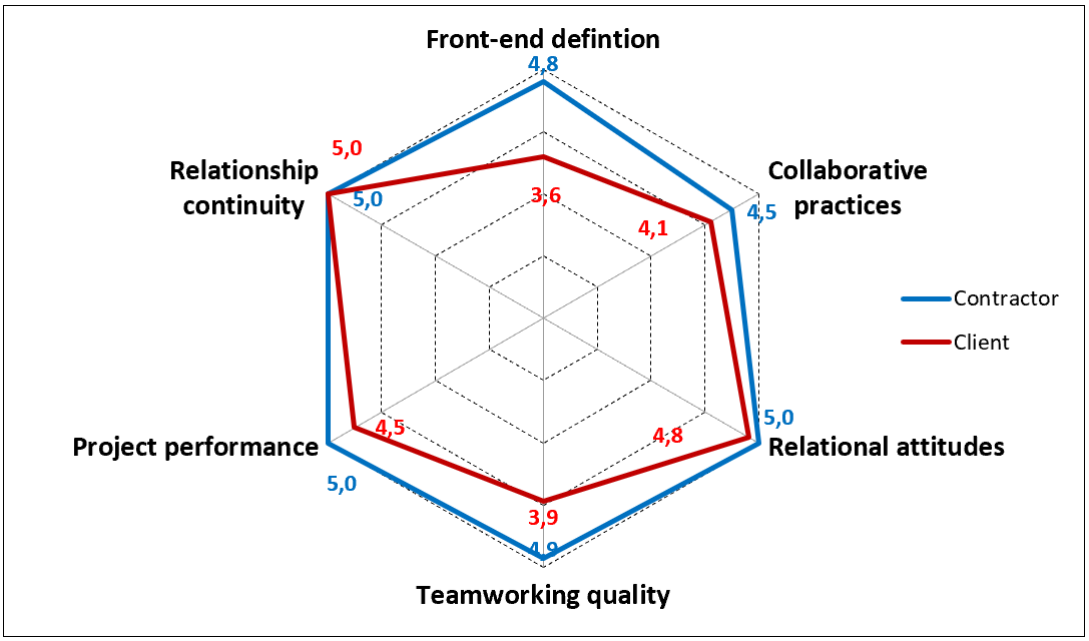

Figure 16: Scores main criteria for case ECI A. (own ill.)

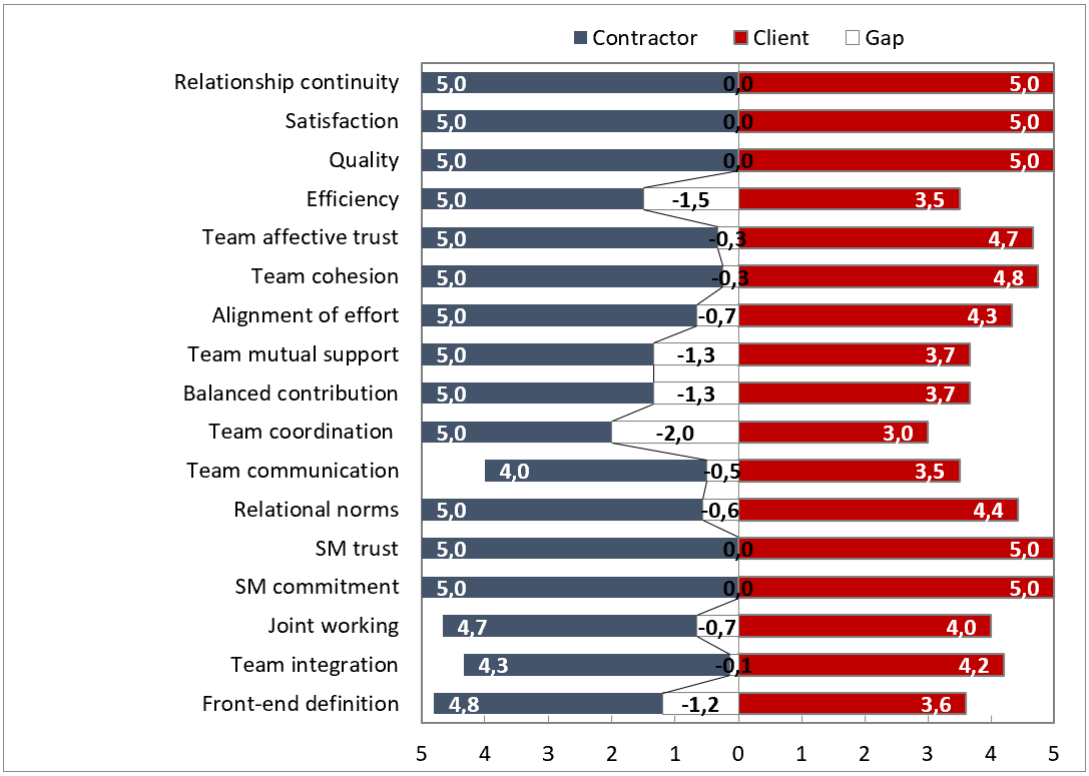

Figure 17:Scores sub criteria for case ECI A. (own ill.)

The results show that the overall level of collaboration is perceived as very good by Contractor A. The scores for the collaborative main criteria range from 4,5 to 5,0. This is regarded as extremely high. The scores for the performance criteria of Project performance and Relationship continuity are also very high, both 5,0. The perspective of Client A on the collaborative criteria is also positive, with scores ranging from 3,6 to 4,8. The perspectives on the Project performance criterion is similar, with a score of 4,5 on Project performance and 5,0 on Relationship continuity. This suggests that case ECI A is delivered according to the required plan, budget and quality (both scored 5,0 on quality). A notable aspect in the Project performance criteria is the scores on Efficiency, Client A scored 3,5, Contractor A scored 5,0. This would suggest that the client was less satisfied with the efficiency planned beforehand compared to the contractor. However, that did not affect the client-contractor relationship, as both parties score 5,0 for Relationship continuity.

Despite the satisfactory results, there are some substantial score gaps on Front-end definition (1,2 points) and Teamworking quality (1,0 point) between the client and the contractor. Contractor A scores higher on Front-end definition (4,8 points) than Client A (3,6 points). That is a remarkable gap, especially because this is an ECI project. In ECI projects a design team is formed, and therefore it would be expected that the Front-end definition would not differ so much. The reason for the gap could be that the expectation of Client A was higher compared to that of Contractor A. This will be a discussion point for the second round of RECAP. The gap in Teamworking quality is also quite high, in which again Contractor A (4,9 points) scores higher than Client A (3,9 points). In case ECI A, the gaps are quite high in the alignment of effort criterion (Client A scores 0,7 points lower than Contractor A). The gaps are substantial for the Team mutual support criterion (Client A scores 1,3 points lower than Contractor A), Balanced contribution criterion (Client A scores 1,3 points lower than Contractor A) and Team coordination criterion (Client A scores 2,0 points lower than Contractor A).

These RECAP results indicate that even though the project is seen as successful by both participants, regarding the Project performance and Relationship continuity, the results reveal some differences in the perspectives of the participants about the client-contractor collaboration. In case ECI A, Client A seems less satisfied with the mentioned criteria, but still satisfied enough as the Project performance and Relationship continuity were scored very high. It is important to note that Contractor A scored very high on all criteria, almost unrealistic high. That could partly explain some of the gaps, in the second round of RECAP.

Results from round two of RECAP for case ECI A

The results from the interviews reflected the overall expectations as described in the first round. Both Client A and Contractor A were satisfied with the overall collaboration and performance of the project. During the discussion about the overall progress of the project it became clear that the project had a standstill for about a year. This was because of issues with the land acquisition on behalf of the client. Despite the standstill, the essence of ECI was clear in this project. During the construction phase there were no issues regarding errors in the design. The project was executed within the expected time and costs beforehand. In this project, workshops were held throughout the design team phase in order to maintain the collaboration.

During the interviews, the RECAP results were shown to the participants. It is important to note that Client A mentioned a limitation regarding the results from the first round. He stated that from the RECAP results, it could be derived that the client was less satisfied than the contractor. He explained that it was unlikely for him to rate scores extremely high, as rating scores differ for each individual. Contractor A agreed with Client A, stating that he himself is more likely to rate scores perfect. This limitation became clear when the results were discussed. The discussed criteria with a gap of 1,0 point and higher are shown in Table 8.

Criterion	Score contractor	Score client	Gap
Front-end definition	4,8	3,6	1,2
Efficiency	5,0	3,5	1,5
Team mutual support	5,0	3,7	1,3
Balanced contribution	5,0	3,7	1,3
Team coordination	5,0	3,0	2,0

Table 8: The criteria with a gap of 1.0 point and higher in scores for case ECI A.

For the criterion of Front-end definition, the scores were as was expected from an ECI project. When Client A was asked about the gap, the gap could not be explained. He stated that the scope, goals, roles and responsibilities were clear and set up together. Client A noted that the complexity at the start of the design was high and that the use of ECI was helpful. Client A stated that his organization did not have the expertise to draft a feasible design and that the early involvement of the contractor was useful to fill the lack of expertise.

The criterion of Efficiency suggested beforehand that the project was not executed as planned. This is partly true, as the project had a standstill. However, the standstill was not caused by poor collaboration or a conflict. The standstill was caused because of issues with the land acquisition. One would expect that the contractor would be less satisfied with this. When Contractor A was asked why he rated that score a 5,0, he explained that even though the standstill was caused because of a shortcoming on the side of the client, that this kind of risks

are unforeseen. He stated that the client could not expect to take a year for the acquisition of the needed lands.

As for the criteria of Team mutual support, Balanced contribution and Team coordination no clear explanation was found for the significant gaps. Both participants stated that during the design team phase the coordination, contribution and mutual support was very high. Furthermore, they stated that during the construction phase these aspects were less relevant. There were no significant issues during the construction phase.

RECAP evaluation

Both participants reacted positively on the practicality of RECAP. The assessment form was regarded a bit too long by both participants. However, they also stated that the covered statements were not ambiguous, and the assessment form was quite comprehensive and complete. They both found the form easy to fill in and it was completed in 30/35 minutes. Furthermore, both were positively surprised by the extent to which the success factors for collaboration are included in the tool. Client A compared it to the 'Past Performance' tool by RWS and stated that this tool was more extensive. Contractor A even suggested that some aspects of RECAP could be added to the 'Past Performance' tool.

Furthermore, both participants agreed that the RECAP tool could be useful to use during an infrastructure project. Client A recognized that the RECAP tool can be used to identify differences in perception between members of the project teams. Then the project teams can be aware of the perspective of each other, and they can work on those aspects. Both agreed that the use of RECAP should be done multiple times, in different phases of a project.

Lastly, Contractor A suggested that some statements on the Relational norms criterion could be combined to make the list shorter. However, he stated that if the tool would be used during a project that would not be an issue. The use of the tool would then be seen as a method to improve the collaboration and the managers would not mind the length of the form because of that. He also stated that when the RECAP will be used, the terms should be checked. A small number of statements (he could not remember which) contained some terms which were unusual when ECI is used. Client A suggested that the use of RECAP should be done by more participants, instead of one on each side.

Additional interview findings

During the interviews, some remarks were made by both participants regarding aspects that needed attention and potential pitfalls in ECI projects. Contractor A suggested that the use of ECI should mainly considered when the client lacks a certain area of knowledge or expertise. He warned that when ECI is used, the client and contractor should complement each other with their expertise. Both participants also agreed that the use of ECI may not always be the ideal choice. They both referred to articles in Cobouw in which ECI is eulogized as a solution for most projects. Both stated that there is not one contract that fits all projects. Furthermore, Client A remarked that for the use of ECI means that more capacity is needed during the design team phase and that clients should be aware of that. Especially when multiple ECI projects are being carried out. This capacity is needed in the design team but is beneficial for the construction phase. Client A also recommended including a cost expert on the side of the client to the design team. He stated that this does not necessary mean that this is because of distrust,

but rather a confirmation to the senior management of the client. Contractor A agreed that this was recommended for the client.

Contractor A made some remarks on the differences between clients and contractors in general. He mentioned a pitfall regarding the aspect of the lacking mandate on the side of the client. In general, a contractor makes decisions quicker compared to clients. This is because of the structure of the organisation of the client. A manager on the side of the client cannot make critical decisions, with financial consequences, on his own. Normally, that manager has to have the support from the SM. On the side of the contractor, the structure of the organisation is less complicated and a manager on the side of the contractor has more mandate to take critical decisions. Contractor A stated that this difference in mandate could hamper the process of the design team phase.

Lastly, Client A stated the need for change of the culture in the Dutch infrastructure sector when using ECI or 'ECI like' forms of collaborations, such as alliances and partnering. He stated that the traditional attitude, in which the hierarchy between the client and contractor is dominant, would not work in ECI projects. He stated that the project teams should be open and honest to each other, as ECI provides room to do this.

5.4.2. Case ECI B

ECI project B consist of the maintenance of two districts of a city in the centre of the Netherlands. The two projects are part of large maintenance project, divided into five projects. All five projects will be done in different phases with the same contractor. The first phase is completed in January 2019, the second phase is in the construction phase which started in October 2018 and is expected to be completed in October 2019. The budget for ECI project B is around sixteen million euros.

The client (Client B) is a project manager for a municipality of a medium sized city in the centre of the Netherlands. The contractor (Contractor B) is a project manager for a large contractor company located in the east of the Netherlands, specialised in infrastructure, environmental and maintenance projects.

Results from round one of RECAP for case ECI B

The assessment forms filled in by Contractor B and Client B are used for this section. The average scores of both parties on the main criteria are shown in Figure 18, and the average scores of both parties on the sub-criteria are shown in Figure 19.

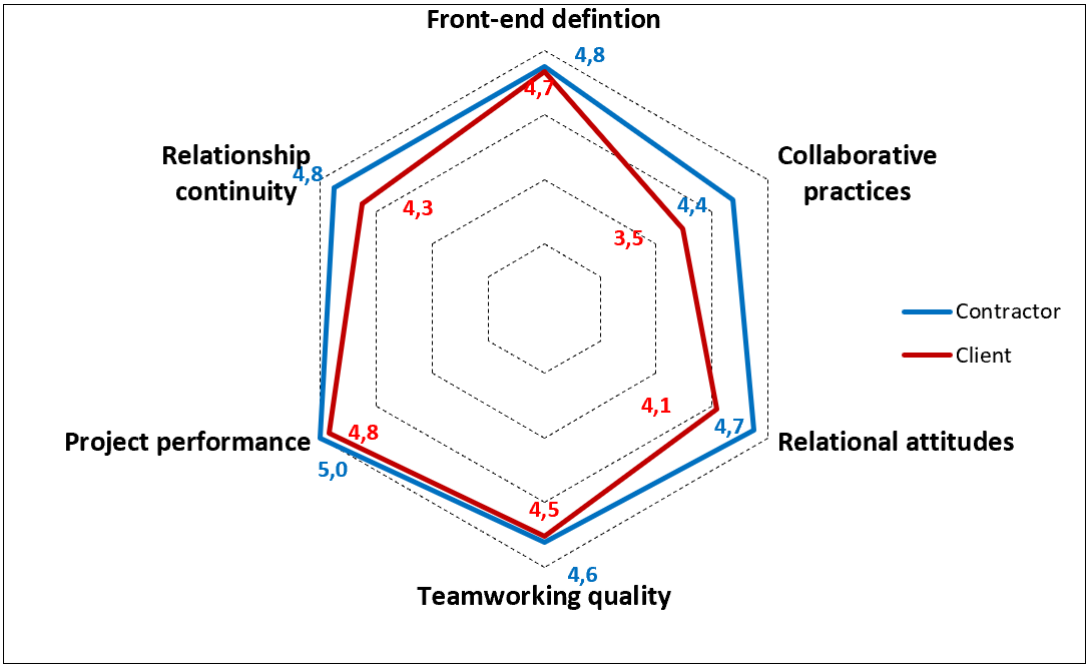

Figure 18: Scores main criteria for case ECI B. (own ill.)

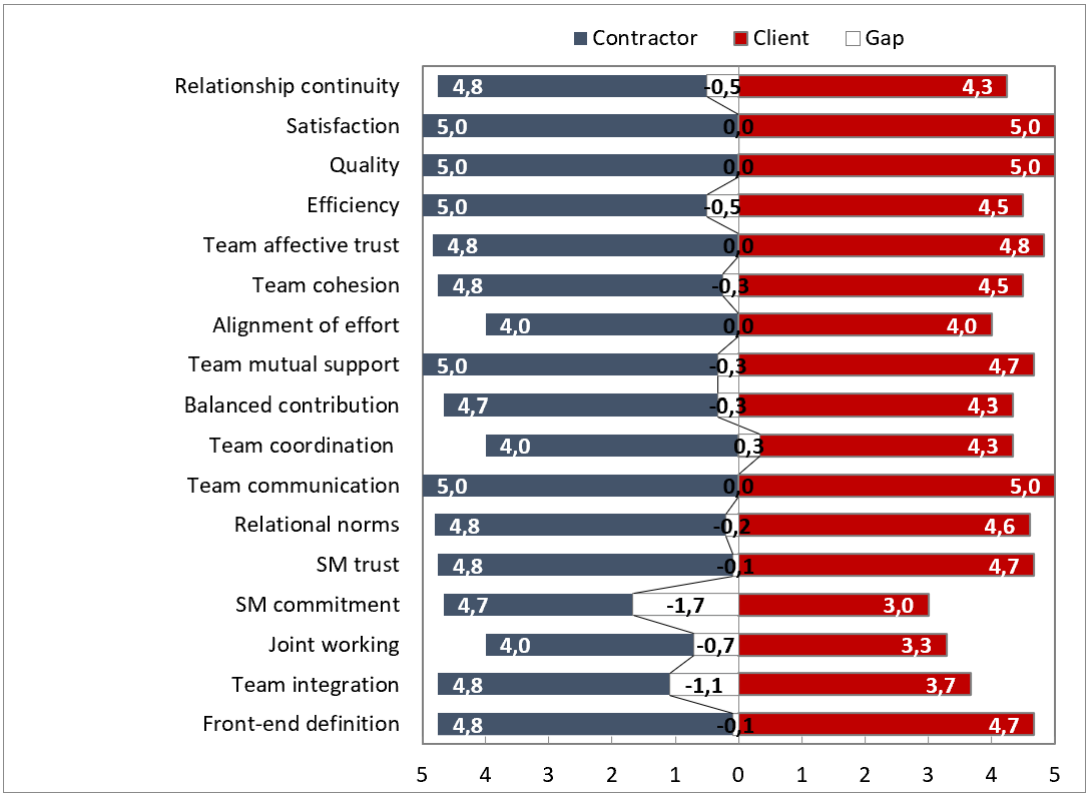

Figure 19: Scores sub criteria for case ECI B. (own ill.)

The RECAP results show that the overall collaboration is perceived as very high by both Client B and Contractor B. The scores for the main criteria range from 3,5 to 5,0. Contractor B scores higher on all main and sub-criteria than Client B. There are no significant gaps in the scores on the main criteria. The highest gap in the main criteria is 0,9 points on Collaborative practices. Furthermore, the criteria of Project performance and Relationship continuity are rated as very high, ranging from 4,3 to 5,0 points.

Looking at the scores for the sub criteria, both participants rate all sub criteria from moderate to relatively high, ranging from 3,0 to 5,0 points. The scores are high and, there are almost no large gaps in the sub criteria. The remarkable gaps, which will be discussed in the second round, are present in the following sub criteria: Senior management commitment (Client B scores 1,7 points lower compared to Contractor B) and Team integration (Client B score S 1,1 points lower compared to Contractor B). That would suggest that Client B is less satisfied with the Senior management commitment, even though Client B scores 4,7 points on Senior management trust. This is interesting because this suggests that the trust is present, but the commitment is lacking. Also, the fact that the criteria of Joint working and Team integration were rated lower by Client B suggests that the client was less satisfied with the Collaborative practices.

Overall, case ECI B scores high to very high, without substantial gaps in the main criteria. There are some significant gaps in a small number of sub criteria. Despite those gaps, both parties seem satisfied and would continue the relationship. That is important, as both parties still have to collaborate within three more maintenance projects in the near future.

Results from round two of RECAP for case ECI B

The results from the interviews reflected the overall expectations as described in the first round. Both Client B and Contractor B were satisfied with the overall collaboration and performance of the project. There were no significant issues during the design team phase and the construction phase. The project is not completed yet, the first phase is completed within budget and time. The second phase is also expected to be completed as planned. Both participants stated that the client-contractor relationship had been very good. In this project, workshops were held throughout the design team phase in order to maintain the satisfactory collaboration.

During the interviews, the RECAP results were shown to the participants. Both participants said not to be surprised by the results, as there were only few gaps in perception. The discussed criteria with a gap of 1,0 point and higher are shown in Table 9.

Criterion	Score contractor	Score client	Gap
SM commitment	4,7	3,0	1,7
Team integration	4,8	3,7	1,1

Table 9: The criteria with a gap of 1.0 and higher for ECI project B.

For the criterion of SM commitment, it is important to note that both participants only rated the statements regarding their own SM. Client B stated that he would have preferred more commitment from the SM of his organisation. This was because the SM rejected some proposed decisions which were critical. Client B felt that the design team phase would have been done more smoothly if the SM of his organisation would be more consistent and provide the necessary means to his team. When this aspect was discussed with Contractor B, he stated that it did indeed hamper the design team phase. However, he also stated that the lack of commitment of SM on the side of the client did not have a major effect on the client-contractor collaboration.

For the criterion of Team integration, there was no relevant explanation. For this aspect, the client only stated that he felt that the contractor's pace was very high compared to the client.

However, he also stated that the difference in pace between a client and contractor is a known phenomenon in general.

RECAP evaluation

Both participants reacted positively on the practicality of RECAP. The assessment form was regarded a bit too long by Client B. However, he also stated that the covered statements were not ambiguous, and the assessment form was quite complete. Contractor B did not find the form too long and he agreed on the completeness of the form. They both found the form easy to fill in and it was completed in 30/40 minutes.

Furthermore, both participants agreed that the RECAP tool could be useful to use during an infrastructure project. Contractor B even suggested to use the RECAP tool in the following phases of the major maintenance projects. Both recognized that the RECAP tool can be used to identify differences in perception between members of the project teams. It provides awareness for the project teams, and they can work on significant gaps in perceptions. Both agreed that the use of RECAP should be done multiple times, in different phases of a project.

Lastly, Client B stated that there is a pitfall using these kinds of tools. There is a risk for misinterpreting for some statements (he did not mention which statements). However, when the interviewer explained that these misinterpretations could be identified during the second round of RECAP, Client B agreed that that would help to prevent the pitfall. Client B added to this, that the second round would be more useful if it is conducted in a group, instead of separately.

Additional interview findings

Contractor B made some statements about the comparison of the ECI model and the D&C contract, as he had experience with both. He stated that the D&C is in general the same as the Design-Bid-Build contract, but the risks and responsibilities are transferred to the contractor. While this may provide opportunity for innovation and quicker delivery, he stated clearly that those opportunities are based on the tender procedure and the requirements put to tender. He stated that the UAC-IC 2005 is based on a lot of paperwork, and the chances for misinterpretations are high. Contractor B went on by saying that the fact that misinterpretations exist in integrated contracts is not the pitfall of the integrated contracts. Misinterpretations can occur with any model or contract. However, a clear distinction between ECI and D&C is the room for jointly solving those kinds of problems. Using integrated contracts, the client and contractor are not motivated to jointly solve the issue of misinterpretations. It feeds the blame culture, with parties pointing at each other and the contract. In ECI projects, during the design team phase, all parties have the freedom to jointly solve issues like misinterpretations. Of course, every member has its own responsibilities and liabilities, but it feeds a no blame culture. The ECI model sets a basis to collaborate. Client B was presented this aspect and he agreed that Contractor B was somewhat right. However, Contractor B also stated that the D&C does also have its advantages for clients. He understood that in some cases in the Dutch infrastructure sector, the transfer of risks and responsibilities was out of balance. However, he stated that it is important to learn from those mistakes and to try to solve it, instead of throwing away the concept of integrated contracts.

In addition to this, Contractor B mentioned that a great pitfall of integrated contracts compared to ECI is the fact that the client has to use functional specifications in the tender documents. The following quote summarises this: *"Sometimes the client thinks he specified a Ferrari to tender, and that is what he expects. However, in some cases the contractor interprets it as a Mini Cooper. While a Mini Cooper is not a bad car, I personally would be disappointed if I got a Mini Cooper while expecting a Ferrari"*

Client B provided some recommendations on applying ECI. He agreed that the use of ECI needs more capacity in the design team phase. He stated that this need of more capacity is beneficial to speed up the design phase of a project. However, he mentioned that while despite the benefits of ECI for speeding up the design phase, there is a lot of time needed to start a design team. He mentioned that a lot of time and capacity is used to set up a design team and to find the balance at the start. He concluded that it would not be beneficial if ECI is used for small projects. The essence of ECI is then diminished, so much time is lost to start up the design team. For larger projects, the ECI is ideal. He gave the example of case ECI B. He mentioned that right now, two phases are being designed and constructed. The design phase of the first project took longer, as the design team had to be set up. However, in the second project the design was already in place and the design phase was done a lot quicker. He mentioned that in the remaining three projects of the major maintenance projects are expected to be delivered quicker because of the time and capacity spent in the first project.

Contractor B mentioned, like Contractor A, a pitfall of ECI regarding the aspect of the lacking mandate on the side of the client. He stated that the difference in mandate between the project teams of the client and contractor could hamper the process of the design team phase. Client B agreed to this, but he also stated that it is not simple to change this aspect. He stated that the structure of the organisations is different. Clients are not structured to make profit, so if some decisions are delayed it does not have consequences of the probability of the organisation to be in loss. However, the structure of contractor companies is based on financial gains which is their right to do so, as there is a lot of competition. So, the organisation benefits from the fact that the project team has the mandate to make critical decisions.

Both participants mentioned that the use of ECI cannot be successful if the traditional attitude is applied by the project teams, as mentioned in case ECI A as well. There is a need for a different culture when using ECI or alliances.

Lastly, Client B also recommended the use of a cost expert during the design team phase. Contractor B stated that this is always wise to do, and that he always recommends clients to include a cost expert in the design team.

5.4.3. Case ECI C

ECI project C is the construction of several roads, pipelines, power lines and a bridge near a large city in the south of the Netherlands. In this project, the design phase and construction phase were done partly in parallel. The project was awarded, after a tender process, to the contractor in May 2017. The design team started in August 2019 and lasted for nine months, ending in April 2019. The construction phase started in January 2019, as part of the design was completed for the roads, pipelines and power lines. The project is still in the construction phase and is expected to be completed in December 2020. The budget for the project was

originally estimated at around nine million euros. However, during the design team phase this estimation was adjusted to seventeen million euros. This was because the client underestimated the costs for the bridge. The contractor made a new estimation.

The client (Client C) is a project manager for a municipality of a large city, located in the south region of the Netherlands. Client C had no experience with ECI prior to this project. The municipality is using ECI increasingly often, because of the rising popularity of ECI. The contractor (Contractor C) is a project manager of a medium to large sized contractor company located in the south region of the Netherlands, specialised in infrastructure, environmental and maintenance projects.

Results from round one of RECAP for case ECI C

The assessment forms filled in by Contractor C and Client C are used for this section. The average scores of both parties on the main criteria are shown in Figure 20, and the average scores of both parties on the sub-criteria are shown in Figure 21.

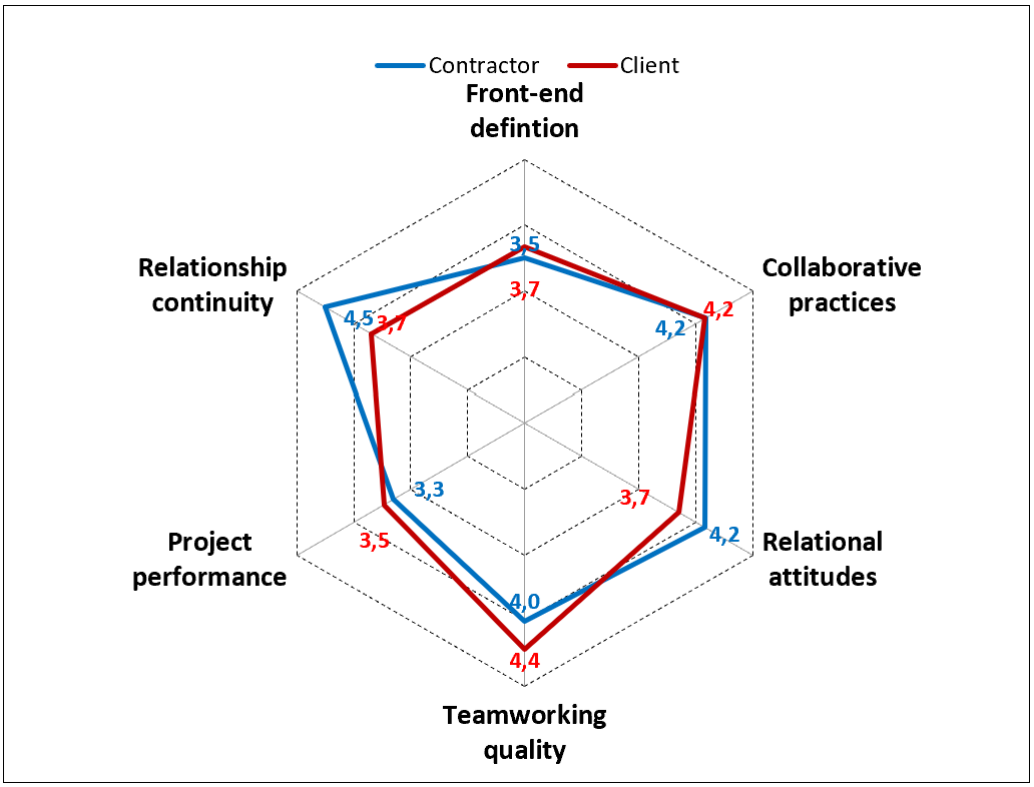

Figure 20:Scores main criteria for case ECI C. (own ill.)

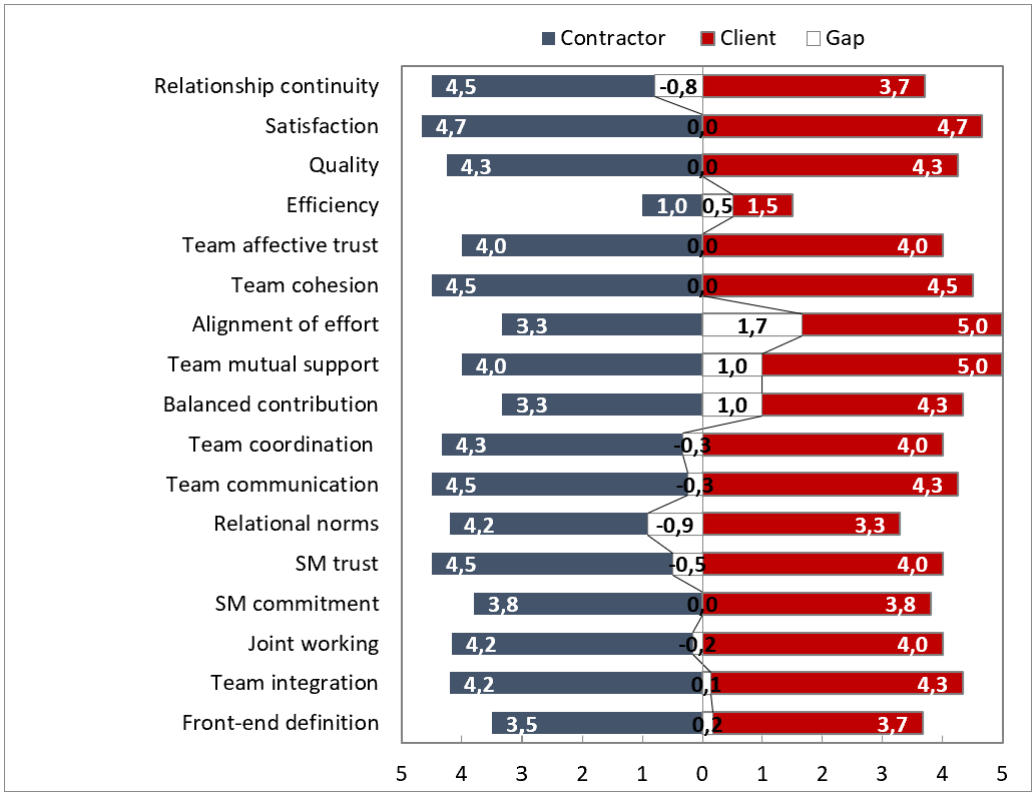

Figure 21: Scores sub criteria for case ECI C. (own ill.)

The assessment results show that the over level of collaboration is regarded as good to very good, by both Client C and Contractor C. The scores for all main criteria range from 3.5 to 4,5. In Figure 20 the balance regarding to which participant was more satisfied is clear. There are no significant gaps of 1,0 point or higher. The largest gap in the main criteria is in Relationship continuity (0,8 points). Lastly, this project is still ongoing. Part of the design is being constructed and the design for the bridge is done in parallel.

While there are no significant gaps of 1,0 point and higher in the main criteria, there are some significant gaps and remarkable scores for some sub-criteria. Firstly, the sub criterion of Efficiency is rated 1,0 by Contractor C and 1,5 by Client C. This suggests cost or time overruns. Furthermore, the sub criteria of Alignment of effort, Team mutual support and Balanced contribution show significant gaps of 1,7 points, 1,0 point and 1,0 point, respectively. All these sub criteria were rated higher by Client C. This would suggest that Contractor C was less satisfied with those aspects. These aspects will be discussed during the interviews with Contractor C and Client C.

Overall, case ECI C shows relatively high scores with no significant gaps in the main criteria. There are some significant gaps in some sub criteria and the efficiency was rated very low. Despite these gaps and the low score for efficiency, both parties scored relatively high for Relationship continuity.

Results from round two of RECAP for case ECI C

The results from the interviews reflected the overall expectations as described in the first round. Both Client C and Contractor C were satisfied with the overall collaboration and performance of the project. The differences in the cost estimations for the steel bridge was perceived as the

only significant issue during the project. Both stated that this issue did not have an effect on the collaboration between the project teams.

When asked about the low scores on Efficiency, both participants agreed that the addition of the bridge did not affect the relationship. The cost estimation of the steel bridge was done by the SM of the client. Originally, the budget for the overall project was set at around nine million euros. Contractor C stated that the bridge would actually cost seven million euros extra, totalling in eighteen million euros. While Client C did understand this, his SM did not agree to this. The SM of Client C found this expense too high and suggested a cost estimation by a third party. It is important to note that Client C and his project team did not agree to do this, as they were convinced by the cost estimations of Contractor C for the steel bridge. Despite disagreeing, a cost expert reviewed Contractor C's estimation. This resulted in a change in design, lowering the cost overrun from seven million euros to six million euros. Both Contractor C and Client C stated that they understood the SM and that it did not affect the trust in Contractor C. When asked why the trust in Contractor C was not affected, Client C stated that Contractor C was not wrong about the cost estimation. The cost estimation was based on a different design than that of the final design.

Client C noted that the relationship between him and his SM was poor. This was surprising as the RECAP results did not show this. Client C stated he misinterpreted the statements regarding SM. Client C furthermore stated that the poor relationship with his SM was internally and had nothing to do with the project. He explained that the introduction of a third party to review the cost estimation was a result of this poor relationship. Client C stated that the collaboration with Contractor C was very good and that he felt that project teams of both sides were acting as one project team.

During the interview, the RECAP results were shown to the participants. The discussed criteria with a gap of 1.0 point and high are shown in Table 10.

Criterion	Score contractor	Score client	Gap
Alignment of effort	3,3	5,0	1,7
Team mutual support	4,0	5,0	1,0
Balanced contribution	3,3	4,3	1,0

Table 10: The criteria with a gap of 1,0 points and higher for ECI project C.

The criterion of Alignment of effort was perceived as very high by Client C and average by Contractor C. When Contractor C was asked about this, it became clear that he misinterpreted the statement. He stated that his score was lowering because of the issues with the SM of Client C. He stated that the effort was in balance between the project teams.

For the criterion of Balanced contribution, Contractor C mentioned the lack of proposed ideas by the project team of Client C. He stated that did not affect the relationship in a significant way, but he would have preferred more contribution on that matter. He also stated that Client C was contribution regarding the client's expertise. Client C agreed with Contractor C, stating that his project team could have contributed by proposing ideas. He also stated that because of his lack of experience with ECI, there was a fear of transferring responsibility to his organisation by proposing ideas outside of his expertise. He stated that the knowledge and expertise of the project team of Contractor C was remarkably high. As mentioned in case ECI

A and B, in this project the aspect of differences in pace and mandate was also mentioned.For the criterion of Team mutual support, there was no significant explanation found during the interviews.

RECAP evaluation

Both participants reacted positively on the practicality of RECAP. Both also agreed that the form was not too long, and they found it to be complete. Client C complimented Suprapto for the completeness of the tool, because of the coverage of all the success factors for collaboration. Furthermore, both compared the tool to the 'Past Performance' tool by RWS Lastly, both participants found it easy to fill in and the process of filling the form was done in 25/30 minutes.

Both participants agreed that the RECAP tool could be useful to use during an infrastructure project. They recognized that the RECAP tool can be used to identify differences in perception between members of the project teams. Both agreed that the use of RECAP should be done multiple times, in different phases of a project. Contractor C stated that there are different types of personalities in a design team. Some of them do not come forward with issues regarding the collaboration. With a tool like this, these issues do come forward and could be discussed in a meeting.

Lastly, some suggestions for further improvements of the tool were made. Client C stated that there is a pitfall using these kinds of tools. There is a risk for misinterpretation by members of the project teams. Also, both agreed that the second round would be more useful if it is conducted in a group, instead of separately. Contractor C mentioned a limitation which is not specifically for RECAP but in most tools, which consist of a scale from 1 to 5 or 1 to 10. He stated that he personally would never rate the maximum score or the minimum score. He mentioned that there are also people who rate only extremes. That is something to keep in mind, when reviewing the scores. If you see there is one participant with mainly extremes, you could normalise it by using statistical tools.

Additional interview findings

For this section it is important to note that Client C had no experience with ECI projects prior to this project. Therefore, his contribution in this section is limited to his experience in this project only.

Contractor C had some remarks about ECI and D&C. Contractor also mentioned the issue of the need for extra capacity during the design team phase. He stated that it is easy to solve by hiring skilled people for a few ECI projects. However, during the design team phase the contractor company does not generate significant revenue. Contractor C stated that the role of the contractor was that of a consultant. However, he also remarked that the fact that the contractor had the perspective of the works in the future was more relevant. It was stated that the advantage of being the first and only contractor to bid on the design (which he worked on himself) by far outweighs the disadvantage of the extra capacity. Contractor C mentioned his concerns if ECI is applied more often in an organisation. The organisation has to be aware of the fact that this cannot be solved by only hiring extra workforce. Client C agreed that this was also an issue for the client's organisation. However, his organisation does not apply ECI often

yet. He did foresee issues regarding the need for extra capacity if ECI is applied more often in the future.

Both participants also mentioned that the use of ECI cannot be successful if the traditional attitude is applied by the project teams, as mentioned in case ECI A and B as well. There is a need for a different culture when using ECI or alliances. Contractor C added to this, that the traditional culture in the sector should be tackled earlier compared to how it is being tackled at the moment. He stated that the culture change should be addressed during the education of students in technical universities, such TU Delft, TU Eindhoven and TU Twente. He looked back to his experience as a student and mentioned that in that period there was no attention to the soft aspects of collaborating whatsoever. He recommended students to conduct studies such as this study. There is a need for knowledge on the soft aspects of collaboration.

Contractor C mentioned, like Contractor A and B, a pitfall of ECI regarding the issue of the lacking mandate on the side of the client. He stated that the difference in mandate between the project teams of the client and contractor could hamper the process of the design team phase. Both participants agreed that this issue cannot be solved by simply providing more mandate to the client's project team. They stated that it should be discussed that the imbalance is present, and it could help if contractors are included in meetings between the client's project team and senior management.

Contractor C stated that ECI should mainly be considered when the client lacks a certain area of knowledge or expertise. He warned that when ECI is used, the client and contractor should complement each other with their expertise. When this is done, the base for collaboration is also set toward the construction phase.

Contractor C stated that integrated contracts are based on a lot of paperwork, and the chances for misinterpretations are quite high. He went on by saying that the fact that misinterpretations exist in integrated contracts is not the pitfall of the integrated contracts. However, a clear distinction between ECI and D&C is the room for jointly solving those kinds of problems. Using integrated contracts, the client and contractor are not motivated to jointly solve the issues. It feeds a blame culture, with parties pointing at each other and the contract. In the design team phase the parties have the freedom to jointly solve misinterpretation, it feeds a no blame culture. In addition to this, Contractor C mentioned that a great pitfall of integrated contracts compared to ECI is the fact that the client has to use functional specifications in the tender documents.

5.4.4. Case D&C 1

Case D&C 1 is a dike reinforcement project in the west region of the Netherlands. The project started in 2015 and was completed in September of 2017. The dike reinforcement was done for 8 kilometres assuring the safety of the region from floods till at least 2050. The project budget was around thirty million euros. After the project was awarded to the contractor a cost overrun of four million euros was expected, due to cables and pipes not being laid down yet. Also, the project delivery was expected to be delayed by a year. This was the responsibility of the client and was not part of the project scope. Despite the shortcoming the contractor still managed to execute the project within the budget and time.

The contractor (Contractor 1) is a project manager for one of the largest contractor companies of the Netherlands. The contractor company is specialised in the infrastructure sector and also in the water sector. The client (Client 1) is an environmental manager for a Dutch water board, which is a regional government entity in charge for managing water barriers, waterways, water levels, water quality and sewage treatment of their respective region.

Results from round one of RECAP for case D&C 1

The assessment forms filled in by Contractor 1 and Client 1 are used for this section. The average scores of both parties on the main criteria are shown in Figure 22, and the average scores of both parties on the sub-criteria are shown in Figure 23.

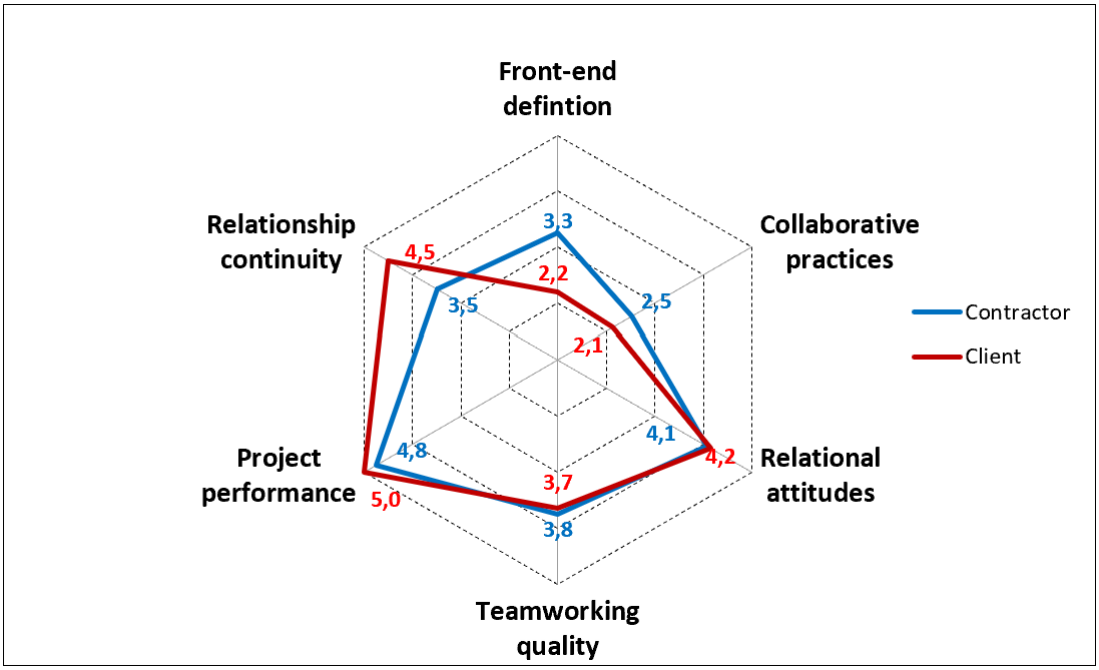

Figure 22: Scores main criteria for case D&C 1. (own ill.)

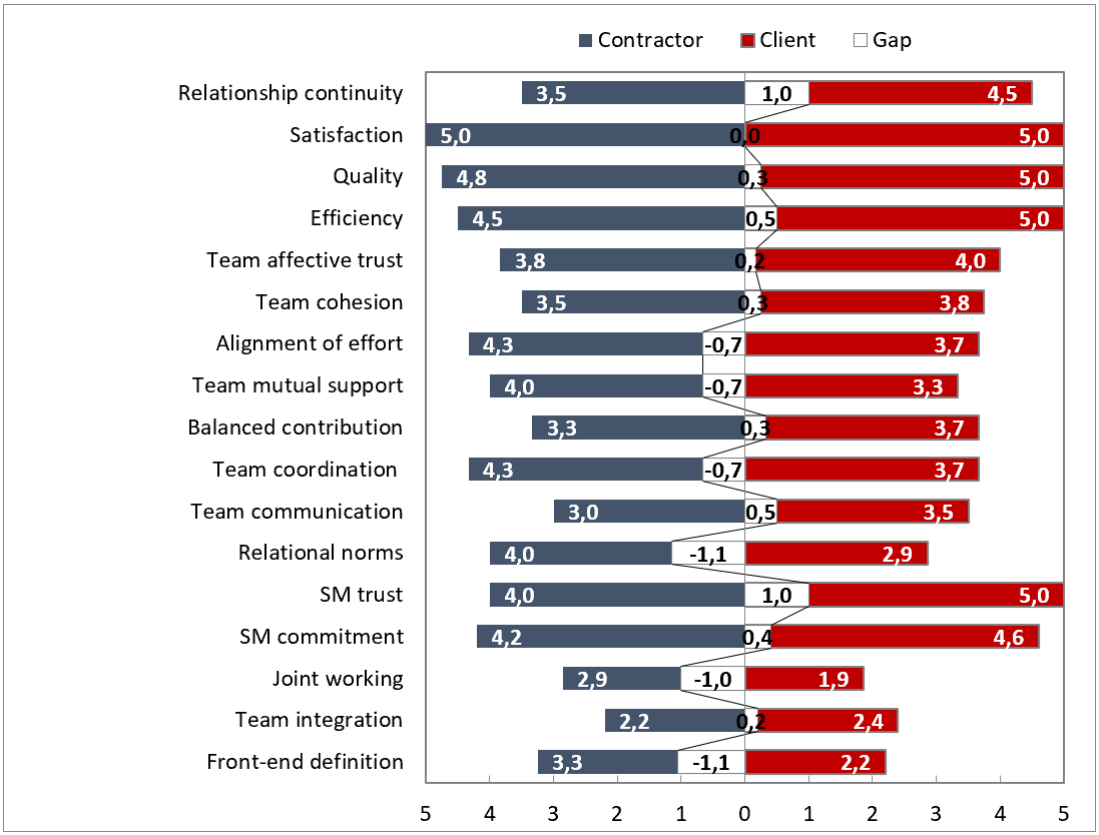

Figure 23: Scores sub criteria for case D&C 1. (own ill.)

The results for the main criteria show a wide range, with scores ranging from 2,1 points to 5,0 points. The overall scores of the collaborative criteria are relatively low compared to the cases. On Front-end definition (Client 1 scores 2,2 points and Contractor 1 scores 3,3 points) and Collaborative practices (Client 1 scores 2,1 points and Contractor 1 scores 2,2 points) the scores are the lowest. Also, Client 1 rated those criteria lower than Contractor 1 (gap of 1,1 points). The criterion of Relational attitudes is rated quite good by both parties, and the gap is only 0,1 points. Furthermore, the Teamworking quality is rated just above average by both participants. Interestingly, the scores on Project performance are very high. Client 1 scores 5,0 points on Project performance and Contractor 1 scores 4,8 points. This is interesting because of the low scores on Front-end definition and Collaborative practices. Furthermore, there is a difference in perception in the Relationship continuity criterion, Contractor 1 rated that criterion with 3,5 points and Client 1 with 4,5 points (gap of 1,0 point). The gaps on Front-end definition and Relationship continuity will be discussed during the interviews. Also, the low scores mentioned will be discussed.

Looking at the sub criteria, there are substantial gaps shown in Relational norms (gap 1,1 points), Senior management trust (gap 1,0 point), Joint working (gap 1,0 point) and Front-end definition (gap 1,1 points). The lowest scores in the sub criteria are that of Joint working (Client 1 scores 1,9 points and Contractor 1 scores 2,9 points) and Team integration (Client 1 scores 2,4 points and Contractor 1 scores 2,2 points). This confirms the results shown in the main criteria, which is that both perceived the client-contractor collaboration as relatively poor.

Even though the collaborative aspects within this project were rated as low, the project was still within budget and schedule. This suggests that a successful project does not always mean

that the client-contractor collaboration is successful. The reasons for this are not clear looking at the RECAP results. It will be interesting what the results will be in the second round.

Results from round two of RECAP for case ECI C

The results from the interviews in some way did reflect the overall expectations as described in the first round. The expectation was that the collaboration within project D&C 1 would be unusual. After the project was awarded to the contractor, there was already a delay caused by shortcoming from the client. Due to cables and pipes not being laid down yet, which had to be done before the project started by the client as this was stated in the contract. Furthermore, the land acquisition of the lands described in the Employer's requirement was not done in time. Because of these shortcomings there was a cost overrun of four million euros was expected. Also, the project delivery was expected to be delayed by a year. This was the responsibility of the client and was not part of the project scope. Despite the shortcoming, the contractor still managed to execute the project within the budget and time. Contractor 1 was asked how this was achieved. He described the progress of the project. As mentioned, the project started with an expected delay. The reinforcement of the dikes is normally not allowed in the winter (from October till April). The contractor proposed to work in those months, this was necessary to deliver the project in time. For this proposal the support was needed from the SM of Client 1. The SM allowed the works to be done in the winter and that was mainly why there was no delay.

During the interview with Contactor 1, the unusual overall results of the RECAP were presented. The relationship in this project was different. Contractor 1 described the relationship as detached (in Dutch: afstandelijk). The contract manager of Client 1 stated to the project teams that it was the intention to let the contractor do the works and that it was not intended for the client to be engaged to come up with a solution. Contractor 1 and his team initially thought that this was ignorant from the client and that the progress would be difficult. However, Contractor 1 stated that the attitude of the client was the main reason why the cost and time overrun was prevented. The reason for this was, according to Contractor 1, the trust in the contractor. Even though the client's team was not directly engaged but rather preferred to work remotely, the client's attitude was positive. This was because of the trust in the contractor. The client asked the contractor to propose solutions to prevent the delay and cost overruns. The contractor could have refused this, as this was not in the contract. However, the contractor accepted this and was given trust and the necessary means. The following summary was given by Contractor 1 (citation in Dutch):

"Dat zat er meer in dat de contractmanager van de opdrachtgever zei vanaf het begin dat het uitgangspunt is dat wij niets doen. Wij doen niets, jullie werken het uit. Dat klinkt negatief maar het positieve is dat de opdrachtgever ons enorm veel verantwoordelijkheid en vrijheid gaf. Het voorbeeld van in het gesloten seizoen werken werd door de contractmanager toegelaten. Dat was de risico van de opdrachtgever maar omdat wij het leverden verdienden we er ook aan. Dus er is wel een afstand tussen de opdrachtgever en aannemer maar met vertrouwen. Dat zag je ook terug in het feit dat wij als aannemer de vtw's ook zelf tekstueel mochten verwerken. Dat vergt veel vertrouwen, normaal gebeurt dat niet. Desondanks dat de afstand er was, was de opdrachtgever over heel veel problemen ook transparant. Normaal houdt de opdrachtgever de problemen voor zichzelf, want hij denkt dan dat de aannemer er misbruik van maakt. Hier was er juist vertrouwen door de problemen te vertellen. Hij vroeg ons het op te lossen en hield vervolgens weer afstand. We hebben dus in dit project niet zozeer samen aan problemen

gewerkt maar juist problemen transparant voorgelegd en zij lieten ons ruimte om de problemen op te lossen en er aan te verdienen. In eerste instantie dachten wij als aannemer van die opdrachtgever doet helemaal niets. Achteraf zie je pas wat hun achterliggende gedachte was daarvoor. Ze durfden het uit de hand te geven door de benodigde informatie te delen met ons. Normaal durft de opdrachtgever dat niet, uit wantrouwen. Hier was er veel vertrouwen in de aannemer. Het gedrag is ergens wel logisch omdat het probleem formeel bij de opdrachtgever lag, zij hadden ons ook wel nodig. Voor de aannemer geldt: Als er geld verdient wordt, dan vertrouw je de opdrachtgever ook sneller. Als de opdrachtgever de aannemer geen geld gunt, dan creëer je als het ware een situatie waarbij de aannemer het geld ergens moet halen. Daardoor krijg je ook dat de aannemer naar meerwerk gaat zoeken. Dan krijg je wantrouwen."

Client 1 was presented the description of the relationship and agreed fully. Client 1 stated that the conditions were not ideal but that they needed the help of the contractor to prevent the expected overruns. Client 1 further stated that the issues were known beforehand. However, because of time pressure the tender process was started regardless.

In hindsight, the results from the first round reflected this relationship as well. The scores were low on Collaborative practices, Joint working and Team integration. On the other hand, the scores on Team affective trust, Team mutual support, Team coordination, SM trust, and SM commitment were above average/relatively high.

During the interview, the RECAP results were shown to the participants. The discussed criteria with a gap of 1,0 point and higher are shown in Table 11.

Criterion	Score contractor	Score client	Gap
Front-end definition	3,3	2,2	1,1
Relationship continuity	3,5	4,5	1,0
Relational norms	4,0	2,9	1,1
SM trust	4,0	5,0	1,0
Joint working	2,9	1,9	1,0

Table 11: The criteria with a gap of 1.0 and higher for D&C project 1.

For the criterion of Front-end definition, the scores were explained by the distance between the client and the contractor. The Project Management Plan was not drafted together, and the specifications were not assessed together. However, both Client 1 and Contractor 1 stated that this is not always done when using the D&C contract. It depends on the client. In this case, the client clearly did not have the intention to engage.

The criterion of Relationship continuity was perceived higher by the client. Client 1 was more satisfied with the relationship. Contractor 1 stated that the relationship was not ideal but because of the open attitude and trust given by the client he would collaborate with the client in the future. For the gaps in the criteria of SM trust and Joint working, no explanation was found. This could be because of the limitation of having only one participant from the client and one participant from the contractor.

RECAP evaluation

Both participants reacted positively on the practicality of RECAP. They agreed that the form was not too long, and they found it to be complete. They both found the form easy to fill in and it was completed in 30/35 minutes. Furthermore, both were positive about the extent to which the success factors for collaboration are included in the tool. Furthermore, both participants compared the tool to the 'Past Performance' tool by RWS.

Both participants agreed that the RECAP tool could be useful to use during an infrastructure project. They recognized that the RECAP tool can be used to identify differences in perception between members of the project teams. Both agreed that the use of RECAP should be done multiple times, in different phases of a project. Contractor 1 added that the use of tools like RECAP do not really matter if the client wants to hold on to the hierarchical separation, as the goal is not to collaborate in those situations.

Client 1 suggests some adjustments on statements in Front end definition. It is stated that some processes (planning and scope for example) are done jointly. Using integrated contracts, this is not the goal. It is unusual to do this in D&C projects. Same goes for Team integration, stating that the project teams of both parties function as one team. That also is unusual in D&C projects, the goal is not be one team. There is a clear distinction in the roles. Furthermore, Client 1 suggests the addition of identifying each other's interests. That aspect is regarded as crucial as she has experiences with different types of projects, and she observed that aspect. She went on by clarifying that it is not necessary to align the interests, because the interests of the client and contractor are clearly different. However, by identifying the interests it helps the client and contractor to understand each other better.

Additional interview findings

Client 1 was presented the issue of imbalance in mandate between the project teams of the client and contractor. While this issue was mainly observed in the ECI cases, Client 1 provided some statements on it. She stated that it is not possible to change public organisations just to provide the project team with the right mandate. No organisation would consider that. She did recommend the project teams of clients to pay attention to knowing their organisation. She said: *"You have to know what is possible, and what is not possible. Sometimes you can go over the limit of your mandate a bit, but if you know your organisation well enough this would not be an issue. Also, it depends on your personality if you are willing to go over your mandate a bit."*

Furthermore, Client 1 stated that the personal click between project teams is very crucial for the collaboration. It weighs maybe 70/80 percent to the collaboration. She stated that this personal click cannot always be created artificially, by conducting workshops for example. She recommended changing members in the team when the personal click is not present at all. Furthermore, she also stated that workshops do help in some cases. However, if the client-contractor collaboration is already healthy and satisfactory, then workshops might even be counterproductive. Contractor 1 agreed to this, stating that the use of workshops could always help. He did not see any pitfalls in workshops, stating that it could always be of help.

5.4.5. Case D&C 2

D&C project 2 is a major road maintenance project in the north-west of the Netherlands. The project is completed in 2017. The design phase lasted for one year and the construction phase was done in parts. The construction phase was executed in eight weekends. This was done because of the importance of accessibility of the road. For this project there was pressure on time. The project budget was around twelve million euros. The project suffered some quality issues after completion, as the sensor of the traffic lights were not working as required in the Employer's requirements.

The contractor (Contractor 2) is a project manager for a large contractor company. The contractor company is specialised in the infrastructure sector and maintenance. On the side of the client two managers participated (Client 2.1 & Client 2.2). Client 2.1 was the contract manager and Client 2.2 was the technical manager in this project. The client is a province in the west of the Netherlands.

Results from round one of RECAP for case D&C 2

The assessment forms filled in by Contractor 2, Client 2,1, and Client 2,2 are used for this section. The average scores of both parties on the main criteria are shown in Figure 24, and the average scores of both parties on the sub-criteria are shown in Figure 25. While there are two participants on the side of the client, there is only one score shown in the results. This is the average of the score of Client 2.1 and Client 2.2. This average score is referred to as Client 2.

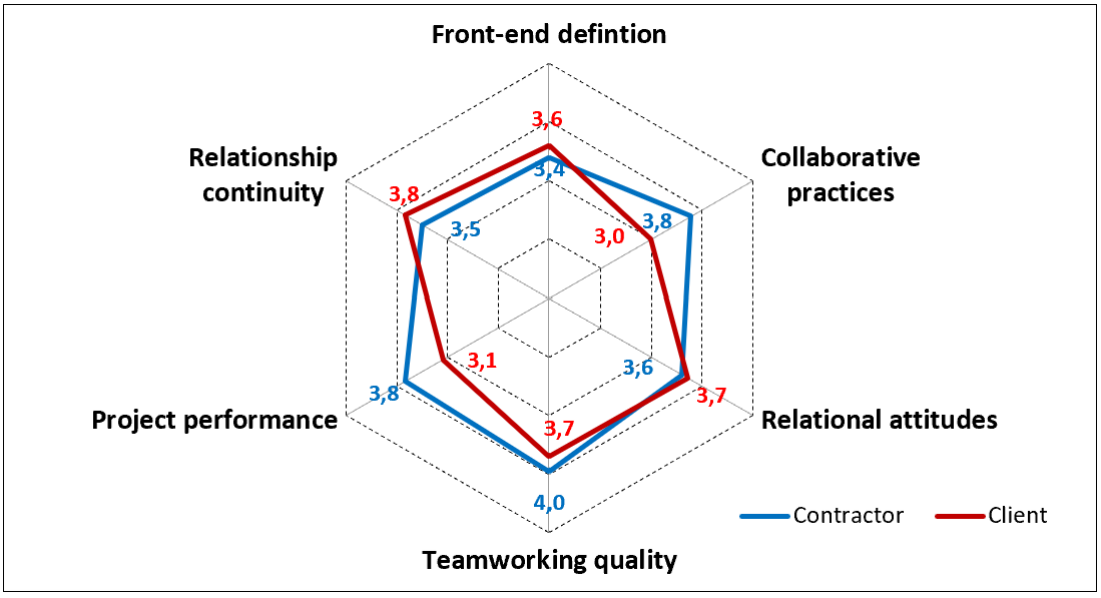

Figure 24: Scores main criteria for case D&C 2. (own ill.)

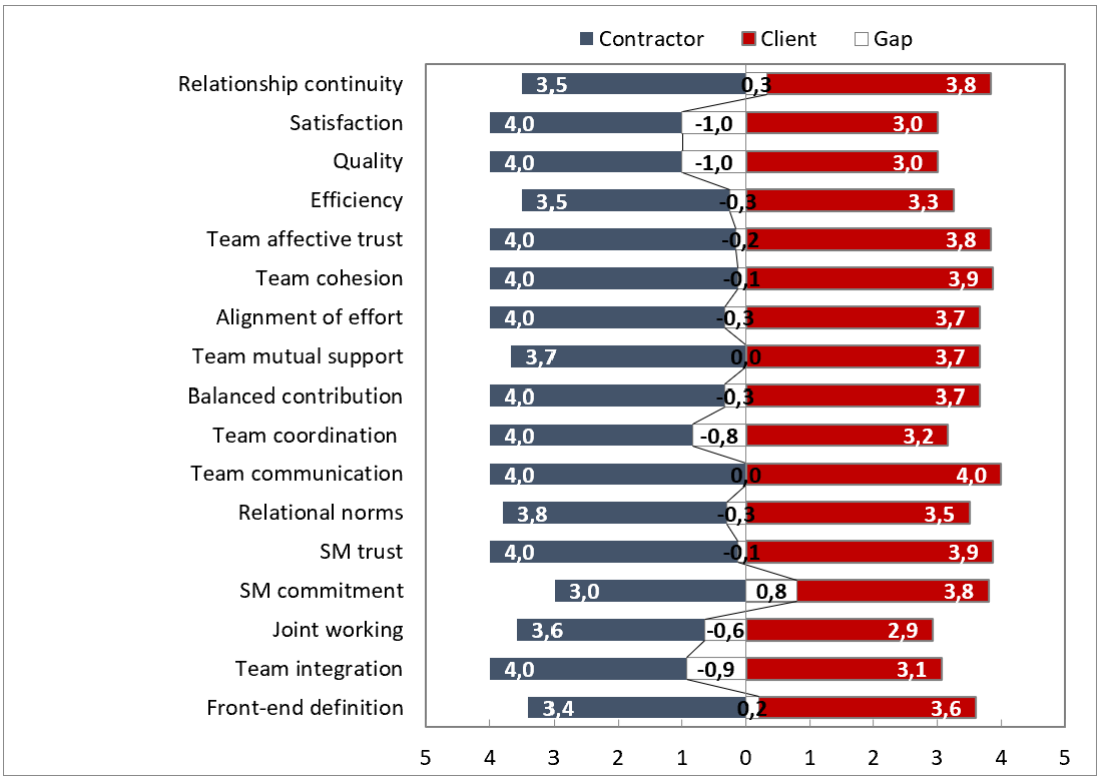

Figure 25: Scores sub criteria for case D&C 2. (own ill.)

The scores on the main criteria show consistency, with scores ranging from 3,0 points to 4,0 points. There are no significant gaps in the main criteria the highest gaps are in the Collaborative practices (gap of 0,8 points) and Project performance (0,7 points). That would suggest that the Client 2 is less satisfied with the Team integration and with the delivered works.

Looking at the sub criteria, there are some substantial gaps shown in Quality (gap 1,0 points) and Efficiency (gap 1,0 point). These will be discussed during the interviews. Also, there is Team integration (gap 0,9 points). For the Project performance criteria Client 2 scores lower than Contractor 2, which suggests that Client 2 is less satisfied with the Efficiency and Quality. This might be because the contractor is responsible for both the design and construction, giving the client has less influence in the design phase. Lastly, there no remarkable scores on the main criteria or sub criteria. The scores are moderate to high.

Results from round two of RECAP for case D&C 1

The results from the interviews reflected the overall expectations as described in the first round. Client 2.1, Client 2.2 and Contractor 2 were satisfied with the overall collaboration during the project. Client 2.1 and Client 2.2 was not satisfied with the performance, as there were issues with the sensors of the traffic lights after completion. At the moment of the interview, which is two years after completion, the quality issues were just sorted. The contractor was liable for this issue in relation to the client. However, during the interview it became clear that the shortcoming was caused by the subcontractor. The subcontractor was held liable for the suffered damages and it was the subcontractor who fixed the issues with the sensors.

During the interview it became clear that Client 2.1 and Client 2.2 did not agree with the choice for the D&C contract. When asked why the D&C contract was used, both stated that it was the

standard form of contracting. Client 2.1 and Client 2.2 agreed that the project team preferred the Design-Bid-Build contract over the D&C contract, as the project team knew their wishes in detail. Because of this project and some other project in which the D&C contract was not preferred, the Senior Management of Client 2 agreed to make exceptions for similar projects in the future. Contractor 2 agreed with these statements by Client 2.1 and Client 2.2, adding that it would have been cheaper for the client.

During the interview, the RECAP results were shown to the participants. The discussed criteria with a gap of 1.0 point and high are shown in Table 12.

Criterion	Score contractor	Score client	Gap
Satisfaction	4,0	3,0	1,0
Quality	4,0	3,0	1,0

Table 12: The criteria with a gap of 1.0 and higher for D&C project 2.

For both criteria of Satisfaction and Quality, the reason for the gap was the quality issues after completion. Contractor 2 added that the time pressure was a cause for this. Contractor 2 had worked with the same subcontractor for several years and the quality was usually according to expectations. One of the requirements in the contract was that the works had to be executed in different time periods. The works consisted of the resurfacing of eight intersections of a main road. It was required that the works had to be done in eight weekends, in which during those weekends the intersections would be fully closed for traffic. Contractor 2 stated that the works for resurfacing the intersection was too much to do in one weekend. As a result, the sensors in the roads of all intersections were not working as stated in the contract. Contractor 2 suggested that the works would have been completed according to the quality requirements if the main road would be closed for about two full weeks, instead of eight different weekends.

Lastly, all participants stated that the client-contractor relationship was as reflected in the RECAP results.

RECAP evaluation

All three participants reacted positively on the practicality of RECAP. They agreed that the form was not too long, and they found it to be complete. They found the form easy to fill in and it was completed in 30/35 minutes. Furthermore, all three were positive about the extent to which the success factors for collaboration are included in the tool. Furthermore, the participants compared the tool to the 'Past Performance' tool by RWS.

The three participants agreed that the RECAP tool could be useful to use during an infrastructure project. They recognized that the RECAP tool can be used to identify differences in perception between members of the project teams. Furthermore, they agreed that the use of RECAP should be done multiple times, in different phases of a project. Contractor 2 remarked a potential pitfall, stating that there are different types of personalities in a project. Some are closed to show their perspective on soft aspects. Especially the alpha types, they might see a tool like this as nonsense.

In general, there were no suggestions for improving the tool. The only recommendation for the use of RECAP was to use it with more participants than two or three. Client 2,1 stated that it could be helpful to include one manager of each IPM model. By doing that you include most of the different elements of the project in the tool.

Additional interview findings

Contractor 2 mentioned the fact that the quality issues originated from the time pressure in the construction phase. As mentioned, the works had to be executed in eight separate weekends. This was done to assure the accessibility of the major road during the week. When Client 2,1 and 2,2 were presented this, they stated that the time pressure was in the requirements and that it was an invalid argument. However, all participants did agree that the choice for an integrated contract was not the right one. The client knew already what he wanted to be constructed. Clients 2,1 and 2,2 stated that the choice for the Design-Bid-Build contract would be preferred next time. Contractor 2 stated that the E&C contract would also suffice in this case. As a result of this project and some other projects with the wrong contract, the senior management of the client has promised to consider other forms of contracting in the future, for similar projects.

5.5. Mapping the results

The results from RECAP will be summarized by mapping the cases on a capability-performance matrix. This is adopted from the study by Suprapto (2016, pp. 195 - 197). On the horizontal axis the scores on the four main collaborative criteria are averaged, and on the vertical axis the scores on the two performance criteria are averaged. The mapping is done the show overall scores of the cases in this research in relation to the average scores adopted from Suprapto (2016). Suprapto (2016) conducted surveys in which he collected 119 responses. He used the average scores of these 119 data points as reference to map three pilot projects, in which RECAP was used. By crossing the average scores on both axis (3.56 points on the collaborative criteria, and 3.53 points on the performance criteria), four quadrants are identified (Suprapto, 2016, p. 195) :

- Q1: low degree of collaboration and low project performance
- Q2: high degree of collaboration and low project performance
- Q3: high degree of collaboration and high project performance
- Q4: low degree of collaboration and high project performance
-

The input data used to map the cases onto the capability-performance matrix is shown in Table 13. These scores are derived from the RECAP results from the case studies.

	ECI A		ECI B		ECI C		D&C 1		D&C 2	
Relational capability	Client A	Contractor A	Client B	Contractor B	Client C	Contractor C	Client 1	Contractor 1	Client 2	Contractor 2
Front-end definition	3,6	4,8	4,7	4,8	3,7	3,5	2,2	3,3	3,6	3,4
Collaborative practices	4,1	4,5	3,5	4,4	4,2	4,2	2,1	2,5	3	3,8
Relational attitudes	4,8	5	4,1	4,7	3,7	4,2	4,2	4,1	3,7	3,6
Teamworking quality	3,9	4,9	4,5	4,6	4,4	4	3,7	3,8	3,7	4
Average	**4,1**	**4,8**	**4,2**	**4,625**	**4**	**3,975**	**3,05**	**3,425**	**3,5**	**3,7**
Performance										
Project performance	4,5	5	4,8	5	3,5	3,3	5	4,8	3,1	3,8
Relationship continuity	5	5	4,3	4,8	3,7	4,5	4,5	3,5	3,8	3,5
Average	**4,75**	**5**	**4,55**	**4,9**	**3,6**	**3,9**	**4,75**	**4,15**	**3,45**	**3,65**

Table 13: input data used to map the cases. (own ill.)

Figure 26 the mapping of the cases on the matrix is done for with the average scores of both the client and the contractor. The different data points are grouped by different colours, each colour for a different case. The differentiation in the data points from the client and the contractor are shown by the different shapes. The square shapes are the data points from the clients and the circle shapes are the data points from the contractors.

All ECI cases are positioned in the third quadrant. As mentioned before, the third quadrant is the most ideal position. ECI case A & B score exceptionally high on both the relational capability axis and project performance axis. ECI C scores above average on the relational capability axis and average on the project performance axis. D&C 1 is placed in the fourth quadrant meaning that the project performance was high, and the relational capability was low. Case D&C 1 scores below average on the relational capability axis and above average on the project performance axis. Case D&C 1 is the only case outside the regression line. The results did not predict the high outcome on project performance for case D&C 1. Case D&C 2 scores exactly average on both the relational capability axis and the project performance axis. Case D&C 2 is the only case on the regression line. Case D&C 2 does not fall into any quadrant as it is positioned in the middle of all four quadrants.

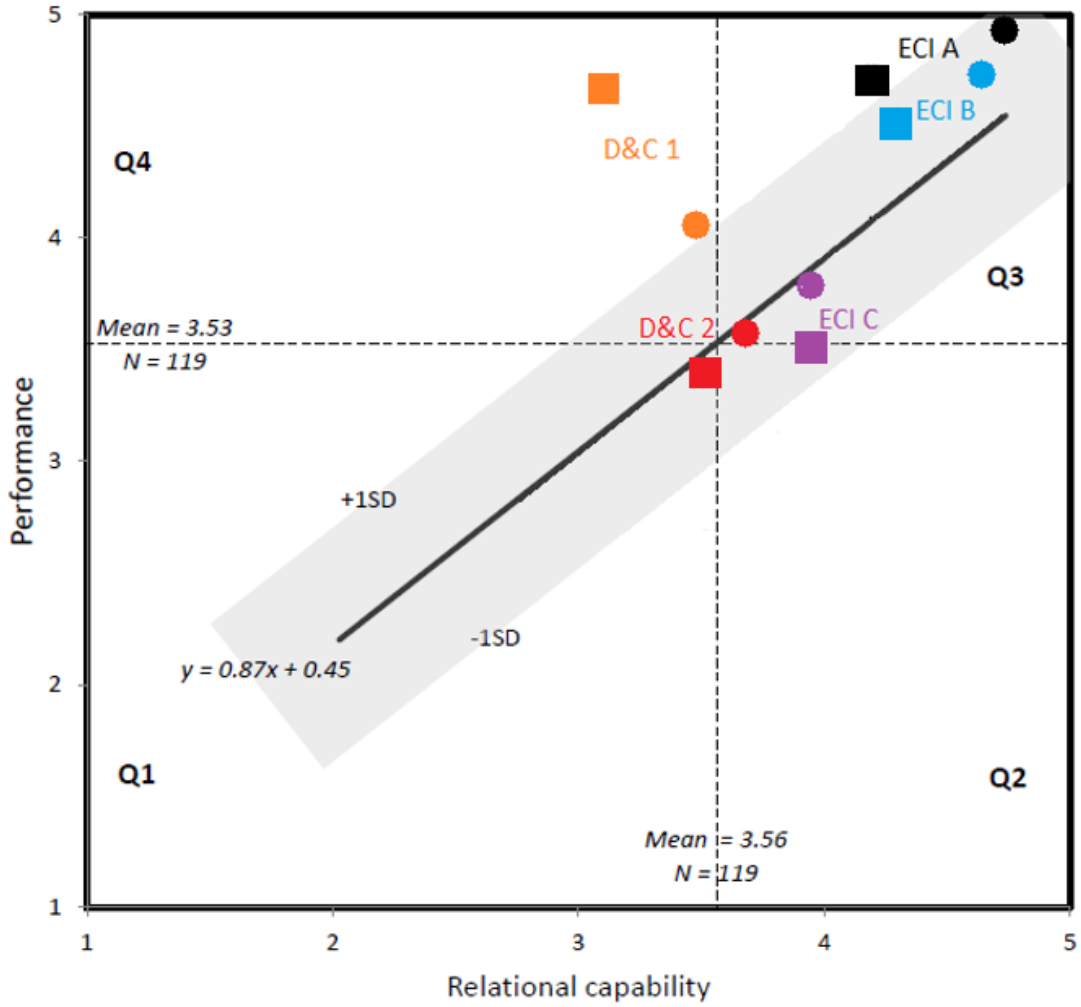

Figure 26: All the cases mapped on the capability-performance matrix. The squares are the scores from the client, and the circles are the scores from the contractor (own ill.)

Furthermore, the scores on the relational capability axis is lower for the clients in all cases. The scores on the project performance is also lower for the clients in all cases, except for case D&C 1. These observations could suggest that clients are less satisfied in general compared to contractors. Contractors A, C, and 2 stated that this could be because of the relation between the client and contract. The client puts his wishes into a tender process and expects that his wishes will be fulfilled. However, the interpretation of the contractor could be different than that of the client. D&C 1 is an exception to this. This could be because of the fact that the client had a problem, which was expected to cause cost and time overruns. However, the contractor still managed (with some help from the client) to execute the project within the budget and time. As the overruns were prevented the client logically was more satisfied, as his shortcomings did not result in cost and times overruns.

5.6. Conclusion

In this chapter the case studies of this research were designed and conducted. The focus in this chapter was on the assessment of the client-contractor collaboration in the ECI and the D&C cases. Furthermore, the focus of this chapter was to evaluate the RECAP tool for the Dutch infrastructure sector. As a result, from this chapter sub-questions 3 and 4 can be answered:

3. To what extent do the success factors to the client-contractor collaboration apply to the case studies?

4. To what extent is the RECAP tool practical and useful to assess the state of the client-contractor collaboration in Dutch infrastructure projects?

5.6.1. Client-contractor collaboration in the cases.

From the RECAP results it can be derived that the scores for case ECI A are all good to very good. Especially the criterion of Relational attitudes scores extremely high (4,9). Case ECI B shows similar results as ECI A, from good to very good. In case ECI B the score on Front-end definition is extremely high (4,8). Case ECI C shows results rated from moderate to very good. In case ECI C the score on the criterion of Front-end definition is lower. This was explained when the RECAP results were discussed. The issues regarding the difference in cost estimations for the steel bridge explains for the lower score on Front-end definition.

The average scores of case D&C 1 shows varying results. The scores on Front-end definition and Collaborative practices are poor to moderate. On the other hand, the scores on Relational attitudes and Teamworking quality are good. The average scores of case D&C 2 are closer to each other compared to D&C 1, scoring on all criteria from moderate to good.

5.6.2. RECAP evaluation

The RECAP tool is evaluated based on the responses from the participants. In total there were 11 participants who were asked the following three questions at the end of the interview:

1. What is your opinion on the practicality of the RECAP tool in the Dutch infrastructure sector? And why?
2. How would you use the RECAP tool in future projects?
3. What are your suggestions to further develop the RECAP tool to use in the Dutch infrastructure sector?

Practicality

All participants reacted positive on the practicality of the RECAP tool in the Dutch infrastructure sector. In general, the participants found the statements easy to rate and the statements were not ambiguous. The time it took the participants to fill in the form was around 30 minutes. Most participants regarded the RECAP to be complete, the criteria reflect the success factors for collaboration. Only Client 1 had something to add to criteria, namely: identifying each other's interests. RECAP was compared to the 'Past Performance' tool of RWS by most participants. Some of them found RECAP to be more extensive and more comprehensive.

Usefulness

The participants also reacted positive on the usefulness of the RECAP tool in the Dutch infrastructure sector. They perceived the tool to be useful to identify differences in perceptions between members of the project teams on the collaboration. Many stated that the tool could provide awareness to evaluate the state of the client-contractor relationship. Furthermore, most participants also stated that RECAP could be integrated in projects in the Dutch infrastructure sector. The RECAP could be used multiple times during an infrastructure project, with several participants on each side. Contractor 1 stated that the use of tools like RECAP do not really matter if the client wants to hold on to the hierarchical separation, as the goal is not to collaborate in those situations. Contractor B reacted very positive on the tool, even suggesting using the tool for the remaining projects in the near future. He recommended to further develop the tool, as tools like this will become crucial with the rise of new forms of collaboration.

Suggestions for improvement

There were suggestions provided by some of the participants. Firstly, most agreed that the use of RECAP should be done with more people and the second round should be done together with all the participants. For planning reasons, this could not be done in this research. However, the RECAP can be used with many participants. Client 2,1 suggested that it could be helpful to include one manager of each IPM model. By doing this most of the different elements of the project are included in the tool.

Furthermore, Contractor A suggested that some statements on the Relational norms criterion could be combined to make the list shorter. However, he stated that if the tool would be used during a project that would not be an issue. The use of the tool would then be seen as a method to improve the collaboration and the managers would not mind the length of the form because of that. He also stated that when the RECAP will be used, the terms should be checked. A small number of statements (he could not remember which) contained some terms which were unusual when ECI is used.

Client 1 suggests some adjustments on statements in Front end definition. It is stated that some processes (planning and scope for example) are done jointly. Using integrated contracts, this is not the goal. It is unusual to do this in D&C projects. Same goes for Team integration, stating that the project teams of both parties function as one team. That also is unusual in D&C projects, the goal is not be one team. There is a clear distinction in the roles. Contractor C mentioned a limitation which is not specifically for RECAP but in most tools, which consist of a scale from 1 to 5 or 1 to 10. He stated that he personally would never rate the maximum score or the minimum score. He mentioned that there are also people who rate only extremes. That is something to keep in mind, when reviewing the scores.

Lastly, Client 1 suggests the addition of identifying each other's interests. That aspect is regarded as crucial as she has experiences with different types of projects, and she observed that aspect. She went on by clarifying that it is not necessary to align the interests, because the interests of the client and contractor are clearly different. However, by identifying the interests it helps the client and contractor to understand each other better.

6. Analysis

6.1. Introduction

In this chapter, the analysis of the case studies will be conducted and described. The client-contractor collaboration in the ECI cases will be compared to that of the D&C cases. This is done to show the differences in collaboration between ECI projects and D&C projects. It is important to note that the project performance will not be analysed, as this research is only on the client-contractor collaboration. The aspect of project performance is likely to be related to the client-contractor collaboration. However, the objective of this research is to provide recommendations on improving the client-contractor collaboration, regardless of its effect on the project performance. Also, as described in chapter 5, all cases in this research scored well on the performance criteria. The goal of this chapter is to answer sub question 5:

5. What are the differences in the client-contractor collaboration between the ECI and D&C cases?

6.2. Analysis approach

The analysis will be done using the RECAP results from chapter 5. Several analyses will be conducted and provided in this chapter by following similar steps. The reason for conducting multiple analysis is because of the amount of data available. Furthermore, there are several research units available. As the RECAP scores will be combined and averaged to show the differences in the client-contractor collaboration between the ECI and D&C cases, other relevant observations could be missed. Therefore, the RECAP scores will be dissected in different ways. Lastly, it is important to note that the scale used for the analysis is based on the data distribution. In Appendix H this is explained, and the scale is provided. After the description of the results from the analysis for each sub-criterion, the results will be synthesised to provide an overall comparison on the client-contractor collaboration. In total, five different analysis will be conducted, also shown in Table 14:

- **Analysis 1:** The first analysis is the main analysis of this research. In this analysis, all the RECAP scores will be used to provide the comparison of the client-contractor collaboration between the ECI cases and the D&C cases, as perceived by the participating clients and contractors. The steps of Analysis 1 are shown in Appendix I. As Analysis 1 is the main analysis, all the results from Analysis 1 will be covered in this chapter.

- **Analysis 2:** The second analysis consists of the comparison of the client-contractor collaboration between the ECI cases and the D&C cases, as perceived by the participating contractors. The steps of Analysis 2 are shown in Appendix J. From Analysis 2, only the moderate and substantial gaps between the scores will be covered in this chapter.

- **Analysis 3:** The third analysis consists of the comparison of the client-contractor collaboration between the ECI cases and the D&C cases, as perceived by the participating clients. The steps of Analysis 3 are shown in Appendix K. From Analysis 3, only the moderate and substantial gaps between the scores will be covered in this chapter.

- **Analysis 4:** The fourth analysis consists of the comparison of the client-contractor collaboration between the perceptions of the participating clients and contractors, within the ECI cases. The steps of Analysis 4 are shown in Appendix L.

- **Analysis 5:** The fifth analysis consists of the comparison of the client-contractor collaboration between the perceptions of the participating clients and contractors, within the D&C cases. The steps of Analysis 5 are shown in Appendix M.

Analysis	ECI	D&C	Clients	Contractors
1				
2			X	
3				X
4		X		
5	X			

Table 14: The used data units for each analysis of the collaborative sub-criteria. (own ill.)

In Analysis 1,2, and 3, the comparison is between the ECI and D&C cases. Results from these analyses are relevant to answer sub-question 5. Analysis 2 and 3 are conducted to find out if the differences in scores observed in Analysis 1 are mainly caused by the perception of the client or by the perception of the contractor. For example, it could be observed from Analysis 1 that the score for a criterion is substantially higher in the D&C cases compared to the ECI cases. This result could be mainly caused by the perception of the client, while the perception of the contractor suggests there is no gap. This cannot be derived from Analysis 1, but it could be observed from Analysis 2 or 3.

In Analysis 4 and 5 the comparison is not between the ECI and D&C cases, but rather between the clients' and contractors' perception within the ECI cases and within D&C cases. Results from these analyses may not be relevant to answer sub-question 5, however results from these analyses may show interesting insights in the differences between the client's and contractor's perceptions. Because the results from Analysis 4 and 5 are not relevant for the answer to sub-question 5, the results will be covered in chapter 8 of this thesis, the discussion.

The structure of this chapter will be based on the collaborative sub-criteria of RECAP, as those criteria are used to assess the client-contractor collaboration in the cases of this research. The sub-criteria will be categorised to their corresponding main criteria. The differences between the ECI and D&C cases will be covered based on the gaps in the results from the analysis. The gaps for all the analyses are categorised as following:

- Negligible gaps: < 0,50
- Moderate gaps: 0,50 - 0,99
- Substantial gaps: > 1,00

6.3. Front-end definition

The Front-end definition criterion is both a main and sub-criterion of the RECAP. The 'Front-end definition' criterion is defined as: *"The ability to comprehend the project scope, basic design, execution plan, and roles and responsibilities".* From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,18 points for the ECI cases and 3,13 points for the D&C cases. The gap between these scores is substantial, namely 1,05 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,35 points for the ECI cases and 3,33 points for the D&C cases. The gap between these scores is substantial, namely 1,02 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 3,98 points for the ECI cases and 2,90 points for the D&C cases. The gap between these scores is substantial, namely 1,08 points.

The results from the analyses for the Front-end definition criterion are evident. From the results of Analyses 1,2, and 3, it can be derived that "*the ability to comprehend the project scope, basic design, execution plan, and roles and responsibilities"* (Suprapto, 2016, p. 184) is substantially higher in the ECI cases compared to the D&C cases.

Connections with the literature study and case study

From the literature study and case studies in chapters 4 and 5 this result was to be expected, as the main difference between ECI and D&C projects is the early involvement of the contractor in the design phase. In ECI projects, a design team is formed including the client, contractor and consultants. Furthermore, a coordination agreement is signed by the members of the design team. During the design team phase, the project scope, design, execution, and responsibilities are drafted together. In D&C projects, the project scope and Employer's Requirements are laid down by the client for the tender phase. The design and execution plan are drafted by contractor, to which the project is awarded to following the tender phase. This does not automatically mean that the ability to comprehend the aforementioned aspects is lower. However, because of this separation, the ability to comprehend the scope, design, execution plan, and roles and responsibilities by both the client and contractor is more probable to be higher in ECI projects than D&C projects.

6.4. Collaborative practices

The main criterion 'Collaborative practices' consists of two sub-criteria: Team integration and Join working processes. In this section the results from the analyses for both sub-criteria will be covered and explained.

6.4.1. Team integration

The 'Team integration' criterion is defined as*: "The extent to which the owner and the contractor teams are structured and integrated as a single team with no apparent boundaries"* Suprapto (2016, p. 184). From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,25 points for the ECI cases and 2,93 points for the D&C cases. The gap between these scores is substantial, namely 1,33 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,43 points for the ECI cases and 3,10 points for the D&C cases. The gap between these scores is substantial, namely 1,33 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 4,07 points for the ECI cases and 2,73 points for the D&C cases. The gap between these scores is substantial, namely 1,34 points.

The results from the analyses for the Team integration criterion are evident. From the results of Analyses 1,2, and 3, it can be derived that "t*he extent to which the owner and the contractor teams are structured and integrated as a single team with no apparent boundaries"* (Suprapto, 2016, p. 184) is substantially higher in the ECI cases compared to the D&C cases.

Connections with the literature study and case study

From the literature study and case studies in chapters 4 and 5 this result was to be expected. While the design team in ECI projects ends after the final design is drafted, the collaboration during the design team phase between client and the contractor provides opportunity for a better relationship going into the construction phase. The fact that a design team is set up in the early phases of a project, could provide lead to a better understanding between the client and contractor. Suprapto (2016, p. 96) remarked that the early involvement of the contractor could also be seen as a disadvantage if the relationship between the client and the contractor is disrupted in the early phases of a construction project. Also, the goal of the design team is to integrate different expertise from the members to draft a final design. This integration could also cause the integration of the project teams into a single team. In the case studies of this research, this was the case. In case ECI C there were some struggles regarding the costs for the steel bridge, however both the client and contractor stated that this had no effect for the relationship of the design. The effects were mostly on the relationship between the clients' project team and senior management. A similar situation was present in case ECI B, in which the senior management of client was not actively involved in the design team phase. That also had no effect on the relationship between the project teams of the client and contractor in the design team.

From the literature study, the substantially lower results for the D&C cases could be derived from the separation of roles between the client and contractor. While this provides opportunities for more innovation and quicker project delivery, compared to the Design-Bid-Build contract, the separation does not positively feed the client-contractor relationship. This was also clearly stated by Client 1 and 2,1 during the interviews. They stated that collaboration is not a goal of integrated contracts, but rather an additional aspect within the project.

6.4.2. Joint working

The 'Joint working processes' criterion is defined as*: "The extent to which the owner and the contractor teams perform joint working processes"* Suprapto (2016, p. 184). From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,03 points for the ECI cases and 2,83 points for the D&C cases. The gap between these scores is substantial, namely 1,20 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,28 points for the ECI cases and 3,21 points for the D&C cases. The gap between these scores is substantial, namely 1,07 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 3,76 points for the ECI cases and 2,39 points for the D&C cases. The gap between these scores is substantial, namely 1,37 points.

The results from the analyses for the Joint working processes criterion are evident. From the results of Analyses 1,2, and 3, it can be derived that "t*he extent to which the owner and the contractor teams perform joint working processes"* (Suprapto, 2016, p. 184) is substantially higher in the ECI cases compared to the D&C cases.

Connections with the literature study and case study

From the literature study and case studies in chapters 4 and 5 this result was to be expected. Firstly, it is important to note that the assessment of this criterion could be in favour for ECI projects. As Client 1 stated that within in D&C projects it is not intended to perform working processes jointly. She suggested to change the statements regarding the 'jointly' performing processes. Examining the separation in the roles of the client and contractor within integrated contracts, as described in chapter 4, the client has a directing and passive role. The client could order changes if the contractor does not abide to the awarded design. The jointly conducting planning, monitoring, identifying risks, and decision making are not intended within D&C projects.

On the other hand, in ECI projects it is also not intended to jointly conduct these aspects. Every member has his own responsibility for his area of expertise, so a higher score would not be expected. However, from the interviews with the participants of case ECI A, B and C, it became clear that while it may not be intended, the design team phase feeds a collaborative behaviour to conduct the mentioned aspects jointly. Furthermore, in the design team, the members consult each other with their experiences.

Lastly, the results from Analysis 1,2 and 3 show that the scores for sub-criteria 'Team integration' and 'Joint working processes' are strongly related. This confirms the categorization of these two criteria by Suprapto.

6.5. Relational attitudes

The main criterion 'Relational attitudes' consists of three sub-criteria. In this section the results from the analyses for the sub-criteria will be covered and explained.

6.5.1. Senior Management commitment

The 'Senior management commitment' is defined criterion as*: "How well the senior management of the owner and the contractor commit to support the collaboration"* Suprapto (2016, p. 184). In this research the *owner* is called the client. From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,22 points for the ECI cases and 3,90 points for the D&C cases. The gap between these scores is negligible, namely 0,32 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,49 points for the ECI cases and 3,60 points for the D&C cases. The gap between these scores is moderate, namely 0,89 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 3,93 points for the ECI cases and 4,20 points for the D&C cases. The gap between these scores is negligible, namely 0,27 points.

The results from the analyses for the Senior management commitment criterion are mixed. From Analysis 1 the gap between the scores of ECI and D&C is negligible. The same goes for the results from Analysis 3, which is based on the perception of the client. However, in Analysis 2, the contractor's perception, the results show a moderate gap of 0,89 points.

Connections with the literature study and case study

From the literature study, no connection to the Senior management commitment can be found. From the case studies, the senior management commitment has been a discussion point with some of the participants (Client B, 1, and C, and Contractor B, 1, and C). In all the interviews in which the senior management commitment was discussed, the discussions were about the clients' senior management. Especially during the interview with the Client C, who was critical about his senior management's attitude. However, from these discussions there are no connections to be found to explain the moderate gap from Analysis 2. From Analysis 1 it can be derived that the difference between the ECI and D&C in Senior management commitment is negligible.

6.5.2. Senior Management trust

The 'Senior management trust' criterion is defined as*: "The extent of mutual trust between firms"* Suprapto (2016, p. 184)*.* From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,67 points for the ECI cases and 4,23 points for the D&C cases. The gap between these scores is negligible, namely 0,44 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,75 points for the ECI cases and 4,00 points for the D&C cases. The gap between these scores is moderate, namely 0,75 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 4,56 points for the ECI cases and 4,44 points for the D&C cases. The gap between these scores is negligible, namely 0,12 points.

The results from the analyses for the Senior management trust criterion are mixed and are similar to that of the Senior management commitment criterion. In Analysis 1 the gap between the scores of ECI and D&C is negligible. The same goes for the results from Analysis 3, which is based on the perception of the client. However, in Analysis 2, the contractor's perception, the results show a moderate gap of 0,75 points. From Analysis 1 it can be derived that the difference between the ECI and D&C in Senior management trust is negligible.

6.5.3. Relational Norms

The 'Relational norms' criterion is defined as*: "Established norms of no blame culture, win-win, and communication openness."* Suprapto (2016, p. 184)*.* From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,38 points for the ECI cases and 3,55 points for the D&C cases. The gap between these scores is moderate, namely 0,83 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,67 points for the ECI cases and 3,90 points for the D&C cases. The gap between these scores is moderate, namely 0,77 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 4,10 points for the ECI cases and 3,18 points for the D&C cases. The gap between these scores is moderate, namely 0,93 points.

The results from the analyses for the Relation norms criterion are evident. From the results of Analyses 1,2, and 3, it can be derived that the established norms of no blame culture, win-win and communication openness are moderately more present in the ECI cases compared to the D&C cases.

Connections with the literature study and case study

From the literature study and case studies in chapters 4 and 5 this result was to be expected. While the design team in ECI projects ends after the final design is drafted, the collaboration during the design team phase between client and the contractor provides opportunity for a better relationship going into the construction phase. The fact that a design team is set up in the early phases of a project, could provide lead to a better understanding between the client and contractor. From the interviews with the participants of cases ECI A, B and C, it became clear that while it may not be intended, the design team phase feeds a collaborative behaviour with a 'no blame' culture (Contractor A and B, and Client B, C). Furthermore, collaborative workshops were used in cases ECI A, B and C to sustain and improve the relationship between the members of the design team.

The lower results for the D&C cases could be derived from the separation of roles between the client and contractor. The separation does not positively feed the client-contractor relationship. Contractor B compared ECI projects with D&C projects, as he has experience with both, and stated that the UAC-IC 2005 feeds a blame culture in which the parties point to each other when something goes wrong.

6.6. Teamworking quality

The main criterion 'Teamworking quality' consists of seven sub-criteria. In this section the results from the analyses for the sub-criteria will be covered and explained.

6.6.1. Team communication

The 'Team communication' criterion is defined as*: "The extent of to which the teams communicate with each other effectively"* Suprapto (2016, p. 184). From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,38 points for the ECI cases and 3,63 points for the D&C cases. The gap between these scores is moderate, namely 0,75 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,50 points for the ECI cases and 3,50 points for the D&C cases. The gap between these scores is significant, namely 1,00 point.

- In Analysis 3, the perception of the clients only, the score for this criterion is 4,25 points for the ECI cases and 3,75 points for the D&C cases. The gap between these scores is moderate, namely 0,50 points.

The results from the analyses for the Team communication criterion are evident. From the results of Analyses 1,2, and 3, it can be derived that "*the extent of to which the teams communicate with each other effectively"* (Suprapto, 2016, p. 184) is moderately higher in the ECI cases compared to the D&C cases. The gaps between the scores are moderate in Analysis 1 and 3. In Analysis 2, the gap is substantial.

Connections with the literature study and case study

From the literature study and case studies in chapters 4 and 5 this result was to be expected from the main difference between ECI and D&C projects, which is the forming of the design team in ECI projects. In D&C projects the roles are separated, the client has a directing and passive role. While this provides opportunities for more innovation and quicker project delivery, compared to the Design-Bid-Build contract, the separation does not positively feed the client-contractor relationship. This was also clearly stated by Client 1 and 2,1 during the interviews. Furthermore, Contractor B made a clear distinction between ECI and D&C projects. He stated that the design team phase feeds a collaborative relationship in which the members are motivated to indicate issues quickly, so the design team can solve it together. In D&C projects this is less probable, as the UAC-IC 2005 feeds a blame culture in which parties point to each other when issues arise. Furthermore, the goal of the design team is to integrate different expertise from the members to draft a final design. This integration could also benefit the team integration into a single team.

The score for the sub-criterion of Team communication of the ECI cases is higher than the D&C cases, the gap is 0.8 points between the average scores on the ECI cases and D&C cases. The score for ECI is 4,4 and for D&C 3,6. This is relatively high. The sub-criterion of Team communication is defined as: The extent of to which the teams communicate with each other effectively.

In the ECI cases this was clearly present. All participants of the ECI cases stated that open communication was necessary. This was also expected according to the literature study on ECI. In the D&C cases, there were some differences to this. In D&C 1 open communication was clearly present, as Client 1 provided the necessary information to Contractor 1 to come up with a solution to an expected delay that was caused by the client. In case D&C 2, this aspect was not clearly shown.

6.6.2. Team coordination

The ‘Team coordination’ criterion is defined as*: “The extent to which the teams achieve synergies in coordinating interdependent activities.”* Suprapto (2016, p. 184)*.* From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,10 points for the ECI cases and 3,80 points for the D&C cases. The gap between these scores is negligible, namely 0,30 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,44 points for the ECI cases and 4,17 points for the D&C cases. The gap between these scores is negligible, namely 0,28 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 3,78 points for the ECI cases and 3,42 points for the D&C cases. The gap between these scores is negligible, namely 0,36 points.

The results from the analyses for the Team coordination criterion are evident. In Analysis 1,2 and 3 the gaps between the scores of ECI and D&C are negligible. Therefore, there is no difference between the ECI and D&C cases in "*the extent to which the teams achieve synergies in coordinating interdependent activities"* (Suprapto, 2016, p. 184). Furthermore, in the literature study and case studies no connections to this observation are found.

6.6.3. Balanced contribution

The 'Balanced contribution' criterion is defined as*: "The extent to which the teams contribute their specific knowledge and expertise."* Suprapto (2016, p. 184). From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,22 points for the ECI cases and 3,68 points for the D&C cases. The gap between these scores is moderate, namely 0,54 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,33 points for the ECI cases and 3,67 points for the D&C cases. The gap between these scores is moderate, namely 0,67 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 4,11 points for the ECI cases and 3,67 points for the D&C cases. The gap between these scores is negligible, namely 0,44 points.

The results from the analyses for the Balanced contribution criterion are evident. In Analysis 1 and 2 the gaps between the scores of ECI and D&C are moderate. In Analysis 3 the gap is negligible. From these results it can be derived that "t*he extent to which the teams contribute their specific knowledge and expertise"* (Suprapto, 2016, p. 184) is moderately higher.

Connections with the literature study and case study

From the literature study and case studies in chapters 4 and 5 this result was to be expected. The essence of the formed design team in ECI projects is to benefit from the expertise of al the members. All members agree, by signing a coordination agreement, to the willingness to collaborate and consult with one another using their knowledge and expertise. The contribution during the design team phase may not be balanced fully, but it is more balanced compared to D&C projects. It is important to note that the balanced contribution is mainly present in the design team phase. In D&C projects, the imbalance between the client and contractor is laid down in the responsibilities. The design and construction will be conducted by the contractor. The client usually does not provide his specific knowledge or expertise, as in some cases that knowledge and expertise is absent. The client has a passive and directing role during the process of a D&C project.

6.6.4. Team mutual support

The 'Team mutual support' criterion is defined as*: "The extent to which the teams help each other in achieving project goals* Suprapto (2016, p. 184). From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,57 points for the ECI cases and 3,68 points for the D&C cases. The gap between these scores is moderate, namely 0,89 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,67 for the ECI cases and 3,83 points for the D&C cases. The gap between these scores is moderate, namely 0,83 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 4,44 points for the ECI cases and 3,50 points for the D&C cases. The gap between these scores is moderate, namely 0,94 points.

The results from the analyses for the Team mutual support criterion are evident. From the results of Analyses 1,2, and 3, it can be derived that "*the extent to which the teams help each other in achieving project goals"* (Suprapto, 2016, p. 184) is moderately higher in the ECI cases than to the D&C cases. For this criterion the same connections were found as the Balanced contribution criterion.

6.6.5. Alignment of effort

The 'Alignment of effort' criterion is defined as*: "The extent to which the teams align their effort"* (Suprapto, 2016, p. 184). From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,27 points for the ECI cases and 3,93 points for the D&C cases. The gap between these scores is negligible, namely 0,34 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,11 points for the ECI cases and 4,17 points for the D&C cases. The gap between these scores is negligible, namely 0,06 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 4,44 points for the ECI cases and 3,67 points for the D&C cases. The gap between these scores is moderate, namely 0,78 points.

The results from the analyses for the Alignment of effort criterion are mixed. From Analysis 1 the gap between the scores of ECI and D&C is negligible. The same goes for the gap in the results from Analysis 2, which is based on the perception of the client. Interestingly the results from Analysis 2, the contractor's perception, show a moderate gap of 0,78 points. From this it can be derived that the '*the extent to which the align their effort'* is higher in the ECI cases

compared to the D&C cases, from the client's perception. For this observation, no clear connections with the literature study and case studies were found.

6.6.6. Team cohesion

The 'Team cohesion' criterion is defined as*: "The extent to which the teams behave as one team"* (Suprapto, 2016, p. 184). From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,68 points for the ECI cases and 3,80 points for the D&C cases. The gap between these scores is moderate, namely 0,88 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,75 for the ECI cases and 3,75 points for the D&C cases. The gap between these scores is substantial, namely 1,00 point.

- In Analysis 3, the perception of the clients only, the score for this criterion is 4,58 points for the ECI cases and 3,81 points for the D&C cases. The gap between these scores is moderate, namely 0,77 points.

The results from the analyses for the Team cohesion criterion are evident. From the results of Analyses 1,2, and 3 it can be derived that "*the extent to which the teams behave as one team"* (Suprapto, 2016, p. 184) is moderately higher in the ECI cases than the D&C cases.

Connections with the literature study and case study

From the literature study and case studies in chapters 4 and 5 this result was to be expected. While the design team in ECI projects ends after the final design is drafted, the collaboration during the design team phase between client and the contractor provides opportunity for a better relationship going into the construction phase. The fact that a design team is set up in the early phases of a project, could provide lead to a better understanding between the client and contractor. Suprapto (2016, p. 96) remarked that the early involvement of the contractor could also be seen as a disadvantage if the relationship between the client and the contractor is disrupted in the early phases of a construction project. Also, the goal of the design team is to integrate different expertise from the members to draft a final design. This integration could also benefit the team integration into a single team. In the case studies of this research, this was not the case. In case ECI C there were some struggles regarding the costs for the steel bridge, however both the client and contractor stated that this had no effect for the relationship of the design. The effects were mostly on the relationship between the clients' project team and senior management. A similar situation was present in case ECI B, in which the senior management of client was not actively involved in the design team phase. That also had no effect on the relationship between the project teams of the client and contractor in the design team.

From the literature study, the substantially lower results for the D&C cases could be derived from the separation of roles between the client and contractor. While this provides opportunities for more innovation and quicker project delivery, compared to the Design-Bid-Build contract,

the separation does not positively feed the client-contractor relationship. This was also clearly stated by Client 1 and 2,1 during the interviews. They stated that collaboration is not a goal of integrated contracts, but rather an additional aspect within the project.

6.6.7. Team affective trust

The 'Team affective trust' criterion is defined as*: "The extent to which the teams' members personally trust each other."* (Suprapto, 2016, p. 184). From the conducted analyses, the following results were observed:

- In Analysis 1, the perceptions of the clients and contractors within the ECI cases compared to the D&C cases, the score for this criterion is 4,55 points for the ECI cases and 3,90 points for the D&C cases. The gap between these scores is moderate, namely 0,65 points.

- In Analysis 2, the perception of the contractors only, the score for this criterion is 4,61 for the ECI cases and 3,92 points for the D&C cases. The gap between these scores is moderate, namely 0,69 points.

- In Analysis 3, the perception of the clients only, the score for this criterion is 4,50 points for the ECI cases and 3,92 points for the D&C cases. The gap between these scores is moderate, namely 0,58 points.

The results from the analyses for the Team affective trust criterion are evident. From the results of Analyses 1,2, and 3 it can be derived that "*the extent to which the teams' members personally trust each other"* (Suprapto, 2016, p. 184) is moderately higher in the ECI cases than the D&C cases.

Connections with the literature study and case study

From the literature study and case studies in chapters 4 and 5 this result was to be expected. While the design team in ECI projects ends after the final design is drafted, the collaboration during the design team phase between client and the contractor provides opportunity for a better relationship going into the construction phase. The fact that a design team is set up in the early phases of a project, could provide lead to a better understanding between the client and contractor. From the interviews with the participants of case ECI A, B and C, it became clear that while it may not be intended, the design team phase feeds a collaborative behaviour with a 'no blame' culture (Contractor A and B, and Client B, C). This creates trust between the members of the design team.

6.7. Synthesis

In this section, the results from the previous paragraphs will be put together. This is done to provide an overall conclusion on the differences of the client-contractor collaboration in the ECI cases compared to the D&C cases. This will be done for Analysis 1, 2 and 3. Firstly, the synthesis of the results from Analysis 1 will be provided. The result of the synthesis from Analysis 1 will provide the differences in the client-contractor collaboration in the ECI cases compared to the D&C cases, as perceived by the participating clients and contractors combined. Secondly, the synthesis of the results from Analysis 2 will be provided. The results

of the synthesis from Analysis 2 will provide the perception of the participating contractors on the differences between the client-contractor collaboration in the ECI cases compared to the D&C cases. From this synthesis different conclusions could be derived compared to Analysis 1, as the perception of the participating contractors is focused on. Thirdly, the synthesis of the results from Analysis 3 will be provided. The results of the synthesis from Analysis 3 will provide the perception of the participating clients on the differences between the client-contractor collaboration in the ECI cases compared to the D&C cases. From this synthesis different conclusions could be derived compared to Analysis 1, as the perception of the participating clients is focused on.

6.7.1. Analysis 1

The results from Analysis 1 are shown in Table 15. Each sub-criterion has been covered in the previous paragraphs.

Sub-criteria	ECI	D&C	Gap	
Front-end definition	4,18	3,13	●	1,06
Team integration	4,25	2,93	●	1,33
Joint working	4,03	2,83	●	1,21
SM commitment	4,22	3,90	○	0,32
SM trust	4,67	4,23	○	0,44
Relational norms	4,38	3,55	●	0,83
Team communication	4,38	3,63	●	0,76
Team coordination	4,10	3,80	○	0,30
Balanced contribution	4,22	3,68	●	0,54
Team mutual support	4,57	3,68	●	0,89
Alignment of effort	4,27	3,93	○	0,34
Team cohesion	4,68	3,80	●	0,88
Team affective trust	4,55	3,90	●	0,65

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	○ negligible	● moderate	● substantial		

Table 15: Average scores of the clients and contractors combined for the ECI and D&C cases for each sub-criterion, including the gaps. (own ill.)

The substantial gaps between the scores of the ECI cases and the scores of the D&C cases were observed for the sub-criteria of Front-end definition, Team integration, and Joint working processes. The moderate gaps between the scores of the ECI cases and the scores of the D&C cases were observed for the sub-criteria of Relational norms, Team communication, Balanced contribution, Team mutual support, Team cohesion, and Team affective trust.

Interpretation

The differences were also clearly connected to the literature study and case studies. In the ECI cases the project teams of the client and contractor are integrated and behave as one project team actively collaborating together, in the design team phase. As a result, a ‘no blame’ culture is created, the team communicates more effectively, and the members trust each other. This may not be the goal of the ECI model, it is a result from forming the design team in the design phase. By forming a design team, the members do not become formal partners. The members all enter into separate contracts with the client, so each member has his own role and responsibility. Also, the members sign a coordination agreement stating their willingness to

collaborate and consult with one another using their knowledge and expertise. From the case studies it became clear that by forming the design team, there are positive effects on the client-contractor relationship. The members benefit from the integration of the different expertise of the other members. As the project scope, design, execution, and responsibilities are drafted together, the front-end definition is clearer for the members. Furthermore, the forming of the design team feeds a collaborative behaviour, in which the parties jointly solve problems and jointly identify potential risks and pitfalls. The teams support each other, because they know that by supporting each other they themselves will benefit from it also. It is important to note that the design team ends after the final design is drafted, and therefore also the collaboration ends. However, as the client-contractor relationship has been set up in the design team, this provides opportunities for a collaborative relationship between the client and contractor for the construction phase.

In the D&C cases, the client-contractor relationship is different. The roles of the client and contractor in D&C projects is clearly separated and there is an imbalance in the involvement during the process of D&C projects. The contractor is responsible for the design and construction of the project, based on the Employer's Requirements submitted to the tender phase by the client. The client has a directing role, in which he has a passive attitude and checks the contractors processes and works. This separation results in the substantially lower scores on the sub-criteria of Front-end definition, Team integration, and Joint working processes, compared to the ECI cases. The project teams of the client and contractor are not integrated into one project team. Furthermore, the jointly working processes is not stimulated by the D&C contract. Contractor B stated that the UAC-IC 2005 does not feed a 'no-blame' culture, the parties could be pointing to each other instead of jointly working on issues. The client-contractor collaboration in the D&C cases could be seen as remote collaboration. Especially in case D&C 1 this was clearly the case. While Contractor 1 stated that this did work, as the client had great trust in the contractor, the collaboration was not ideal. However, from the case studies it also became clear that it is not intended to integrate the project teams of the client and contractor and to behave as one project team. The separation between the client and contractor is known and is set. For the overall collaboration, this does not have to mean that there is an adversarial relationship between the client and contractor. In D&C projects there is room for a good understanding between the client and contractor. This was clearly observed in case D&C 1, in which the contractor had the trust and support from the client. Of course, the client had to come up with a solution because of his shortcomings just after the tender phase. This shows that remotely collaborating, with a passive attitude from the client can work. It may not have positive effects on the client-contractor collaboration in general, however the project performance could benefit from it. Contractor 1 did clearly state that for remote collaboration to work, the parties have to agree beforehand on how to implement that.

6.7.2. Analysis 2

The results from Analysis 2 are shown in Table 16. Each sub-criterion has been covered in the previous paragraphs.

Contractors			
Sub-criteria	**ECI**	**D&C**	**Gap**
Front-end definition	4,35	3,33	1,03
Team integration	4,43	3,10	1,33
Joint working	4,28	3,21	1,06
SM commitment	4,49	3,60	0,89
SM trust	4,75	4,00	0,75
Relational norms	4,67	3,90	0,77
Team communication	4,50	3,50	1,00
Team coordination	4,44	4,17	0,28
Balanced contribution	4,33	3,67	0,67
Team mutual support	4,67	3,83	0,83
Alignment of effort	4,11	4,17	-0,06
Team cohesion	4,75	3,75	1,00
Team affective trust	4,61	3,92	0,69

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 16: Average scores of contractors combined for the ECI and D&C cases for each sub-criterion, including the gaps. (own ill.)

Firstly, it is notable that the average scores of the contractors for the ECI cases are generally higher compared to the average scores of the contractors and clients combined for the ECI cases in Analysis 1. This will be discussed in chapter 8.

From the results of Analysis 2, the substantial gaps in between the scores of the ECI cases and the scores of the D&C cases were observed for the sub-criteria of Front-end definition, Team integration, Joint working processes, Team communication, and Team cohesion. The moderate gaps between the scores of the ECI cases and the scores of the D&C cases were observed for the sub-criteria of Senior management commitment, Senior management trust, Relational norms, Balanced contribution, Team mutual support, and Team affective trust. From this it can be concluded that the perception of the contractor is broadly the same as the results from Analysis 1. The differences in the gaps compared to Analysis 1 are observed for the sub-criteria of SM commitment, SM trust, Team communication, and Team cohesion.

Interpretation

The scores on the sub-criteria of SM commitment and SM trust are moderately higher for the ECI cases compared to the D&C cases. In Analysis 1, these gaps were negligible. For these sub-criteria, there were no connections found in the literature study and the case studies. During the interviews the Senior management was discussed for all cases, however the discussions were mainly about the conflicts between the project team of the client with the Senior management of client, especially in case ECI C and also in case ECI B. During the interviews for the cases D&C 1 and 2 the Senior management of client was also discussed, but on different topics of discussion. In case D&C 1, both Client 1 and Contractor 1 were very

positive on the attitude from the Senior management of the client. In case D&C 2, the choice for the D&C contract was questioned by Client 2,1 and 2,2.

The gaps between the scores of the ECI and D&C cases for the sub-criteria of Team communication and Team cohesion are substantially higher in Analysis 2. In Analysis 1, these gaps were moderately higher in the ECI cases compared to the D&C cases. The difference in these gaps is mainly caused by the higher scores of the contractors for the ECI cases and the lower scores of the contractors for the D&C cases, in Analysis 2. From this it can be derived that contractors are especially more satisfied with the team communication in ECI projects compared to the team communication in D&C projects. Also, the contractors perceive the project teams of the client and contractor to be behaving as one team. The reasons for this could be explained by the forming of the design team in ECI projects. That could provide the opportunity for better communication between the client and contractor in the construction phase, as the client-contractor relationship has been set during the design team phase. In D&C projects, the relationship starts after the tender phase. The transition from the tender phase to the design and construct phase could affect the relationship, and therefore the communication. During the interviews, participants stated that the probability of misinterpretation of the Employer's Requirements in D&C projects is higher because of the use of functional specification. This misinterpretation has the consequence that the relationship starts off on the wrong foot, and it could affect the team communication and cohesion.

6.7.3. Analysis 3

The results from Analysis 3 are shown in Table 17. Each sub-criterion has been covered in the previous paragraphs.

Clients			
Sub-criteria	**ECI**	**D&C**	**Gap**
Front-end definition	3,98	2,90	1,08
Team integration	4,07	2,73	1,33
Joint working	3,76	2,39	1,37
SM commitment	3,93	4,20	-0,27
SM trust	4,56	4,44	0,12
Relational norms	4,10	3,18	0,93
Team communication	4,25	3,75	0,50
Team coordination	3,78	3,42	0,36
Balanced contribution	4,11	3,67	0,44
Team mutual support	4,44	3,50	0,94
Alignment of effort	4,44	3,67	0,78
Team cohesion	4,58	3,81	0,77
Team affective trust	4,50	3,92	0,58

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 17: Average scores of clients combined for the ECI and D&C cases for each sub-criterion, including the gaps. (own ill.)

From the results of Analysis 3, the substantial gaps between the scores of the ECI cases and the scores of the D&C cases were observed for the sub-criteria of Front-end definition, Team integration, and Joint working processes. The moderate gaps between the scores of the ECI

cases and the scores of the D&C cases were observed for the sub-criteria of Relational norms, Team communication, Team mutual support, Alignment of effort, Team cohesion and Team affective trust. From this it can be concluded that the perception of the client is broadly the same as the results from Analysis 1.

Interpretation

The differences in the gaps compared to Analysis 1 are observed for the sub-criteria of Balanced contribution and Alignment of effort. The difference for the Balanced contribution criterion is very small, 0,44 points in Analysis 1 and 0,54 points in Analysis 3. Therefore, this difference will not be covered. The difference for the Alignment of effort criterion is higher, 0,34 points in Analysis 1 and 0,78 points in Analysis 3. For the difference in Alignment of effort, in paragraph 6.6.5, no connections with the literature study and case studies were found. In ECI and D&C cases, the alignment of effort was not actively done. Looking at the statement in the RECAP assessment form, some clarification can be provided (Suprapto, 2016, p. 204):

- Both teams give this project the priority it needs.
- Both teams put their best effort into this project.
- There is no conflict regarding the effort that each team put into this project.

From these statements, it could be derived that the client is less satisfied with the given priority by the contractor in D&C projects compared to ECI projects. From the case studies the criterion of Alignment of effort was not a subject of discussion. The only case in which there was a discussion about the alignment of effort, was case ECI C. In which Contractor C scored 1,7 points lower than Client C. When Contractor C was asked about this, it became clear that he misinterpreted the statements. He stated that his score was lowering because of the issues with the SM of Client C. He stated that the effort was in balance between the project teams.

6.8. Conclusion

In this chapter the analysis of the case study results is conducted. Three analyses were conducted and described. Analysis 1 was on the combined perceptions of the client and contractor on the client-contractor collaboration within the ECI and D&C cases. Analysis 2 was only on the perception of the contractor on the client-contractor collaboration within the ECI and D&C cases. Analysis 3 was only on the perception of the client on the client-contractor collaboration within the ECI and D&C cases. Lastly, the results from these analyses were synthesis and the differences between the client-contractor collaboration in the ECI cases compared to the D&C cases were described. As a result, from the analyses in this chapter sub-question 5 can be answered:

5. What are the differences in the client-contractor collaboration between the ECI and D&C cases?

Differences in the client-contractor collaboration between the ECI and D&C cases

The results from the analyses in this chapter are evident. The client-contractor collaboration in the ECI cases is perceived to better compared to the D&C cases, as the scores for each collaborative criterion are higher in the ECI cases. While the scores are higher for each sub-criterion, some gaps in the scores are negligible. The differences in the client-contractor collaboration between the ECI and D&C cases will be described.

Main differences

The main differences in the client-contractor collaboration between the ECI and D&C cases is observed in the Front-end definition, Team integration, and Joint working processes. The gaps in scores are substantial for these criteria.

In the ECI cases the project teams of the client and contractor are integrated and behave as one project team actively collaborating together. The main cause for this, is the forming of the design team. By forming the design team, the client has more influence on the design, and higher certainty in costs and planning. The contractor's expertise and knowledge of technical aspects, preparation, and costing enables the construction phase to be executed quicker and to be coordinated more effectively. This results in an integrated design and also a better comprehension of the front-end definition by the members of the design team. The contractor is motivated to collaborate into drafting a feasible design, as he has a better position to be award the building contract compared to the traditional process of Design-Bid-Build. He is the first and only to bid on the final design, on which he had worked on himself. Furthermore, the design team feeds a collaborative behaviour, in which the parties jointly solve problems and jointly identify potential risks and pitfalls. The project teams of the client and contractor are integrated as one project team.

In the D&C cases, the client-contractor relationship is different. The roles of the client and contractor in D&C projects is clearly separated and there is an imbalance in the involvement during the process of D&C projects. The contractor is responsible for the design and construction of the project, based on the Employer's Requirements submitted to the tender phase by the client. The client has a directing role, in which he has a passive attitude and checks the contractors processes and works. The project teams of the client and contractor are not integrated into one project team. Furthermore, the jointly working processes is not stimulated by the D&C contract. Contractor B stated that the UAC-IC 2005 does not feed a 'no-blame' culture, the parties could be pointing to each other instead of jointly working on issues. Also, from the case studies it also became clear that it is not intended to integrate the project teams of the client and contractor and to behave as one project team. The separation between the client and contractor is known and is set.

Moderate differences

From the analyses there are also moderate gaps observed in the scores between the ECI and D&C cases for the sub-criteria of Relation norms, Team communication, Balanced contribution, Team mutual support, Team cohesion, and Team affective trust.

In the ECI cases there is a collaborative behaviour with 'no blame' culture, effective communication, mutual support and trust between the project teams, and the projects teams behave as one project team. These effects may not be the goal of the ECI model, it is a result

from forming the design team in the design phase. By forming a design team, the members do not become formal partners. The members all enter into separate contracts with the client, so each member has his own role and responsibility. It is important to note that the design team ends after the final design is drafted, and therefore also the collaboration ends. However, as the client-contractor relationship has been set up in the design team, this provides opportunities for a collaborative relationship between the client and contractor for the construction phase. From the case studies it became clear that by forming the design team, there are positive effects on the client-contractor relationship. The forming of the design team feeds a collaborative behaviour, in which the parties jointly solve problems and jointly identify potential risks and pitfalls. There is a balance in the contribution from all the members of the design team. The teams support each other, because they know that by supporting each other they themselves will benefit from it also. Furthermore, the teams communicate more open towards each other as this is needed to integrate the final design. Especially, the participating contractors were highly satisfied with the team communication in the ECI cases. Also, the cohesion within the design team was perceived as highly satisfying by the clients and contractors.

In D&C projects, the relationship starts after the tender phase. The transition from the tender phase to the design and construct phase could affect the relationship, and therefore the communication. During the interviews, participants stated that the probability of misinterpretation of the Employer's Requirements in D&C projects is higher because of the use of functional specification. This misinterpretation has the consequence that the relationship starts off on the wrong foot, and it could affect the team communication and cohesion. For the overall collaboration in the D&C cases, the low scores on Front-end definition, Team integration, and Joint working processes do not have to mean that there is an adversarial relationship between the client and contractor. In D&C projects there is room for a good understanding between the client and contractor. This was clearly observed in case D&C 1, in which the contractor had the trust and support from the client. This shows that remotely collaborating, with a passive attitude from the client could work. It may not have positive effects on the client-contractor collaboration in general, however the project performance could benefit from it. Contractor 1 did clearly state that for remote collaboration to work, the parties have to agree beforehand on how to implement that.

7. Expert validation

7.1. Introduction

The findings derived from chapters 5 and 6 will be validated in this chapter by an expert panel. The validation gives an insight into the validity of the findings. When for instance the experts on average agree with a finding, that finding is more likely to be true in practice. This process strengthens or weakens the finding as it indicates if the identified finding holds in projects according to industry experts.

7.2. Methodology

The conclusions of chapter 5 and chapter 6 will be validated by transferring the conclusions into several statements. Per conclusion one or more statements are created. This amount can differ per conclusion as each conclusion in chapters 5 and 6 may be of different importance. If one conclusion had multiple factors of analysis, multiple statements are drafted. In total 20 statements are selected to be validated by 6 experts. The limitations of the expert validation are described in chapter 8.

7.2.1. Expert selection

The expert validation will be done with experts within phbm. In this thesis a respondent is regarded as an expert when he or she has at least 7 years of experience within Dutch infrastructure projects. The work experience may be in traditional projects and/or integrated projects. Phbm is a firm consisting of advisors that consult both parties, the client and contractor. The experts are therefore diverse and could take different points of view for each statement. This is important as some of the statements are about the client or the contractor.
The expert panel consists of 6 experts with an average of 13,5 years work experience in the Dutch infrastructure sector.

7.2.2. Statements

In Appendix N the statements that will be validated by the experts are presented. In the second column of the table the topic to which the statement is part of is presented. In the third column the statement itself is drafted. Columns four to eight form the scale, the experts can rate to what extent they agree with the statement. The scale is explained in the next paragraph. The last column is the elaboration of each expert on the statement and given score. Both the score based on the input with the slider and the elaboration on the score are used to give a final verdict if the statement is confirmed, rejected or that there is uncertainty regarding the validity of the statement. It is important to note that the table presented in the appendix is in English, however the experts were presented statements in Dutch.

It is important to note that not all statements are regarded relevant for the answer of the main research question. Most statements in the validation are interesting interview findings and will be discussed in chapter 8. Furthermore, not all conclusions and results from chapter 5 and 6 will be validated, the main conclusions are evident and do not need to be validated or are too specific to be put into a statement.

7.2.3. Scale

The scale used for the expert validation is from 1 to 5, where 1 resembles full disagreement and 5 resembles full agreement on the statement. The following scale is used for the interpretation of the level of agreement declared by the experts:

- **1,0 – 2,4:** The experts disagree with the statement. The statement is rejected unless there are strong indicators in the case studies or the literature study that will justify disregarding the disagreement.
- **2,5 – 3,4:** The experts are neutral on the statement. If the score is neutral, the elaboration of the experts on the statement will be used to validate or reject the statement. If the elaboration of the experts does not strongly point in the direction of agreement or disagreement, the statement will be regarded as uncertain/unclear.
- **3,5 – 5,0:** The experts agree with the statement. The statement is confirmed.

7.3. Results

The results from the expert validation are presented in Table 18 with the average scores for each statement. Of the 20 statements, the experts disagreed with the following 3 statements:

- 8) Collaborating remotely has a negative effect on the relationship between the client and contractor because no team spirit can be formed.
- 17) For good collaboration, it is not necessary in D&C projects to decide on project goals, scope and objectives together.
- 18) The D&C contract is favourable for the client because the client has less responsibilities and liabilities.

On statement 8, the scores and explanations of the experts varied. Two experts stated that the team spirit is not necessary in integrated contracts. This is somewhat similar to some statements by Client 1, and 2, who stated that team cohesion and collaboration in general are not objectives of the D&C contract.

On statement 17, all experts unanimously disagreed with the statement. The experts explained that the comprehension of the project goals, scope and objectives, are essential for the project's success and the client-contractor collaboration. This is in line with the results from this research, the importance of the front-end definition for the client-contractor collaboration.

On statement 18, the experts explained that the imbalance in responsibilities and risks may seem in favour of the client in theory. However, if there are too many risks transferred to the contractor in practice, the client-contractor collaboration and project performance could be disrupted and therefore the client will no benefit from the transferred risks.

Of the 20 statements, the experts are neutral for the following 3 statements:

- 12) The used contract / form of collaboration determines the collaboration.
- 14) ECI is beneficial for the client if he does not have the required knowledge / expertise.
- 15) ECI is disadvantageous for the client because the contractor is the first and only allowed to make a bid after the design team phase (lack of competition).

On statement 12 two experts fully agreed, and three experts fully disagreed. The experts who fully disagreed explained that the contract does not determine the collaboration, but the project teams' attitude and openness do. One of them stated that the contract is mainly used in case of conflicts. The two experts who agreed referred to the roles stated in the contract to be determining the collaboration. The experts' explanations conclude that this statement is rejected. The used contract / form of collaboration does not determine the collaboration.

On statement 14 the experts varied a lot. The explanations from the experts and statements from the interviews in the case studies, may provide a clear conclusion on this statement. Three experts moderately or fully agreed with the statement explaining that the lack of expertise from the client can be complemented by the expertise from the contractor or consultants. The two who disagreed stated that the expertise from the client is just as important as the expertise from the other members. In the case studies Clients A, B, and Contractors A and C stated that the choice for ECI is ideal for clients lacking expertise in a specific area. From the explanation of the experts and the interviews in the case studies this statement is confirmed. ECI is beneficial for the client if he does not have the required knowledge / expertise.

On statement 15 the experts' explanations did not show a clear conclusion. Two experts mentioned that it is disadvantageous, as the contractor can influence the price during the design team phase. Two other experts stated that it was disadvantageous, however the advantages of ECI outweigh this disadvantage. In literature the issue of pricing is mentioned, but there is no clear conclusion on it. This statement will remain unclear, as the experts' explanations and the literature do not show a clear conclusion.

	Source	Statement	Mean	Conclusion
1	Interviews	Without trust, there is no collaboration.	4,7	**Agreed**
2	Interviews	Good collaboration is mainly the result of the chemistry between project teams from the client and the contractor.	3,8	**Agreed**
3	Interviews	Good collaboration cannot be created artificially when there is a lack of chemistry between the project teams of the client and the contractor	3,5	**Agreed**
4	Case D&C 1	Poor collaboration could result in good project performance (time, budget, scope).	3,5	**Agreed**
5	Conclusion	An open and transparent attitude always has positive effects on the collaboration	4,3	**Agreed**
6	Case D&C 1	Collaborating remotely is possible by clearly agreeing in advance how this will be implemented.	4,2	**Agreed**
7	Case D&C 1	In order for remote collaboration to succeed, the client must trust the contractor.	3,8	**Agreed**
8	Case D&C 1	Collaborating remotely has a negative effect on the relationship between the client and contractor because no team spirit can be formed.	2,3	**Disagreed**
9	Case D&C 1	Collaborating remotely means that it takes longer to solve problems quickly and effectively.	4,7	**Agreed**
10	Conclusion	Forming a single project team ensures a "no-blame" culture. The client and contractor have insight into each other's shortcomings and strengths.	3,7	**Agreed**
11	Interviews	The contact is more important than the contract.	4,5	**Agreed**
12	Interviews	The used contract / form of collaboration determines the collaboration.	2,7	**Neutral**
13	Conclusion	ECI is favourable because the contractor sits at the table during the design phase. The construction phase will therefore be processed smoother	4,3	**Agreed**
14	Interviews	ECI is beneficial for the client if he does not have the required knowledge / expertise.	3,0	**Neutral**
15	Literature study	ECI is disadvantageous for the client because the contractor is the first and only allowed to make a bid after the design team phase (lack of competition).	2,5	**Neutral**
16	Interviews	The advantage for the contractor to be the first and only one to be allowed to bid after the design team phase outweighs the disadvantage of the extra capacity required during the design team phase.	3,7	**Agreed**
17	Conclusion, Interviews	For good collaboration, it is not necessary in D&C projects to decide on project goals, scope and objectives together.	1,7	**Disagreed**
18	Literature study	The D&C contract is favourable for the client because the client has less responsibilities and liabilities.	2,3	**Disagreed**
19	ECI case studies	In order for ECI to succeed extra attention is needed for the soft aspects of collaboration, for example by conducting a number of workshops during the design team phase.	4,3	**Agreed**
20	ECI case studies	During the design team phase, the representatives of the client must have more mandate than within a D&C project, because critical design choices have to be taken during the design team phase.	3,8	**Agreed**

Table 18: The average scores of the expert validation

8. Discussion

8.1. Introduction

In this chapter the discussion of the research is provided. During the course of the research, some additional findings were observed which were not directly linked to the research question. However, these findings are interesting for applying ECI and could be beneficial for the problem owners. Furthermore, the limitations of the research are provided and the recommendations for future research.

8.2. Observations in selecting cases

During the search for selecting cases in this research some remarkable findings were observed regarding different aspects.

8.2.1. Challenges in selecting cases

The selection of projects for the case study in this research was particularly more challenging than expected, there was one remarkable challenge. When contacting people asking to participate in the research, many were quick to agree to participate in this research. However, when the author mentioned that participation of both the client and contractor is required for the research, they did not want to participate anymore. Four managers of different projects on the side of the client informed the author that the participation of the contractor is not desirable. Two of the four projects were still in the construction phase, but there were ongoing conflicts during the course of the projects. Such cases would be very interesting to investigate, however the requirement of the participation of both sides of the client and contractor resulted did not allow this. This was seen in several cases, which were less obvious stated as the cases of the four managers on the side of the client. This was not observed on the side of the contractor. As a consequence of this, only projects with generally good project performance were left to select. Also, the overall collaboration within the selected cases was generally average to very good. The research would be more interesting and reliable if there was more variation in the state of the collaboration. Of course, this is a small sample compared to the total number of projects and this research is not focused on the reaction of the respondents. However, this phenomenon does show a sign of distrust between the client and contractor. This challenge did not aid the reliability of the RECAP results. The RECAP results would be more reliable if more managers would participate in the research.

8.2.2. Use of ECI in particular regions in the Netherlands

Another interesting observation during the selection of cases for the research, is the use of ECI in particular regions in the Netherlands. Cases ECI A, B, and C, and potential cases for this research are all located outside of the Randstad. The reason for this is unknown for the author, this finding was discussed with some people in the sector. A few suggested that the culture differences between the Randstad and the other regions of the Netherlands could be the cause of this. They stated that the culture in the Randstad is Anglo-Saxon, and in the regions close to Germany and Belgium the culture is more a Rhineland culture.

8.3. Interesting interview findings

During the interviews, the participants also made some clear statements regarding the lessons learned of applying ECI or the D&C contract successfully in Dutch infrastructure projects. Originally, this was not a focus of the research. However, the participants made matching

statements regarding the application of ECI and/or the D&C contract in Dutch infrastructure project. In this section the statements on applying ECI in Dutch infrastructure projects are described. Some statements can be linked with conclusion from previous chapters of this thesis. It is important to note that these findings might not be linked to improving collaboration. However, by applying ECI successfully this could indirectly have positive effects on the collaboration.

8.3.1. ECI cannot always be used

During the interviews, some remarks were made by Clients A and B, and Contractors A and C regarding the use of ECI. Client A and B, Contractors A and C suggested that the use of ECI should mainly be considered when the client lacks a certain area of knowledge or expertise. They warned that when ECI is used, the client and contractor should complement each other with their expertise. Both participants also agreed that the use of ECI may not always be the ideal choice. Client B concluded that it would not be beneficial if ECI is used for small projects. The essence of ECI is then diminished, so much time is lost to start up the design team. For larger projects, the ECI is ideal. He gave the example of case ECI B. He mentioned that right now, two phases are being designed and constructed. The design phase of the first project took longer, as the design team had to be set up. However, in the second project the design was already in place and the design phase was done a lot quicker. He mentioned that in the remaining three projects of the major maintenance projects are expected to be delivered quicker because of the time and capacity spent in the first project. From the expert validation, there was no agreement on the statement on this subject.

8.3.2. Capacity needed during the design team phase

Some remarks were made regarding the extra capacity needed in ECI projects. Clients A, B, and C, and Contractor C stated that a disadvantage of the design team is the extra capacity necessary for setting up the design team and during the design team. This would not be an issue if an organisation tendered only a few ECI projects. However, if the use of ECI would become regular this issue would arise for organisations. Contractor A, B and C agreed to this, stating that the contractor company does not generate significant revenue during the design team phase. They stated that the role of the contractor was that of a consultant. However, they did state that the fact that the contractor had the perspective of the works in the future was more relevant. It was stated that the advantage of being the first and only contractor to bid on the design (which he worked on himself) outweighs the disadvantage of the extra capacity. Client B stated that there is a lot of time needed to start a design team. He mentioned that a lot of time and capacity is used to set up a design team and to find the balance at the start. However, the extra capacity needed in the design team but is beneficial for the construction phase

8.3.3. Including a cost expert in the design team

Furthermore, Client A and B suggested the need for a cost expert on the side of the client during the design team phase. they noted that one of the pitfalls using ECI is the price aspect. At the start of the design team phase the costs are not clear yet. They recommended to have a cost expert in the design team and to have cost estimations when critical design decisions are taken. They mentioned an earlier experience in which there were no cost estimations at the moment of critical decisions. As a result of this, a final design was drafted costing twice as much as expected. The design had to be drafted from scratch. When this aspect was discussed

with Contractor A, he agreed that this would be necessary for the client. he suggested that the client could also ask the contractor make cost estimations. However, for this the client has to fully trust the contractor.

8.3.4. Mandate difference between project teams

All participants in the ECI cases mentioned a potential pitfall of ECI regarding the aspect of the lacking mandate on the side of the client. They stated that the difference in mandate between the project teams of the client and contractor could hamper the process of the design team phase. The clients stated that it is not simple to change this aspect. They stated that the structures of the clients' and contractors' organisations are different. Clients are not structured to make profit, so if some decisions are delayed it does not have consequences of the probability of the organisation to be in loss. However, the structure of contractor companies is based on financial gains which is their right to do so, as there is a lot of competition. So, the organisation benefits from the fact that the project team has the mandate to make critical decisions. Client 1 stated that it would be beneficial if the members of the clients' project teams would know their senior management well enough to make an estimation of whether or not a decision can be made. In the expert validation, the statement on this subject was clearly agreed on. The subject of the difference in mandate should be paid extra attention to in ECI cases.

8.3.5. Different culture needed for ECI projects

Clients A, B, C, and Contractors B, C stated the need for change of the culture in the Dutch infrastructure sector when using ECI or 'ECI like' forms of collaborations, such as alliances and partnering. They stated that the traditional attitude, in which the hierarchy between the client and contractor is dominant, would not work in ECI projects. He stated that the project teams should be open and honest to each other, as ECI provides room to do this. Contractor C added to this, that the traditional culture in the sector should be tackled earlier compared to how it is being tackled at the moment. He stated that the culture change should be addressed during the education of students in technical universities, such TU Delft, TU Eindhoven and TU Twente. He looked back to his experience as a student and mentioned that in that period there was no attention to the soft aspects of collaborating whatsoever. He recommended students to conduct studies such as this study. There is a need for knowledge on the soft aspects of collaboration.

8.4. Interesting RECAP results

Besides interesting findings from the interviews, there were also some interesting findings observed in the RECAP results

8.4.1. Case D&C 1

Case D&C 1 was an interesting case with relatively low scores on the Front-end definition and Collaborative practices criteria and high scores on the project performance. On the other hand, the scores on the Project performance and Relationship continuity was very high. From the interviews it was concluded that the collaboration was an exceptional one. The collaboration was remotely from each other, with a lot of trust in the contractor. Some observations from this case study were included in the expert validation. Statements 4, 6, 7, 8, and 9 were based on the findings from case D&C 1. On all these statements, except for statement 8, the experts agreed. From case D&C 1 it can be concluded that the element of trust is very important for

the project performance. However, the remote collaboration in case D&C 1 was perceived as not ideal by both its participants.

8.4.2. High scores for Project DOEN

Initially this research included Project DOEN as one of the case studies. The case study was conducted for Project DOEN, both RECAP round one and two. As changes were applied during the course of the research, Project DOEN was taken out of the research. The reasons for that are not relevant. However, the results from RECAP for Project DOEN were remarkable. The result from RECAP round one is presented in Figure 27 and Figure 28.

Looking at the results from the RECAP for Project DOEN, some remarks can be made. Firstly, the results of Project DOEN were expected to be high. Surprisingly, the scores were extremely high. The fact that Project DOEN was started as a result of the Market Vision, there was a lot of attention for the project from the Dutch infrastructure sector. Some participants in the other case studies stated that the project was always intended to be highly successful. There was no room for failure and the project teams were highly supported by the senior management of the client and contractor. Project DOEN is a pilot project and is in practice also highly successful, the concept of DOEN is being applied in the near future. However, when researching these kinds of projects, the placebo effect should be considered. Project DOEN is a completely new form of project delivery and collaboration. As the project teams from both the client and contractor have never experienced similar projects, they can be more motivated compared to 'normal' projects.

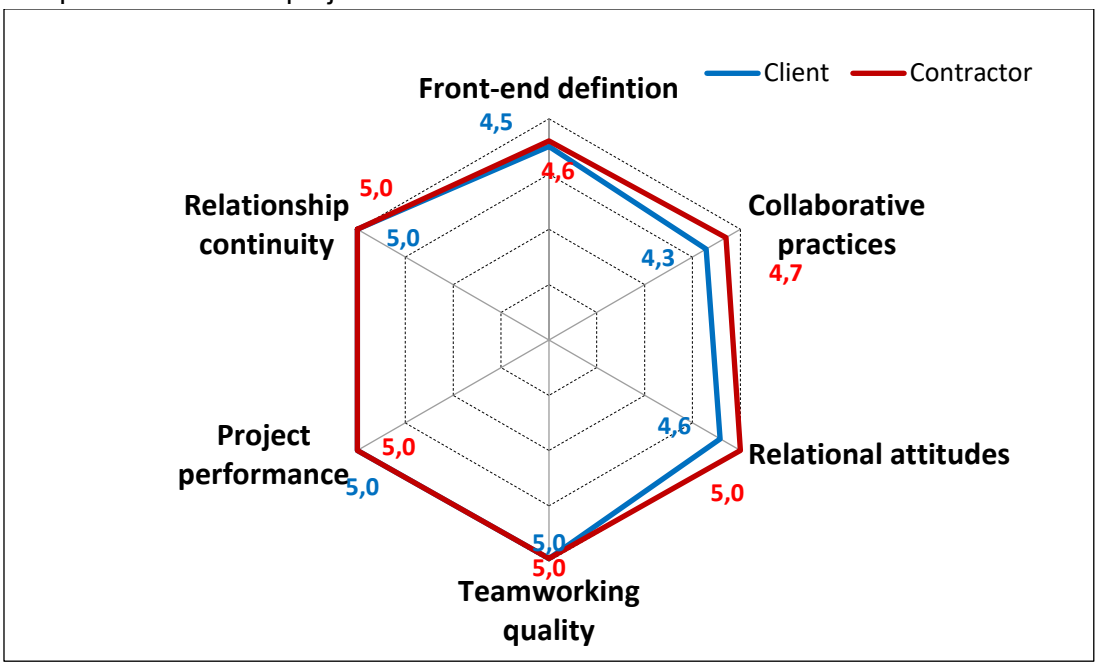

Figure 27: Scores of the main criteria for Project DOEN.

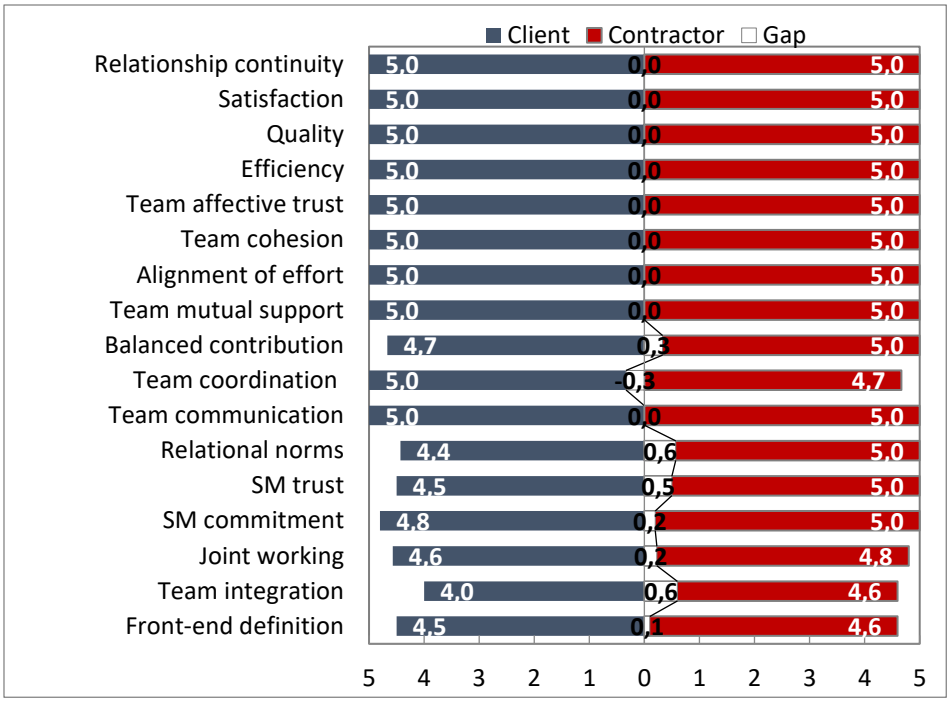

Figure 28: Scores of the sub-criteria for Project DOEN.

8.4.3. Clients' perceptions vs contractors' perceptions

In chapter 6 it was mentioned that 5 analyses were conducted. Analysis 4 and 5 are not relevant to answer the research questions, however the results from those analyses are interesting. From Appendices L and M, Table 19 is used to compare the perceptions. From the table it can be derived that the participating contractors have higher scores in general compared to the clients. Especially for the ECI cases, all scores except on the Alignment of effort, the contractors are more positive than the clients. For the D&C cases the differences are less evident. On the sub-criteria of Balanced contribution, Team cohesion and Team affective trust the gap in the scores was nearly zero. On the sub-criteria of SM commitment, SM trust, and Team communication, the client was more positive.

ECI cases			
Sub-criteria	**Contractors**	**Clients**	**Gap**
Front-end definition	4,35	3,98	0,37
Team integration	4,43	4,07	0,36
Joint working	4,28	3,76	0,52
SM commitment	4,49	3,93	0,56
SM trust	4,75	4,56	0,19
Relational norms	4,67	4,10	0,56
Team communication	4,50	4,25	0,25
Team coordination	4,44	3,78	0,67
Balanced contribution	4,33	4,11	0,22
Team mutual support	4,67	4,44	0,22
Alignment of effort	4,11	4,44	-0,33
Team cohesion	4,75	4,58	0,17
Team affective trust	4,61	4,50	0,11

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

D&C			
Sub-criteria	**Contractors**	**Clients**	**Gap**
Front-end definition	3,33	2,90	0,43
Team integration	3,10	2,73	0,37
Joint working	3,21	2,39	0,82
SM commitment	3,60	4,20	-0,60
SM trust	4,00	4,44	-0,44
Relational norms	3,90	3,18	0,72
Team communication	3,50	3,75	-0,25
Team coordination	4,17	3,42	0,75
Balanced contribution	3,67	3,67	0,00
Team mutual support	3,83	3,50	0,33
Alignment of effort	4,17	3,67	0,50
Team cohesion	3,75	3,81	-0,06
Team affective trust	3,92	3,92	0,00

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 19: Comparison between the scores of the client versus the scores of the contractor of the ECI and D&C cases separately (own ill.)

8.5. Limitations of the research

This research, like any research, has its limitations. The limitations of this research are:

- In this research five case studies were conducted. This is a limited amount of cases and the results could have been more reliable using more ECI cases and D&C cases. Due to the limited number of case studies, the research is of exploratory nature.
- In the case studies there was only one participant from the client's and contractor's project team (in case D&C 2, there were two participating managers of the clients' project team). Therefore, the perception for each case was based on one participant. This is a limitation for the use of RECAP. If there were multiple participants on each side, the RECAP results would have been more reliable. The reasons for the limited number of participants are because of time limits and the lack of willingness to participate. Firstly, conducting the interviews is time consuming. If, for example, there were three participants on each side in each case, the total number of participants would have been thirty. That would have taken too long to conduct. Secondly, the willingness to participate lacked. This is discussed before.
- The RECAP form has been used one to one, similar to the form used by Suprapto. In this research the RECAP has been translated to Dutch, as all participants are Dutch speaking. Translating some terms could change the meaning of a statement compared to the original RECAP. This could result in different outcomes of the RECAP scores.
- The ECI cases scored substantially higher than the D&C cases on the sub-criteria of Front-end definition, Joint working processes, and Team integration. Client 1 remarked that the statements from these criteria have bias towards ECI projects. She stated that in D&C projects it is not intended to integrate the teams or jointly work together. She went on by stating that collaboration is not a goal within ECI projects.
- The expert validation is done by an online survey. This could cause misinterpretations of the statements, as the author of this thesis could not explain the statements directly to the experts. This was done because of planning reasons. The experts are quite busy, and it was difficult to bring them together and plan an expert meeting.
- The experts in the validation are all from phbm. While the experts have different experiences with different parties in the past, the fact that they are from phbm could have resulted in a one sided validation. Because of time and planning reasons, only experts from phbm were asked to validate the statements.

9. Conclusion

9.1. Introduction

In this chapter the conclusions of the research are presented. Firstly, the answers to the sub-questions will be re-stated to provide a build-up to the research question. Based on the answers to the sub-questions, the answer to the research question will be provided. Furthermore, recommendations for the Dutch infrastructure sector will be provided on the improvement of the client-contractor collaboration in the sector. Lastly, recommendations for future research will be provided.

9.2. Conclusions

In this section the answers to the sub-questions will be briefly covered to build up to the answer to the research question.

9.2.1. What does the client-contractor collaboration entail and what are the success factors to the client-contractor collaboration according to literature?

A collaborative relationship in the context of this research is defined as:

"the joint working and behavioural interaction between the client and contractor(s) based on mutual values and norms for the purpose of achieving the larger objectives of the project, as defined by the client, by maximising the effectiveness of each participant's resources and sharing their abilities."

Furthermore, the elements of such a collaborative relationship are divided into the following four categories:

- **Owner and contractor capabilities:** consists of elements concerned with capabilities and financial strength of the client and the contractor, their prior relationship, and senior management support.

- **Relationship indicators:** consists of elements such as open communication, clear definition of the parties' responsibilities, and the jointly alignment of objectives, vision and trust.

- **Relationship practices:** consists of elements regarding practices and processes to enable a collaborative relationship such as knowledge sharing, joint risk management, and joint problem solving.

- **Relational attitudes:** consists of elements concerned with the orientation and willingness of both parties towards added values, sharing knowledge and information, and different corporate values

Finally, the success factors to the client-contractor collaboration are categorised as following:

1. **Relational attitudes:** includes senior management commitment and relational norms
2. **Collaborative practices:** includes team integration and joint working procedures
3. **Teamworking quality:** includes inter-team communication, coordination, balanced contribution, aligned effort, mutual support, cohesion, and affective trust
4. **Front-end definition:** includes the ability to comprehend the scope, design, plan and responsibilities
5. **Joint teams' capabilities:** includes the client's project team capability and contractor's project team capability

9.2.2. What are the characteristics of ECI and D&C infrastructure projects in the Netherlands?

During the design phase of an ECI infrastructure project a design team is formed consisting of the client, contractor and consultant(s). In the design team phase the members collaborate to draft an integrated and feasible design by using the members' expertise and knowledge. The members sign a coordination agreement together and all members enter into a separate contract with the client. Even though the members of the design team form a partnership, there is no collective responsibility for the design. Each member is liable for his own particular area of responsibility. A final design is drafted including the preparation of the works. Thereafter the design team, including the coordination agreement, and the collaboration between the parties is formally ended. Thereafter, the contractor has the advantage that he is the first and only one to make a bid on the design to execute. The client and contractor will negotiate to a price which satisfies both parties. After that, the client enters into a contract with the contractor, and the construction phase of the project will be executed by the contractor. If the client and contractor do not come to an agreement for the price of the execution of the design, the client is allowed to put the design to a tender.

The main advantage of using ECI is that the final design is more integrated, more feasible and to coordinated more effectively compared to the traditional approach of the Design-Bid-Build contract. The design is drafted mainly using the contractor's expertise and knowledge of technical aspects, preparation and costing involvement of contractor in the early phases of the project. Furthermore, the collaboration in the design team provides opportunity for a better client-contractor relationship going into the construction phase and it could also lead to a better understanding of each other.

The challenges for implementing ECI in the Dutch infrastructure are the tendering of ECI projects, as there is no standard for tendering ECI projects, and the risk of the inexperience in the sector, as the use of ECI in the sector is rather new.

The D&C (or D&B) contract is a contract between the client and contractor governed by the UAC-IC 2005, in which the contractor is responsible for the design and construction phase of an infrastructure project. The essence of the D&C contract is the integration of these phases which reduces the chance of misinterpretations of the design by the contractor. After the initiation and project definition phase of an infrastructure project the client drafts the Employer's Requirements to be put to a tender process. In contrast to ECI and the Design-Bid-Build contract, the Employer's Requirements are drafted by means of functional specifications

instead of technical specifications. In the UAC-IC 2005, the client is allowed to include a conceptual or even final design. During the design and construction phase the client has a directing role to check, and order changes when necessary, if the contractor abides by the requirements. The contractor has the obligations to deliver the works in accordance with the requirements, on time and within the promised budget, and the duty to warn the client if the client's documents contains errors.

As a result of integrating the phases and therefore reducing the number of interfaces between the design and construction phase, the design and construction of the works could be more feasible and executed quicker compared to the Design-Bid-Build contract. Furthermore, the integration provides the opportunity for more innovation, as the contractor has more flexibility to design using his expertise. The Employer's Requirements are drafted using functional specifications and thus contractors can come up with different solutions compared to Design-Bid-Build, in which the design is specified in technical details. An additional advantage for the client is that the risks and responsibilities of the design are (partly) transferred to the contractor. On the other hand, the main disadvantage of the D&C contract for the client is his limited influence after the tender phase. As the project progresses, the flexibility to apply changes to the design reduces and the cost of changes increases significantly. The cost of changes outside of the tendered design will be on the client. The client should know his wishes clearly in an early stage and draft the Employer's Requirements correctly. In addition to this, as the Employer's Requirement is usually in the form of functional specifications, the client could end up with a solution which he may not prefer.

9.2.3. To what extent do the success factors to the client-contractor collaboration apply to the case studies?

From the RECAP results it can be derived that the scores for case ECI A are all good to very good. Especially the criterion of Relational attitudes scores extremely high (4,9). Case ECI B shows similar results as ECI A, from good to very good. In case ECI B the score on Front-end definition is extremely high (4,8). Case ECI C shows results rated from moderate to very good. In case ECI C the score on the criterion of Front-end definition is lower. This was explained when the RECAP results were discussed. The issues regarding the difference in cost estimations for the steel bridge explains for the lower score on Front-end definition.

The average scores of case D&C 1 shows varying results. The scores on Front-end definition and Collaborative practices are poor to moderate. On the other hand, the scores on Relational attitudes and Teamworking quality are good. The average scores of case D&C 2 are closer to each other compared to D&C 1, scoring on all criteria from moderate to good.

9.2.4. To what extent is the RECAP tool practical and useful to assess the state of the client-contractor collaboration in Dutch infrastructure projects?

The RECAP tool is evaluated based on the responses from the participants. In total there were 11 participants who were asked the following three questions at the end of the interview:

1. What is your opinion on the practicality of the RECAP tool in the Dutch infrastructure sector? And why?
2. How would you use the RECAP tool in future projects?
3. What are your suggestions to further develop the RECAP tool to use in the Dutch infrastructure sector?

All participants reacted positive on the practicality of the RECAP tool in the Dutch infrastructure sector. In general, the participants found the statements easy to rate and the statements were not ambiguous. The time it took the participants to fill in the form was around 30 minutes. Most participants regarded the RECAP to be complete, the criteria reflect the success factors for collaboration. Only Client 1 had something to add to criteria, namely: identifying each other's interests. RECAP was compared to the 'Past Performance' tool of RWS by most participants. Some of them found RECAP to be more extensive and more comprehensive.

The participants also reacted positive on the usefulness of the RECAP tool in the Dutch infrastructure sector. They perceived the tool to be useful to identify differences in perceptions between members of the project teams on the collaboration. Many stated that the tool could provide awareness to evaluate the state of the client-contractor relationship. Furthermore, most participants also stated that RECAP could be integrated in projects in the Dutch infrastructure sector. The RECAP could be used multiple times during an infrastructure project, with several participants on each side. Contractor 1 stated that the use of tools like RECAP do not really matter if the client wants to hold on to the hierarchical separation, as the goal is not to collaborate in those situations. Contractor B reacted very positive on the tool, even suggesting using the tool for the remaining projects in the near future. He recommended to further develop the tool, as tools like this will become crucial with the rise of new forms of collaboration.

There were suggestions provided by some of the participants. Firstly, most agreed that the use of RECAP should be done with more people and the second round should be done together with all the participants. For planning reasons, this could not be done in this research. However, the RECAP can be used with many participants. Client 2,1 suggested that it could be helpful to include one manager of each IPM model. By doing this most of the different elements of the project are included in the tool.

Furthermore, Contractor A suggested that some statements on the Relational norms criterion could be combined to make the list shorter. However, he stated that if the tool would be used during a project that would not be an issue. The use of the tool would then be seen as a method to improve the collaboration and the managers would not mind the length of the form because of that. He also stated that when the RECAP will be used, the terms should be checked. A small number of statements (he could not remember which) contained some terms which were unusual when ECI is used.

Client 1 suggests some adjustments on statements in Front end definition. It is stated that some processes (planning and scope for example) are done jointly. Using integrated contracts, this is not the goal. It is unusual to do this in D&C projects. Same goes for Team integration, stating that the project teams of both parties function as one team. That also is unusual in D&C projects, the goal is not be one team. There is a clear distinction in the roles. Contractor C mentioned a limitation which is not specifically for RECAP but in most tools, which consist of a scale from 1 to 5 or 1 to 10. He stated that he personally would never rate the maximum score or the minimum score. He mentioned that there are also people who rate only extremes. That is something to keep in mind, when reviewing the scores.

Lastly, Client 1 suggests the addition of identifying each other's interests. That aspect is regarded as crucial as she has experiences with different types of projects, and she observed that aspect. She went on by clarifying that it is not necessary to align the interests, because the interests of the client and contractor are clearly different. However, by identifying the interests it helps the client and contractor to understand each other better.

9.2.5. What are the differences in the client-contractor collaboration between the ECI and D&C cases?

The main differences in the client-contractor collaboration between the ECI and D&C cases is observed in the Front-end definition, Team integration, and Joint working processes. The gaps in scores are substantial for these criteria.

In the ECI cases the project teams of the client and contractor are integrated and behave as one project team actively collaborating together. The main cause for this, is the forming of the design team. By forming the design team, the client has more influence on the design, and higher certainty in costs and planning. The contractor's expertise and knowledge of technical aspects, preparation, and costing enables the construction phase to be executed quicker and to be coordinated more effectively. This results in an integrated design and also a better comprehension of the front-end definition by the members of the design team. The contractor is motivated to collaborate into drafting a feasible design, as he has a better position to be award the building contract compared to the traditional process of Design-Bid-Build. He is the first and only to bid on the final design, on which he had worked on himself. Furthermore, the design team feeds a collaborative behaviour, in which the parties jointly solve problems and jointly identify potential risks and pitfalls. The project teams of the client and contractor are integrated as one project team.

In the D&C cases, the client-contractor relationship is different. The roles of the client and contractor in D&C projects is clearly separated and there is an imbalance in the involvement during the process of D&C projects. The contractor is responsible for the design and construction of the project, based on the Employer's Requirements submitted to the tender phase by the client. The client has a directing role, in which he has a passive attitude and checks the contractors processes and works. The project teams of the client and contractor are not integrated into one project team. Furthermore, the jointly working processes is not stimulated by the D&C contract. Contractor B stated that the UAC-IC 2005 does not feed a 'no-blame' culture, the parties could be pointing to each other instead of jointly working on issues. Also, from the case studies it also became clear that it is not intended to integrate the project

teams of the client and contractor and to behave as one project team. The separation between the client and contractor is known and is set.

From the analyses there are also moderate gaps observed in the scores between the ECI and D&C cases for the sub-criteria of Relation norms, Team communication, Balanced contribution, Team mutual support, Team cohesion, and Team affective trust.

In the ECI cases there is a collaborative behaviour with ‘no blame’ culture, effective communication, mutual support and trust between the project teams, and the projects teams behave as one project team. These effects may not be the goal of the ECI model, it is a result from forming the design team in the design phase. By forming a design team, the members do not become formal partners. The members all enter into separate contracts with the client, so each member has his own role and responsibility. It is important to note that the design team ends after the final design is drafted, and therefore also the collaboration ends. However, as the client-contractor relationship has been set up in the design team, this provides opportunities for a collaborative relationship between the client and contractor for the construction phase. From the case studies it became clear that by forming the design team, there are positive effects on the client-contractor relationship. The forming of the design team feeds a collaborative behaviour, in which the parties jointly solve problems and jointly identify potential risks and pitfalls. There is a balance in the contribution from all the members of the design team. The teams support each other, because they know that by supporting each other they themselves will benefit from it also. Furthermore, the teams communicate more open towards each other as this is needed to integrate the final design. Especially, the participating contractors were highly satisfied with the team communication in the ECI cases. Also, the cohesion within the design team was perceived as highly satisfying by the clients and contractors.

In D&C projects, the relationship starts after the tender phase. The transition from the tender phase to the design and construct phase could affect the relationship, and therefore the communication. During the interviews, participants stated that the probability of misinterpretation of the Employer’s Requirements in D&C projects is higher because of the use of functional specification. This misinterpretation has the consequence that the relationship starts off on the wrong foot, and it could affect the team communication and cohesion. For the overall collaboration in the D&C cases, the low scores on Front-end definition, Team integration, and Joint working processes do not have to mean that there is an adversarial relationship between the client and contractor. In D&C projects there is room for a good understanding between the client and contractor. This was clearly observed in case D&C 1, in which the contractor had the trust and support from the client. This shows that remotely collaborating, with a passive attitude from the client could work. It may not have positive effects on the client-contractor collaboration in general, however the project performance could benefit from it. Contractor 1 did clearly state that for remote collaboration to work, the parties have to agree beforehand on how to implement that.

9.3. Answer to the research question

Based on the findings in the literature study on collaboration, ECI projects and D&C projects, and the case study findings, the research question can be answered:

What are the differences in the client-contractor collaboration between ECI and D&C infrastructure projects, and what possibilities can be derived from the comparison to improve the client-contractor collaboration in the Dutch infrastructure sector?

To answer this question the results from the analysis are used and presented in Table 20 below. The ECI cases scored higher than the D&C cases on all collaborative criteria. From the results of the analysis it was observed that the ECI cases scored substantially higher than the D&C cases for the sub-criteria of Front-end definition, Team integration, and Joint working processes. Furthermore, it was observed that the ECI cases scored moderately higher than the D&C cases for the sub-criteria of Relation norms, Team communication, Balanced contribution, Team mutual support, Team cohesion, and Team affective trust.

Sub-criteria	ECI	D&C	Gap
Front-end definition	4,18	3,13	1,06
Team integration	4,25	2,93	1,33
Joint working	4,03	2,83	1,21
SM commitment	4,22	3,90	0,32
SM trust	4,67	4,23	0,44
Relational norms	4,38	3,55	0,83
Team communication	4,38	3,63	0,76
Team coordination	4,10	3,80	0,30
Balanced contribution	4,22	3,68	0,54
Team mutual support	4,57	3,68	0,89
Alignment of effort	4,27	3,93	0,34
Team cohesion	4,68	3,80	0,88
Team affective trust	4,55	3,90	0,65

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 20: Average scores of the clients and contractors combined for the ECI and D&C cases for each sub-criterion, including the gaps. (own ill.)

In ECI projects the project teams of the client and contractor are integrated and behave as one project team actively collaborating together. The main cause for this, is the design team. By forming the design team, the client has more influence on the design, and higher certainty in costs and planning. The contractor's expertise and knowledge of technical aspects, preparation, and costing enables the construction phase to be executed quicker and to be coordinated more effectively. This results in an integrated design and also a better comprehension of the front-end definition by the members of the design team. The contractor is motivated to collaborate into drafting a feasible design, as he has a better position to be award the building contract compared to the traditional process of Design-Bid-Build. He is the first and only to bid on the final design, on which he had worked on himself. Furthermore, the

design team feeds a collaborative behaviour, in which the parties jointly solve problems and jointly identify potential risks and pitfalls. The project teams of the client and contractor are integrated as one project team. In the ECI cases there is a collaborative behaviour with 'no blame' culture, effective communication, mutual support and trust between the project teams, and the projects teams behave as one project team. These effects may not be the goal of the ECI model, it is a result from forming the design team in the design phase. By forming a design team, the members do not become formal partners. The members all enter into separate contracts with the client, so each member has his own role and responsibility. It is important to note that the design team ends after the final design is drafted, and therefore also the collaboration ends. However, as the client-contractor relationship has been set up in the design team, this provides opportunities for a collaborative relationship between the client and contractor for the construction phase. From the case studies it became clear that by forming the design team, there are positive effects on the client-contractor relationship. The forming of the design team feeds a collaborative behaviour, in which the parties jointly solve problems and jointly identify potential risks and pitfalls. There is a balance in the contribution from all the members of the design team. The teams support each other, because they know that by supporting each other they themselves will benefit from it also. Furthermore, the teams communicate more open towards each other as this is needed to integrate the final design. Especially, the participating contractors were highly satisfied with the team communication in the ECI cases. Also, the cohesion within the ECI cases was perceived as highly satisfying by the clients and contractors.

In the D&C cases, the client-contractor relationship is different. The roles of the client and contractor in D&C projects is clearly separated and there is an imbalance in the involvement during the process of D&C projects. The contractor is responsible for the design and construction of the project, based on the Employer's Requirements submitted to the tender phase by the client. The client has a directing role, in which he has a passive attitude and checks the contractors processes and works. The project teams of the client and contractor are not integrated into one project team. Furthermore, the jointly working processes is not stimulated by the D&C contract. Contractor B stated that the UAC-IC 2005 does not feed a 'no-blame' culture, the parties could be pointing to each other instead of jointly working on issues. Also, from the case studies it also became clear that it is not intended to integrate the project teams of the client and contractor and to behave as one project team. The separation between the client and contractor is known and is set. In D&C projects, the relationship starts after the tender phase. The transition from the tender phase to the design and construct phase could affect the relationship, and therefore the communication. During the interviews, participants stated that the probability of misinterpretation of the Employer's Requirements in D&C projects is higher because of the use of functional specification. This misinterpretation has the consequence that the relationship starts off on the wrong foot, and it could affect the team communication and cohesion. For the overall collaboration in the D&C cases, the low scores on Front-end definition, Team integration, and Joint working processes do not have to mean that there is an adversarial relationship between the client and contractor. In D&C projects there is room for a good understanding between the client and contractor. This was clearly observed in case D&C 1, in which the contractor had the trust and support from the client. This shows that remotely collaborating, with a passive attitude from the client could work. It may not have positive effects on the client-contractor collaboration in general, however the project performance could benefit from it. Contractor 1 did clearly state that for remote collaboration to work, the parties have to agree beforehand on how to implement that.

9.4. Recommendations

In this section the recommendations for the Dutch infrastructure sector and future research are provided.

9.4.1. Recommendations for the Dutch infrastructure sector

From the results it can be concluded that the client-contractor collaboration is perceived more satisfying in ECI projects than D&C projects for all collaborative criteria. However, this does not mean that the ECI model can be applied for every project in the Dutch infrastructure sector. It is evident that the cause for a disrupted client-contractor relationship is mainly in the early phases of a project. Firstly, it is important to choose the right contract/form of collaboration. Based on that choice different approaches can be considered. In the case studies it was suggested that the use of ECI should mainly be considered when the client lacks a certain area of knowledge or expertise. The participants warned that when ECI is used, the client and contractor should complement each other with their expertise. Also, when the ECI model is applied, the client should be aware of the fact that the design team requires extra capacity and energy to build up. Especially if the use of the ECI model becomes regular in an organisation. The ECI model is not a total solution for all projects. Also, it is recommended to include an independent cost expert in the design team. The price aspect after the design team is one of the pitfalls, and an independent cost expert reduces the probability of unexpected costs for the client. In the design team phase critical decisions are made. All participants mentioned the lack of mandate of the client's project team to be a pitfall during the design team phase. While the issue of the imbalance in the mandate cannot be solved easily, the client's project team members could get to know their senior management better. By doing that, the client's representative in the design team knows what decisions are likely to be confirmed or rejected.

In the Dutch infrastructure sector, there is currently a rise of new forms of collaboration. Especially the use of ECI is rising quickly. As concluded from this research, the use of the ECI model results in an improved client-contractor collaboration. However, it is important to note that there is a need of a different culture in ECI projects. The same applies to alliances. The traditional culture, in which the hierarchy between the client and contractor is dominant, would not work in ECI projects. In the case studies it was stated that the project teams should be open and honest to each other, as ECI provides room to do this. Contractor C added to this, that the traditional culture in the sector should be tackled earlier compared to how it is being tackled at the moment. He stated that the culture change should be addressed during the education of students in technical universities, such TU Delft, TU Eindhoven and TU Twente. He looked back to his experience as a student and mentioned that in that period there was no attention to the soft aspects of collaborating whatsoever. He recommended students to conduct studies such as this study. There is a need for knowledge on the soft aspects of collaboration.

Furthermore, it is important to note that this research was on the client-contract collaboration only. The conclusions of this research do not assure a better project performance when using ECI compared to the D&C contract. Integrated contracts still have advantages over the ECI model. Some recommendations can be made for the use of the D&C contract. It is important to look at the case D&C 1 in this research. In that project, the conditions were not ideal. The client-contractor collaboration started on the wrong foot and changes in the project teams were made. The project delivery was estimated to be delayed by a year and around fifteen percent

cost overruns. However, the attitude of the client's project team and senior management, and that of the contractor were decisive to prevent the delay and cost overruns. It became clear that the contract should not be followed one-to-one, otherwise the delay and cost overruns would happen. The client needed the contractor, as the client had a shortcoming at the beginning of the project, to prevent the delay and cost overruns. The collaboration was remote from each other, but the client allowed the contractor to have more responsibilities and the client's senior management supported the contractor. All in all, the delay and cost overruns were prevented. Both participants in case D&C 1 stated that if the contract was followed one-to-one, the budget and planning would never have been met.

Lastly, it is recommended for the Dutch infrastructure sector to invest time, energy and capacity in the collaboration. This can be done by conducting collaborative workshops during the course of the projects. It is recommended to use assessment tools, such as the RECAP tool. By using such tools, the different perspective of the project teams on the collaboration will be identified and assessed. The differences in perceptions can be discussed and the collaboration during the course of a project can be improved.

9.4.2. Recommendations for future research

There are several recommendations for future research:

- The use of RECAP is new in the Dutch infrastructure sector. It is an interesting tool to assess the client-contractor collaboration. All participants reacted positive on the practicality and usefulness of RECAP. The RECAP tool should be used and evaluated in the Dutch infrastructure sector more often.
- The RECAP tool is new in the Dutch infrastructure sector. While the use of RECAP may not become regular, it can add elements to standard assessment tools used in the sector right now. A comparison study can be conducted to research this.
- This research was on the collaboration in ECI and D&C projects. Due to time limitations and challenges in case selection, the project performance could not be included in the research. A similar research can be done considering the project performance of ECI projects compared to D&C projects.
- During the selection of the cases it became clear that the use of ECI was mainly outside of the Randstad. Further research can be conducted into the cultural differences in the Netherlands and the use of contracts.
- The number of cases in this research is limited. The validity of this research can be increased by increasing the number of case studies. The higher the amount of cases, the more reliable the results.
- The number of participants in each case study in this research is limited. The validity of this research can be increased by increasing the number of participants in each case study. This will improve the reliability of the RECAP results greatly.

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Appendix A: Relational Capability Assessment Form (Suprapto, 2016).

RELATIONAL CAPABILITY ASSESSMENT FORM

Owner-contractor collaboration represents a unique capability which significantly determines project performance. The ability to collaborate in projects is embedded in the project team, which is a temporary organization that both firms (owner and contractor) establish in order to deploy their resources in projects. Relational capability in projects is the ability of the two parties, their teams and their people in aligning and integrating their knowledge, skills, and energy to perform interdependent project activities for accomplishing a better outcome.

PURPOSE

This assessment tool is created to evaluate the relational capability at inter-firm and inter-team levels. It is intended for use by a pair of owner-contractor firms working in a project. The assessment results will provide an overview regarding the achievement of specific critical success factors of collaboration in projects.

What's in it for the participating firms? By participating in this assessment, the pair of firms will gain insights regarding their (current/past) achievement and identify specific aspects to improve in future. The assessment focuses on how well the firms 'work together' and not on the 'individual performance' of the firms. When used in an ongoing project, the two parties can formulate joint actions more constructively to achieve better project performance. This assessment also identifies for the participating firms the potential value of continuing the relationships in future.

INSTRUCTION

1. The assessment is designed to be filled-in separately by a pair of senior management representatives or project directors or equivalent position, and/or project managers representing owner and contractor. There are a total of 17 assessment aspects and some open questions. On average, it takes about 45 minutes to complete this assessment.
2. Choose a project you are currently involved in, keep in mind the situation in that project when you rate each statement.
3. Rate each statement by selecting the appropriate level of achievement or realization or performance (**1 = very poor** to **5 = very good**). The rating you give should be based on your own perception that best describes the actual situation occurring in the project.

A. Front-end definition and collaborative practices

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

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

Sub Criteria / Indicators	1	2	3	4	5	NA	DK
1. Front-end definition							
a. The project goals, objectives, and scope are understood by the contractor team.							
b. The project goals, objectives, and scope are understood by the owner team.							
c. All functional/ high level technical requirements (*basic design*) are reviewed together by both teams.							
d. The *project execution plan* is reviewed together by both teams and adjusted accordingly if needed.							
e. There are clear *roles and responsibilities* assigned to both teams.							
2. Team integration							
f. We form an *integrated project team* (IPT) where the owner and the contractor teams are structured and integrated as a single team with no apparent boundaries.							
g. We perform *goal setting and alignment meetings* with sub-contractors and suppliers.							
h. We perform *goal setting and alignment meetings* with the owner's business and operation representatives.							
i. We exercise *inter-team building* workshops to encourage collaboration via fun and excitement.							
j. We have *recognition and rewards program* to stimulate individual and team levels collaborative behavior.							
3. Joint working processes							
k. We jointly conduct *planning*.							
l. We jointly perform *monitoring, controlling*, and *reporting*.							
m. We jointly conduct *issue management*.							
n. We jointly *define* and *monitor* the achievement of key *performance* areas.							
o. We jointly *identify and monitor risks* and formulate a necessary *mitigation plan*.							
p. We have robust *mechanisms to resolve conflicts/disputes*.							
q. We have formal *procedures for joint decision making*.							

B. Project performance and Relationship continuity

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

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

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

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

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

C. Relational attitudes

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

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

Sub Criteria / Indicators	1	2	3	4	5	NA	DK
8. Senior management commitment							
a. Senior management of the owner commits to provide necessary resources and support to the project teams.							
b. Senior management of the contractor commits to provide necessary resources and support to the project teams.							
c. Senior management of the owner shows consistent and passionate leadership.							
d. Senior management of the contractor shows consistent and passionate leadership.							
e. Senior management of both parties actively work together to resolve potential conflicts when needed.							
9. Senior management trust							
f. There is an atmosphere of mutual trust between senior management of both parties.							
g. There is a mutual enthusiasm from senior management of both parties in achieving the project goals.							
h. Senior management of both parties has confidence in each other to do what is right.							
i. Senior management of both parties keeps their promises truthfully.							
10. Established relational norms							
j. The owner intentionally adopts 'no blame culture' when problems arise.							
k. The contractor intentionally adopts 'no blame culture' when problems arise.							
l. The owner is intentionally open and honest in any interactions with no hidden agendas.							
m. The contractor is intentionally open and honest in any interactions with no hidden agendas.							
n. The owner strives for business outcomes whereby both parties either win or both parties lose.							
o. The contractor strives for business outcomes whereby both parties either win or both parties lose.							
p. Both parties agree to have an equal say in any critical decisions that matter to both parties.							

D. Inter-teamworking

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

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

Sub Criteria / Indicators	1	2	3	4	5	NA	DK
11. Communication							
a. Both teams communicate directly with each other.							
b. Project-relevant information is shared openly by both teams.							
c. Whenever a problem is detected, it is immediately and honestly communicated to the other team.							
d. Both teams are satisfied with the usefulness of the information shared by other team.							
12. Coordination							
e. The work done in the teams is closely synchronized between the teams.							
f. There is a clear linkage between the teams for their interdependent tasks.							
g. There is no redundancy regarding the work done between both teams.							
13. Balanced contribution							
h. Both teams recognize the specific strengths and weaknesses of each team's competences.							
i. Both teams are contributing their knowledge/ expertise in accordance with their full potential.							
j. There is a balanced contribution of ideas between the teams.							
14. Mutual support							
k. Both teams help each other as well as they could.							
l. Whenever problems occurred, they are resolved constructively.							
m. Every critical decision is made together by both teams.							
15. Aligned effort							
n. Both teams give this project the priority it needs.							
o. Both teams put their best effort into this project.							
p. There is no conflict regarding the effort that each team put into this project.							

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

This is the end of the assessment, thank you for the cooperation.

Appendix B: RECAP translated to Dutch

Relational Capability Assessment Tool

Het doel van deze assessment tool is om het samenwerkingsvermogen op het managementniveau te meten binnen een project. De tool is bestemd voor de opdrachtgever en opdrachtnemer die binnen hetzelfde project samenwerken. De resultaten zullen een overzicht geven van succesfactoren binnen een project met betrekking tot samenwerkingsaspecten en praktijken.

Na het invullen en opsturen van de enquête zullen de resultaten door de interviewer worden geanalyseerd. Deze resultaten worden tijdens de tweede ronde (het interview) besproken. Door deze assessment tool te gebruiken kunnen opdrachtgevers en opdrachtnemers inzichten verkrijgen van specifieke samenwerkingsaspecten. Aan de hand van de resultaten kan men in de toekomst de samenwerking verbeteren. De focus in de assessment tool is gericht op hoe goed de partijen samenwerken en niet op het individuele prestaties binnen het project.

Het is de bedoeling dat de enquête individueel wordt ingevuld, zonder de aspecten en resultaten te bespreken met collega's die ook aan het project hebben meegewerkt. Graag de enquête invullen binnen de kaders van het besproken project. Eventuele ervaringen (positief of negatief) met de andere partij binnen een ander project graag buiten beschouwing houden, dit om de scores niet beïnvloeden.

Invullen van de enquête is anoniem. Informatie over de deelnemers en het project zullen niet openbaar worden gepubliceerd.

A. Front-end definitie en samenwerking praktijken

In deze paragraaf worden de front-end definitie en samenwerking praktijken behandeld. In hoeverre werden de projectdoelen, doelstellingen en scope daadwerkelijk begrepen door beide teams? Samenwerking praktijken zijn aanvullende processen met als doel om de samenwerking te verbeteren tussen de teams van de opdrachtgever (OG) en de opdrachtnemer (ON). **Als het project nog loopt en er zijn stellingen die over het eindresultaat gaan, graag een verwachting invullen.**

De woorden “beide teams” en “wij” refereren naar de teams van OG en ON. Graag elke stelling met een ‘X’ markeren, waarbij geldt: **1= Zeer Slecht, 2= Slecht, 3= Matig, 4= Goed, 5= Zeer Goed, n.v.t= niet van toepassing, onb= onbekend**

Sub-criteria/Stellingen	1	2	3	4	5	n.v.t	onb
1. Front-end definitie							
a. De projectdoelen, doelstellingen en scope waren duidelijk voor het team van de ON.							
b. De projectdoelen, doelstellingen en scope waren duidelijk voor het team van de OG.							
c. Alle functionele/ technische eisen werden samen beoordeeld door beide teams.							
d. Het Project Management Plan werd samen met beide teams beoordeeld en aangepast indien nodig.							
e. De rollen en verantwoordelijkheden toegewezen aan beide teams waren duidelijk.							
2. Team integratie							
f. Wij vormden een geïntegreerd projectteam waarin de OG en de ON als één team functioneerde zonder duidelijke grenzen.							
g. Wij hielden meetings met onderaannemers en leveranciers over doelstellingen en afstemming.							
h. Wij hielden meetings met de vertegenwoordigers van de OG over doelstellingen en afstemming.							
i. Wij hielden workshops om de samenwerking tussen beide teams (OG/ON) te stimuleren.							
j. Wij gebruikten een erkenning en beloning schema om de samenwerking te stimuleren. Teamleden werden d.m.v financiële/niet-financiële middelen beloond.							
3. Gezamenlijke processen							
k. Wij maakten gezamenlijk de planning.							
l. Wij voerden gezamenlijk monitoring, beheersing en rapporten uit.							
m. Wij stelden gezamenlijk het issue management op.							
n. Wij hebben gezamenlijk de key performances (KPI’s). gedefinieerd en het bewerkstelligen ervan gezamenlijk gemonitord.							
o. Wij hebben gezamenlijk de risico’s geïdentificeerd en gemonitord en maakten gezamenlijk een mitigatieplan.							
p. Wij hadden duidelijke mechanismen om conflicten/geschillen op te lossen.							
q. Wij hadden formele procedures voor gezamenlijke besluitvorming.							

B. Projectresultaat

In deze paragraaf worden de projectresultaten behandeld. De stellingen verdeeld over de volgende groepen: efficiëntie, kwaliteit van het resultaat, tevredenheid van het resultaat, en eventuele herhaling van de samenwerking in toekomstige projecten. **Als het project nog loopt en er zijn stellingen die over het eindresultaat gaan, graag een verwachting invullen.**

Graag de stellingen met een 'X' markeren, waarbij geldt: **1= Zeer Slecht, 2= Slecht, 3= Matig, 4= Goed, 5= Zeer Goed, n.v.t= niet van toepassing, onb=onbekend**

Sub-criteria/Stellingen	1	2	3	4	5	n.v.t	onb
4. Efficiëntie							
a. Het project is binnen de gestelde kostenbegroting opgeleverd.							
b. Het project is volgens planning opgeleverd.							
5. Kwaliteit							
c. Er zijn geen significante herzieningen vanwege ernstige gebreken.							
d. Het project is veilig verlopen zonder incidenten die ernstig letsel veroorzaken.							
e. Het opgeleverd object is in gebruik en is betrouwbaar, zonder grote problemen.							
f. Het opgeleverd object functioneert volgens de gespecificeerde capaciteiten							
6. Tevredenheid							
g. Beide partijen (OG/ON) zijn tevreden met het resultaat.							
h. Het project is een succes voor de organisatie van de OG.							
i. Het project is een succes voor de organisatie van de ON.							

Graag de volgende stellingen markeren met een 'X', waarbij geldt: **1= Onwaarschijnlijk, 2= Enigszins waarschijnlijk, 3= Neutraal, 4= Waarschijnlijk, 5= Zeer waarschijnlijk, n.v.t= niet van toepassing, onb=onbekend**

Sub-criteria/Stellingen	1	2	3	4	5	n.v.t	onb
7. Herhaling van de samenwerking in de toekomst							
j. In toekomstige projecten zouden wij weer willen samenwerken met dezelfde OG of ON.							
k. De ervaringen van de relatie (van de samenwerking) die we hebben opgedaan is nuttig voor toekomstige projecten, zelfs met een andere OG of ON.							
l. Als gevolg van de samenwerking tijdens dit project hebben we voordelen die ons in staat stellen om meer te concurreren in de toekomst.							
m. Als gevolg van deze relatie is mijn organisatie in staat om unieke eigenschappen (met betrekking tot samenwerking) te ontwikkelen.							

C. Houding en gedrag

In deze paragraaf wordt de inzet en houding van het senior management van OG en ON, met betrekking tot de samenwerking, behandeld. De woorden “senior management” refereert naar managers op hoger niveau of leidinggevenden die een organisatie vertegenwoordigen en de bevoegdheid hebben om een definitief besluit te nemen binnen het project. **Als het project nog loopt en er zijn stellingen die over het eindresultaat gaan, graag een verwachting invullen.**

Graag de stellingen met een ‘X’ markeren, waarbij geldt: **1= Zeer Slecht, 2= Slecht, 3= Matig, 4= Goed, 5= Zeer Goed, n.v.t= niet van toepassing, onb=onbekend**

Sub-criteria/Stellingen	1	2	3	4	5	n.v.t	onb
8. Inzet van het senior management							
a. Het senior management van de OG zette zich in om de projectteams de nodige middelen aan te bieden.							
b. Het senior management van de ON zette zich in om de projectteams de nodige middelen aan te bieden.							
c. Het senior management van de OG liet consistentie en gepassioneerd leiderschap zien.							
d. Het senior management van de ON liet consistentie en gepassioneerd leiderschap zien.							
e. Het senior management van beide partijen werkten actief samen om potentiële conflicten op te lossen.							
9. Vertrouwen van het senior management							
f. Er was een sfeer van wederzijds vertrouwen tussen het senior management van beide partijen.							
g. Er was enthousiasme van het senior management van beide partijen om de projectdoelen te bereiken.							
h. Het senior management van beide partijen had vertrouwen in elkaar dat de ander het juiste deed voor het project.							
i. Beloftes van het senior management van beide partijen werden nagekomen.							
10. Vastgestelde normen							
j. De OG implementeerde bewust ‘no blame culture’ wanneer er een probleem ontstond.							
k. De ON implementeerde bewust ‘no blame culture’ wanneer er een probleem ontstond.							
l. De OG had geen verborgen agenda en was in elke interactie open en eerlijk							
m. De ON had geen verborgen agenda en was in elke interactie open en eerlijk							
n. De OG streefde naar win-win/lose-lose oplossingen. De OG streefde niet naar een win-lose oplossing.							
o. De ON streefde naar win-win/lose-lose oplossingen. De ON streefde niet naar een win-lose oplossing.							
p. Bij belangrijke beslissingen, die ertoe doen voor beide partijen, waren OG en ON gelijkwaardig en hadden beide partijen gelijke zeggenschap.							

D. Inter-teamworking

Deze paragraaf is bedoeld om te vast te stellen hoe de teams van OG en ON samenwerken als één team, buiten de eigen organisatie. Inter-teamworking geeft aan hoe twee samenwerkende teams effectief communiceren, gelijkwaardige bijdrage van specifieke kennis en expertise, elkaar helpen om de project doelen te behalen, zich gedragen als één team, en elkaar vertrouwen op een persoonlijk niveau. **Als het project nog loopt en er zijn stellingen die over het eindresultaat gaan, dan graag een verwachting invullen.**
De woorden “beide teams” refereren naar het kernteam van OG en ON. Elk team kan vertegenwoordigd worden door ten minste één persoon (teamleider, manager of vertegenwoordiger). Graag de stellingen met een ‘X’ markeren, waarbij geldt: **1= Zeer Slecht, 2= Slecht, 3= Matig, 4= Goed, 5= Zeer Goed, n.v.t= niet van toepassing, onb=onbekend**

Sub-criteria/Stellingen	1	2	3	4	5	n.v.t	onb
11. Communicatie							
a. Beide teams communiceerden direct met elkaar.							
b. Informatie die van belang was voor het project werd openlijk gedeeld door beide teams.							
c. Wanneer er een probleem werd ontdekt, werd het meteen en eerlijk gecommuniceerd met het andere team.							
d. Beide teams waren tevreden met de relevantie/bruikbaarheid van de gedeelde informatie van het andere team.							
12. Coördinatie							
e. Voltooid werk van de teams werd nauw gesynchroniseerd tussen de teams							
f. Er was een duidelijke koppeling tussen de teams voor hun onafhankelijke taken.							
g. Er werd geen overbodig werk uitgevoerd door beide teams.							
13. Gebalanceerde bijdrage							
h. Beide teams herkenden en erkenden de sterke en zwakke punten van beide teams.							
i. Beide teams droegen bij met hun kennis/expertise.							
j. De balans van de bijdrage van ideeën was gelijk tussen de teams.							
14. Wederzijdse ondersteuning							
k. Beide teams hielpen elkaar zo goed mogelijk.							
l. Wanneer er problemen ontstonden, werden deze constructief opgelost.							
m. Elke kritische beslissing werd door beide teams gezamenlijk gemaakt.							
15. Gebalanceerde inspanning							
n. Beide teams gaven dit project de prioriteit die het project nodig had.							
o. Beide teams spanden zich maximaal in voor dit project.							
p. Er waren geen conflicten met betrekking tot de inspanning van elk team in het project.							

Sub-criteria/Stellingen	1	2	3	4	5	n.v.t	onb
16. Cohesie							
q. Leden van beide teams waren persoonlijk betrokken bij dit project.							
r. Leden van beide teams waren geïntegreerd als één team.							
s. Leden van beide teams waren trots om deel uit te maken van het project team.							
t. Leden van beide teams voelden zich verantwoordelijk om de relaties binnen het projectteam te behouden.							
17. Vertrouwen							
u. Beide teams voelden zich comfortabel om afhankelijk te zijn van elkaar							
v. Beide teams hielden zich aan hun beloftes.							
w. Beide teams werkten met een hoge mate van integriteit.							
x. Beide teams waren redelijk tegen elkaar.							
y. Beide teams streefden om de belangen van elkaar te behartigen.							
z. Beide teams rekenden erop dat er geen misbruik werd gemaakt van de zwakke punten van elkaar.							

Dit is het einde van de enquête, bedankt voor het invullen. Graag mailen naar Alendnader@hotmail.com.

Appendix C: Identification of the elements of collaborative relationships

To identify the different elements of collaborative relationships in projects, Suprapto (2016, p. 19) conducted an in-depth literature review of 11 articles which are based on empirical studies. The authors and titles of the 11 articles are shown in Table 21. In the review the following 24 elements of collaborative relationships in projects were identified (Suprapto, 2016, pp. 21, 22):

1. Owner's technical capability
2. Top/senior management commitment and support
3. Financial strength
4. Prior relationship experience
5. Mutual objectives, goal alignment, and/or shared vision
6. Mutual trust and trust-based arrangement
7. Open and honest communication
8. "No blame" culture attitudes
9. Balance or equitable participation
10. Clear definitions of responsibilities
11. Joint problem solving and active dispute resolution
12. Knowledge sharing
13. Integrated team working
14. Continuous improvement
15. Contractor's early involvement
16. Performance measurement and benchmarking
17. Risk-reward or gain-pain sharing scheme
18. Joint risk management
19. Long-term orientation/commitment
20. Adequate resources or willingness to share resources
21. Organizational cultural compatibility
22. Owner's commitment and support
23. Expectation of future work
24. Reflection and self-assessment

The elements were presented as critical success factors by the 11 authors. Some of these elements are in alignment with each other. Therefore, the elements are further categorized into 4 categories. The 24 elements are divided into the 4 categories. The 4 categories are as following (Suprapto, 2016, pp. 19 - 23):

- Owner and contractor capabilities (CAP);
- Relationship indicators (RI);
- Relationship practices (RP);
- Relational attitudes (RA).

No.	Author(s)	Focus	Method and context
1	Baiden & Price (2011)	The impact of integration on teamwork effectiveness within construction project teams	Case study of 9 construction projects in the UK
2	Black et al. (2000)	The assessment of the success factors and benefits of partnering from the perspectives of owners, consultants, and contractors	Survey with 78 responses from the UK construction industry
3	Bosch-Rekveldt et al. (2011b)	The application of value improving practices during FED on project performance	Case study of 5 engineering projects in the Dutch process industry
4	Chan et al. (2004)	Identifying the critical success factors for partnering projects	Survey with 78 responses in Hong Kong
5	Cheung et al. (2011)	A framework of measuring trust in construction projects	Survey validation based on 163 responses from Hong Kong construction practitioners
6	Davis & Walker (2008)	Project alliancing practices in Australia	Case study of 49 senior participants involved in Australia alliancing projects
7	Drexler & Larson (2000)	The stability (declining and improvement) of the owner-contractor relationship in construction projects	Survey on 276 project cases
8	Larson (1995)	The effect of different nature of working relationships on project success	Survey of 280 construction projects in the North America
9	Meng (2011)	The effect of relationship management on project performance in construction	Survey with 105 responses from UK construction practitioners
10	Pinto et al. (2009)	The effects of competence and integrity trust on enhanced owner/contractor relationships and project success	Survey with 92 responses from 44 large construction projects in Northwest Canada
11	Rahman & Kumaraswamy (2008)	The relative usefulness of various potential strategies and factors for building a relational contracting culture and integrated project team	Survey with 83 responses from Hong Kong construction practitioners

Table 21: The 11 articles reviewed by Suprapto (2016, pp. Table 2-1.)

Appendix D: RECAP tool compared to the Maturity model

As mentioned before, there have been many scholars studying the practice of collaborative relationships. Snehota and Hakansson (1995) conducted a research into 'relational capability'. Other terms researched are 'collaborative working', done by Xue et al. (2010) and Akintoye and Main (2007) and 'relationship management' in supply chains (Meng, 2010; Meng et al., 2011; Smyth & Pryke, 2009).

A well-known assessment framework for construction supply chain relationships is 'the Maturity Model for Supply Chain Relationship in Construction', also briefly explained in chapter 3.2. This assessment framework is consisted of key influencing factors on supply chain relationships, which is based on an extensive literature review by (Meng, 2010). The results of the literature review of that research and the key factors are presented in Table 22 (Meng, 2010, p. 697). For that research, 20 relevant studies were reviewed and 18 key factors that influence supply chain relationships were identified and separated into the following categories (Meng, 2010, p. 696):

- Identification of key factors critical to partnering success;
- Identification of key factors leading to traditional adversarial relationship;
- Identification of key factors impeding partnering success.

The Maturity Model for Supply Chain Relationship in Construction has also been used in the thesis of Moree (2013), who conducted an exploratory research into the role of various aspects of different contract types on the nature of relationships. While this assessment framework is evident and validated, in this research the maturity model will not be used to assess the collaboration between the client and contractor. The first reason for this is that the maturity model is focused on the effect of the different maturity levels of relationships on the project performance (Suprapto, 2016, p. 76). While that is interesting, the focus of this research is on identifying the current state of the relationship between the client and contractor and its success factors. So, the focus of this research is not on the project performance. The search is for the success factors for a proper collaboration between the client and contractor, not what the effect of the collaboration is on the project performance. Furthermore, Meng's maturity model is not specifically based on the Dutch construction sector. The research conducted by Suprapto (2016) combined qualitative and quantitative empirical studies with the focus on the execution of capital projects within the Dutch industry. Another reason is that the Maturity Model is dated from 2010. While that seems not too long ago the RECAP tool is much more recent, namely 2016. Also, the maturity model (among others) was also reviewed in the research and included in the RECAP tool of Suprapto (2016, pp. 19, 34, 61, 63, 64, 76, 122, 181).

Key relationship indicators of construction supply chains.

Perspective	Type of key factors	Author	Trust (mutual trust or suspicion/ mistrust)	Objectives (common or self objectives)	Teamwork or fragmentation	Risk allocation/ sharing risks or not	Continuous improvement or not	Communication (open and effective or ineffective)	Business attitude (win–win or win–lose)	Problem solving/ conflict resolution	Procurement/ competitive tendering/ contract	Senior management commitment or not	Share information and learning or withhold information	Focus (long-term or short-term)	Flexibility to change or resistance to change	Lack of partnering experience	Incentives	Performance assessment	Transparency	Monitoring
Positive perspective	Key factors critical to partnering success	Black et al. (2000)	√	√	√		√	√				√			√					
		Chen and Chen (2007)	√	√	√		√	√					√							
		Cox and Thompson (1997)	√			√					√						√			
		Kwan and Ofori (2001)	√	√		√						√	√							
		Lu and Yan (2007)	√	√			√	√		√		√					√			
		Naoum (2003)	√	√	√		√		√	√	√			√					√	
		Packham et al. (2003)	√		√				√											
		Palaneeswaran et al. (2003)	√			√		√	√					√					√	
		Pheng (1999)	√	√			√	√			√	√	√					√		
		Wilson et al. (1995)	√	√	√					√										
Negative perspective	Key factors leading to adversarial relationship	Bennett and Peace (2006)		√	√					√	√									
		Bower (2003)	√	√		√	√	√	√	√				√						
		Dainty et al. (2001)	√		√		√		√		√									
		Larson (1997)	√			√			√	√			√							√
		Pryke (2009)	√	√	√	√	√													
	Key factors impeding partnering success	Bresnen and Marshall (2000a)	√	√		√			√			√			√					
		Burnes and Coram (1999)				√					√					√				
		Chan et al. (2003)				√			√			√				√				
		Harper and Bernold (2005)	√	√				√							√					
		Ng et al. (2002)	√		√			√	√	√		√								
		Total	17	12	9	9	8	8	8	7	6	6	4	3	3	2	2	1	1	1

Table 22: Key relationship indicators of construction supply chains (Meng, 2010, p. Table 1)

Appendix E: Comparing studies into the success factors for collaboration

Suprapto (2016) compared his results to other comparable empirical studies into the key success factors of relational contracting (M. M. Rahman & Kumaraswamy, 2008) and the success factors for project partnering (Black et al., 2000). The research by M. M. Rahman and Kumaraswamy (2008) is based on the views of 80 respondents from the construction industry in Hong Kong. The research by Black et al. (2000)is based on 78 respondents form the UK construction sector. The success factors of the three studies are shown in Table 23.

Rank	This study (2014)	Rahman and Kumaraswamy (2008)[1]	Black et al. (2000)[2]
1	Team's affective trust	Client's top management support	Mutual trust
2	Open and honest communication	Top management support of all parties	Effective communication
3	Shared objectives	Mutual trust among all parties	Commitment from senior management
4	No blame culture	Open communication among all parties	Clear understanding
5	Contractor's project management capability	Enlightened and enthusiastic client	Acting consistent with objectives
6	Owner's senior management leadership	Effective coordination among all parties	Dedicated team
7	Senior management involvement in conflict handling	Teamworking and can do spirit of all parties	Flexibility to change
8	Contractor's senior management support	Long-term commitment to each other for all parties	Commitment to quality
9	Contractor's trust	Clear defined risk allocation/sharing	Commitment to continuous improvement
10	Contractor's senior management leadership	Knowledgeable client about project processes	Long-term perspective

Note: [1]Based on the overall rank of factors facilitating relational contracting (Rahman and Kumaraswamy, 2008, p51); [2]based on the overall rank of factors responsible for successful partnering (Black et al., 2000, p426).

Table 23: Comparing top 10 rank of relationship elements with prior studies (Suprapto, Bakker, Mooi, & Moree, 2015, p. 678)

In the context of this thesis, the comparison shown in Table 23 is extended with an additional study. The added research is a study into the critical success factors for project partnering based on 22 respondents in Hong Kong (Chan et al., 2004). The research resulted in the following five success factors for project partnering: establishment and communication of conflict resolution strategy, willingness to share resources among project participants, clear definition of responsibilities, commitment to win-win attitude, and regular monitoring of partnering process. While five success factors seem to be a small number compared to the results of the studies (Black et al., 2000; M. M. Rahman & Kumaraswamy, 2008; Suprapto, Bakker, Mooi, et al., 2015), these five success factors are compiled of several elements. The factors and its corresponding elements will be described for the purpose to ease the comparison with the other three studies.

The first factor of establishment and communication of conflict resolution strategy is compiled of the following elements (Chan et al., 2004, p. 194):

- All parties were committed to improving communication within the team;
- Top management consistently and publicly endorsed the principles of partnering;
- Control and resolution mechanism were developed to deal with problems;
- An effective conflict resolution strategy was established;

- All levels of management supported the partnering process;
- Each party felt that it got a fair deal from its partners;
- Mutual goals were established among the project participants;
- Adequate commitment was received from top to bottom of all stakeholder organizations;
- Clear expectations were communicated in the project.

The second ranked success factor, willingness to share resources among project participants, is compiled of the following elements (Chan et al., 2004, p. 194):

- The end-user had a great deal of involvement in the project through the partnering arrangement;
- Each party was willing to share resource with other partners.

The third ranked success factor, clear definition of responsibilities, is compiled of the following elements (Chan et al., 2004, p. 194):

- During the partnering process, the parties developed aligned relationships to support objectives;
- Partners knew and were able to explain to others the mission of the organization;
- Owner was properly represented in the project.

The fourth ranked success factor, commitment to win-win attitude, is compiled of the following elements (Chan et al., 2004, p. 194):

- All parties broke from the win-lose mind-set to a win-win attitude;
- Every party was willing to exchange ideas and visions;
- All parties took appropriate risk commensurate with their rewards;
- The participants were willing to provide a long-term commitment to the process;
- Partners understood which decisions could be made alone and which decisions needed to involve others;
- Responsibility and accountability were accepted by all team members;
- Partners responded in a nondefensive manner during the argument;
- All parties encouraged the open airing of problems and differences of opinion;
- A method to reward the successful completion of the partnering objectives was developed;
- Real commitments were made and kept.

The fifth ranked and last success factor, Regular monitoring of partnering process, , is compiled of the following elements (Chan et al., 2004, p. 194):

- Parties agreed to evaluate the team performance as well as the partnering process on a regular basis;
- Measurable goals determining individual responsibilities were developed in the partnering process;
- Open exchange and consideration of ideas were promoted during the partnering process;
- Roles and responsibilities were well defined in the partnering process;
- A team leader or champion was appointed to ensure that partnering principles did not slip out of focus

The success factors of the 4 studies are ranked and shown in Table 24. The fact that the success factors of the different studies overlap is not surprising, and it partly confirms that collaboration and its factors may be comparable across different countries. Furthermore, the comparison shows that the elements of trust, communication and senior management are regarded as key factors in all the studies. There is a noticeable difference in the element of long-term orientation. In the studies by M. M. Rahman and Kumaraswamy (2008) and Black et al. (2000) that element was regarded as a success factor. In the research by Suprapto, Bakker, Mooi, et al. (2015) the respondents were questioned on the basis of one-off projects, therefore it is understandable that the element of long-term orientation was not perceived as a success factor for client-contractor collaboration.

Interestingly, the element of contractual aspects seems to be perceived as less important for successful collaboration. In the study by M. M. Rahman and Kumaraswamy (2008) the element of 'Clear defined risk allocation/sharing' is a contractual aspect, ranked ninth. The study by Chan et al. (2004) shows a similar element called 'Clear definition of responsibilities' ranked third. In the research by Suprapto, Bakker, Mooi, et al. (2015) the element of contract is not ranked in the top 10. The element of 'the contract to specify targeted performance' is moderately ranked in perspective of the execution focused team. However, all the other contractual aspects received negative scores across the four perspectives (Suprapto, 2016, p. 99). It is important to note that this is about the factors improving the collaboration, an appropriate contract with arrangements is still necessary. The results of these studies show that the contract is necessary, but not to ensure an effective relationship (Suprapto, Bakker, Mooi, et al., 2015).

Rank	Suprapto, Bakker, Mooi, et al. (2015)[1]	M. M. Rahman and Kumaraswamy (2008)[2]	Black et al. (2000)[3]	Chan et al. (2004)[4]
1	Team's affective trust	Client's top management support	Mutual trust	Establishment and communication of conflict resolution strategy
2	Open and honest communication	Top management support of all parties	Effective communication	Willingness to share resources among project participants
3	Shared objectives	Mutual trust among all parties	Commitment from senior management	Clear definition of responsibilities
4	No blame culture	Open communication among all parties	Clear understanding	Commitment to win-win attitude
5	Contractor's project management capability	Enlightened and enthusiastic client	Acting consistent with objectives	Regular monitoring of partnering process
6	Owner's senior management leadership	Effective coordination among all parties	Dedicated team	
7	Senior management involvement in conflict handling	Teamworking and can-do spirit of all parties	Flexibility to change	
8	Contractor's senior management support	Long-term commitment to each other for all parties	Commitment to quality	
9	Contractor's trust	Clear defined risk allocation/sharing	Commitment to continuous improvement	
10	Contractor's senior management leadership	Knowledgeable client about project processes	Long-term perspective	

Note: [1]Based on the overall rank of success factors for collaboration (Suprapto, Bakker, Mooi, et al., 2015, p. 674); [2]Based on the overall rank of factors facilitating relational contracting (M. M. Rahman & Kumaraswamy, 2008, p. 51); [3]Based on the overall rank of factors responsible for successful partnering (Black et al., 2000, p. 426) ; [4]Based on the overall rank of underlying success factors for project partnering (Chan et al., 2004, p. 195)

Table 24: Comparing the success factors in different studies. (own ill.)

Appendix F: Literature study on traditional contracts and integrated contracts

Variants of the traditional model

In the first variant, shown in Figure 29, the client carries out the design, maintenance, operation and finance. The construction phase will be outsourced, a contractor will be chosen by performing a tender. This variant has been used in the Dutch infrastructure by the larger clients. These larger clients had more expertise and capacities with their own design and maintenance departments (Jansen, 2009, p. 57). An important characteristic of this variant is that the client has great influence on the construction phase as the client carries out the design and the preparations (Jansen, 2009, p. 57). Another important characteristic of this variant is the legal responsibility of the construction phase, the client is liable for errors in the design. However, the contractor has a duty to warn for any errors in the design, construction methods and building materials that are of such a nature that execution without warning would not be fair or reasonable. Failing to warn the client means that the contractor is liable (Jansen, 2009, p. 57).

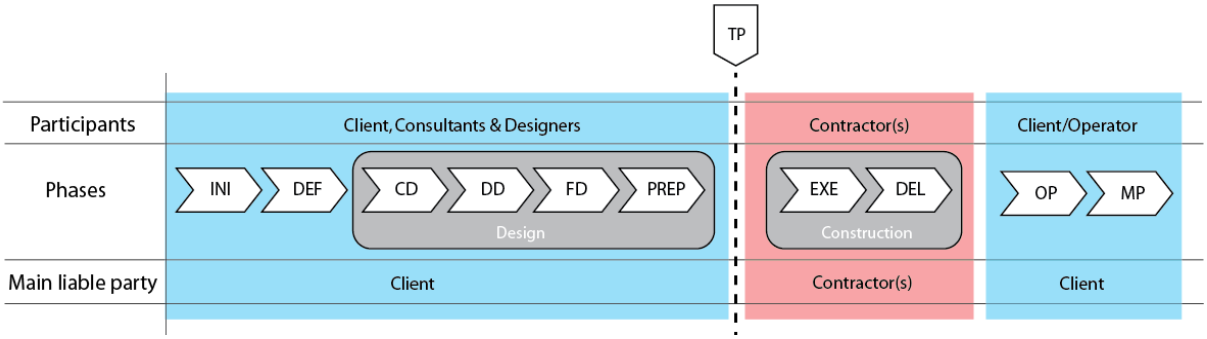

Figure 29: Traditional process in which the client carries out all phases except for the construction phase. Own illustration based on Boijens (2008); Jansen (2009, p. 57).

The second variant, shown in Figure 30, was used more often by smaller clients without their own design and maintenance department (Jansen, 2009, p. 58). However, since the early 2000's larger clients such as RWS also do not have the design expertise anymore (Rijkswaterstaat, 2019, p. 28). Because of this, the second variant is used more often in traditional construction project compared to the first variant. In this variant of the traditional contract the design is outsourced to an architect or design consultant to be carried out. The maintenance of the project is outsourced to a contractor. For the construction the same applies as the first variant (Jansen, 2009, p. 58). Even though the design is carried out by an architect or a design consultant, the client is mainly liable in relation to the contractor for design errors (Jansen, 2009, p. 58). In this variation the contractor also has a duty to warn, as described in the first variant.

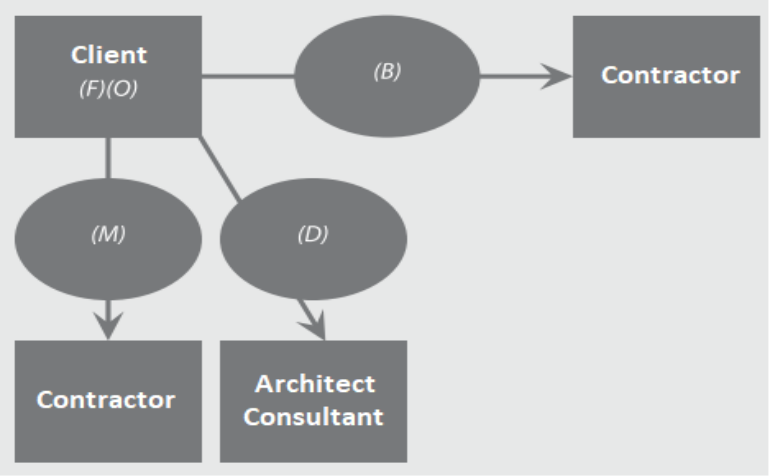

Figure 30: Traditional contract in which the design, construction and maintenance phases are outsourced (Jansen, 2009, p. 58). The arrows refer to the different tenders for the different phases.

Variants of integrated contracts

The E&C contract is a predecessor of the D&C contract. Initially RWS used the E&C contract and after positive experiences the E&C contract paved the way to the more integrated D&C contract (Lenferink et al., 2013, p. 617). In an E&C project the client drafts a detailed design which will then be tendered to a contractor. The contractor will draft a final design by including the technical design based on the detailed design and execute the construction phase (Lenferink et al., 2013; Pianoo, 2018b; Rijkswaterstaat, 2019). By using the E&C contract the client has two advantages. Firstly, he has great influence on the design, as he (could be assisted by consultants/designers) will be drafting the detailed design. Secondly, the contractor is being made responsible for the technical design of the works (Lenferink et al., 2013). The process of an E&C project is shown in Figure 31.

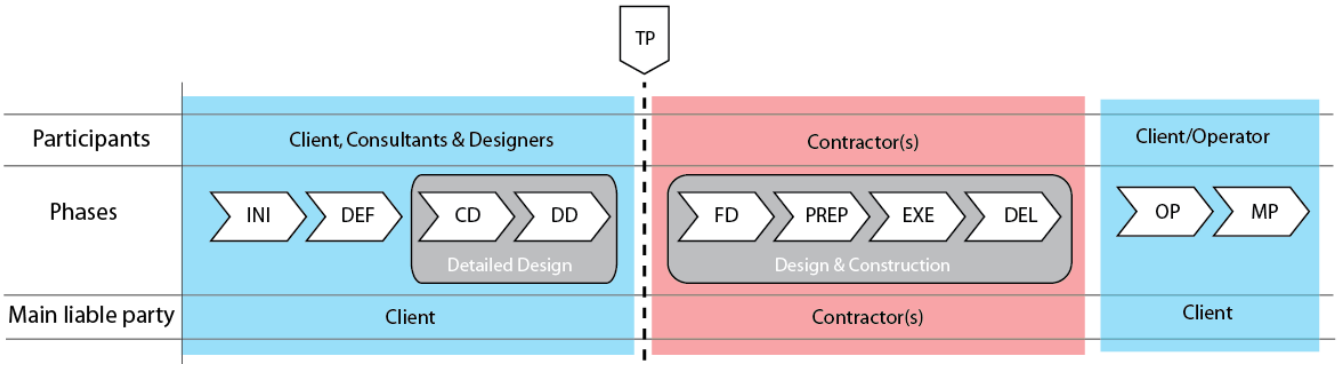

Figure 31: The E&C process of an infrastructure process. Own illustration based on Lenferink et al. (2013).

The DBM and DBFM contracts are more integrated compared to the E&C and D&C contracts. By adding the maintenance phase to the tendered contract, the contractor will draft the design by takin the life cycle of the project into account. This could result into a more sustainable and efficient design, as the contractor will also have to think about the maintenance of the project. The variant of DBFM also includes the financing of the project. Such contracts have a duration

of 15 to 30 years. Using these contracts, the client has less influence compared to less integrated contracts. On the other hand, the responsibility of the complete design is transferred

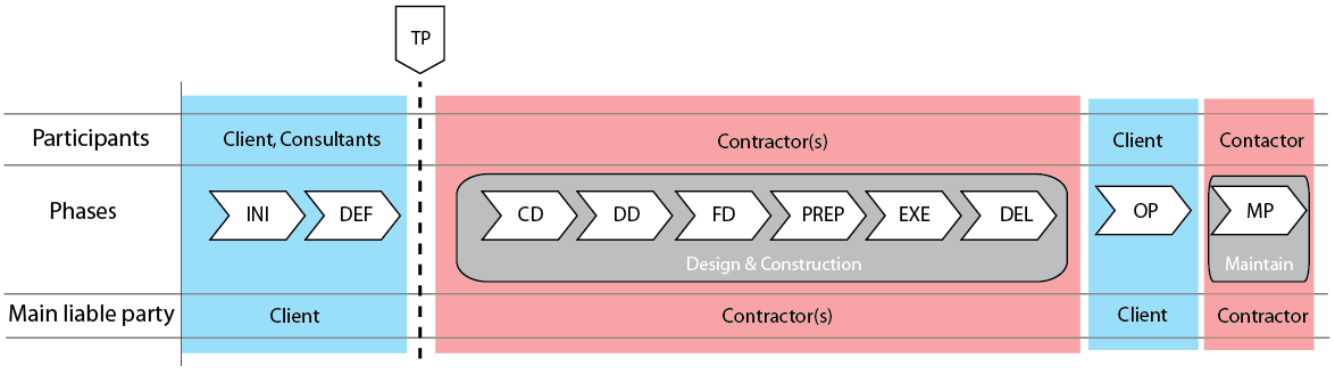

Figure 32: The DCM/DCFM process of an infrastructure project. Own illustration based on Lenferink et al. (2013).

to the contractor. (Jansen, 2009, pp. 64 - 65; Lenferink et al., 2013). The process of a DBM/DBFM project is shown in Figure 32.

The most integrated variants of the integrated contracts are the DBFMO/DBFM contracts. These are the same as the DBM/DBFM variants, with the addition of the operation. The operation is done by means of tolling. The DBFMO/DBMO contracts are used in countries such as Spain, Italy and Germany (Lenferink et al., 2013).These contracts are not used in the Dutch infrastructure sector, as tolling is generally not applied in The Netherlands because of the historical availability of a good national highway network without tolling (Financiën, 2016; Lenferink et al., 2013). These contracts are used in the Netherlands, in the building sector (Financiën, 2016). The process of a DBMO/DBFMO project is shown in Figure 33.

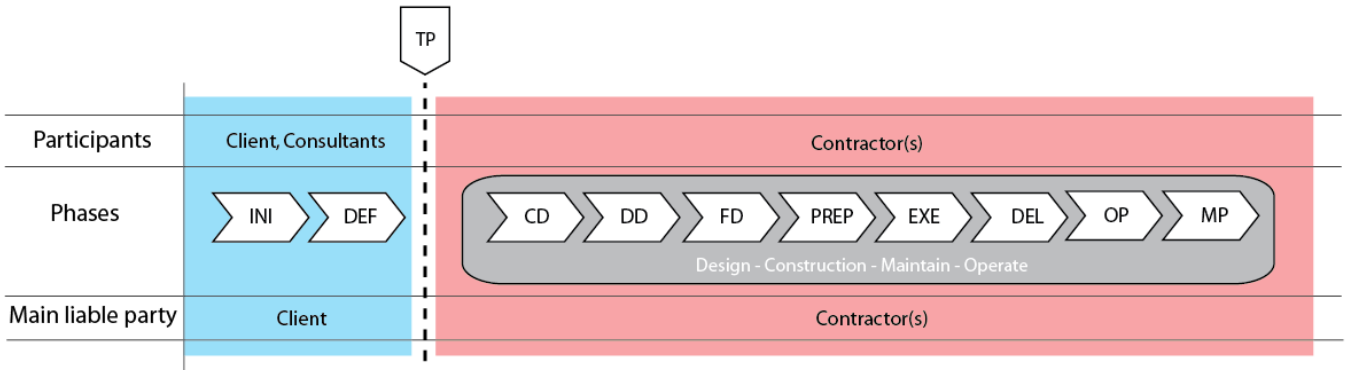

Figure 33: The DBFMO/DBMO process of an infrastructure project. Own illustration based on (Lenferink, Tillema, & Arts, 2013)

Appendix G: Interview protocol (in Dutch)

Profielschets
Toestemming spraakopname
Voorstelronde met uitleg over afstudeeronderzoek en structuur van het interview
Naam, functie, organisatie, ervaring
Rol binnen het project

Vragen over de algemene samenwerking in het project en het project zelf
Projectbeschrijving - Tijd, budget, scope - Is het volgens planning gegaan? - Algemene verloop van project - Bijzondere aspecten - Welk contract is er gebruikt voor het project? - Is dit de juiste keuze geweest?
Samenwerking - Hoe was de samenwerking tussen OG/ON tijdens het project? - Kan je toelichten wat er wel goed ging en wat niet goed ging? - Is de samenwerking veranderd gedurende het project? - Was er specifiek aandacht besteed aan de samenwerking? - Werden er bepaalde methodes gebruikt om de samewerking te verbeteren/ in stand te houden?

Gebruikte contract/samenwerkingsvorm
In dit project is er gebruik gemaakt van D&C/ Bouwteam als contract/samenwerkingsvorm - Is dit de juiste keuze geweest? Waarom? - Wat zou je aanraden bij het toepassen van D&C/ Bouwteam? Waar moet er specifiek aandacht aan besteed worden? - Welke mogelijkheden zie jij om de samenwerking te verbeteren bij het toepassen van D&C/Bouwteam?

RECAP resultaten bespreken
RECAP uitleggen. Opbouw van RECAP toelichten, subcriteria en hoofdcriteria
De vragen over RECAP kunnen verschillen, aangezien de resultaten per case anders kunnen zijn. De volgende scores worden besproken: - Verschillen in perceptie OG en ON van >1,0 punt - Hoge scores - Lage scores
Bij het gebruikte contract, welke van de scores doet er wel toe? En welke niet? Waarom?

RECAP Evaluatie
Je hebt de RECAP uitgevoerd en we hebben de resultaten besproken. - Wat is jouw mening over de toepasbaarheid van de tool? En waarom? - Hoe zou je de tool in de toekomst toepassen? - Heb je verdere suggesties om de tool te verbeteren?

Appendix H: Data distribution of the RECAP scores

To provide detailed differences in collaboration between the cases, the RECAP data will be dissected. To show the differences in the client-contractor collaboration between the ECI and D&C cases, the RECAP data for the cases has to be compared in relation to each other. In this appendix, the data on the 13 collaborative sub-criteria which are part of the collaborative main criteria are used to develop a new scale. This scale will then be used to compare the RECAP results for the cases in relation to each other. The scores of the participants on the collaborative sub criteria are shown in Table 25.

		ECI A		ECI B		ECI C		D&C 1		D&C 2	
Main-criterion	Sub-criterion	Contractor A	Client A	Contractor B	Client B	Contractor C	Client C	Contractor 1	Client 1	Contractor 2	Client 2
Front-end definition	Front-end definition	4,8	3,6	4,8	4,7	3,5	3,7	3,3	2,2	3,4	3,6
	Team integration	4,3	4,2	4,8	3,7	4,2	4,3	2,2	2,4	4,0	3,1
Collaborative practices	Joint working	4,7	4,0	4,0	3,3	4,2	4,0	2,9	1,9	3,6	2,9
	SM commitment	5,0	5,0	4,7	3,0	3,8	3,8	4,2	4,6	3,0	3,8
Relational Attitudes	SM trust	5,0	5,0	4,8	4,7	4,5	4,0	4,0	5,0	4,0	3,9
	Relational norms	5,0	4,4	4,8	4,6	4,2	3,3	4,0	2,9	3,8	3,5
	Team communication	4,0	3,5	5,0	5,0	4,5	4,3	3,0	3,5	4,0	4,0
	Team coordination	5,0	3,0	4,0	4,3	4,3	4,0	4,3	3,7	4,0	3,2
	Balanced contribution	5,0	3,7	4,7	4,3	3,3	4,3	3,3	3,7	4,0	3,7
Teamworking quality	Team mutual support	5,0	3,7	5,0	4,7	4,0	5,0	4,0	3,3	3,7	3,7
	Alignment of effort	5,0	4,3	4,0	4,0	3,3	5,0	4,3	3,7	4,0	3,7
	Team cohesion	5,0	4,8	4,8	4,5	4,5	4,5	3,5	3,8	4,0	3,9
	Team affective trust	5,0	4,7	4,8	4,8	4,0	4,0	3,8	4,0	4,0	3,8

Table 25: The scores of the participants on the collaborative sub-criteria. (own ill.)

The table above is not helpful to show any differences. To show the differences of the cases for the sub criteria, the scale from RECAP will be used. This scale will be used to differentiate the scores into 5 colours. The result of this is shown below in Table 26. The following scale and corresponding colours are used:

- Very poor to poor scores from 1,0 – 1,4 are marked red
- Poor to moderate scores from 1,5 – 2,4 are marked orange
- Moderate to good scores from 2,5 – 3,4 are marked yellow
- Good to very good scores from 3,5 – 4,4 are marked light green
- Very good scores of 4,5 and higher are marked dark green.

		ECI A		ECI B		ECI C		D&C 1		D&C 2	
Main-criterion	Sub-criterion	Contractor A	Client A	Contractor B	Client B	Contractor C	Client C	Contractor 1	Client 1	Contractor 2	Client 2
Front-end definition	Front-end definition	4,8	3,6	4,8	4,7	3,5	3,7	3,3	2,2	3,4	3,6
	Team integration	4,3	4,2	4,8	3,7	4,2	4,3	2,2	2,4	4,0	3,1
Collaborative practices	Joint working	4,7	4,0	4,0	3,3	4,2	4,0	2,9	1,9	3,6	2,9
	SM commitment	5,0	5,0	4,7	3,0	3,8	3,8	4,2	4,6	3,0	3,8
Relational Attitudes	SM trust	5,0	5,0	4,8	4,7	4,5	4,0	4,0	5,0	4,0	3,9
	Relational norms	5,0	4,4	4,8	4,6	4,2	3,3	4,0	2,9	3,8	3,5
	Team communication	4,0	3,5	5,0	5,0	4,5	4,3	3,0	3,5	4,0	4,0
	Team coordination	5,0	3,0	4,0	4,3	4,3	4,0	4,3	3,7	4,0	3,2
	Balanced contribution	5,0	3,7	4,7	4,3	3,3	4,3	3,3	3,7	4,0	3,7
Teamworking quality	Team mutual support	5,0	3,7	5,0	4,7	4,0	5,0	4,0	3,3	3,7	3,7
	Alignment of effort	5,0	4,3	4,0	4,0	3,3	5,0	4,3	3,7	4,0	3,7
	Team cohesion	5,0	4,8	4,8	4,5	4,5	4,5	3,5	3,8	4,0	3,9
	Team affective trust	5,0	4,7	4,8	4,8	4,0	4,0	3,8	4,0	4,0	3,8
	Legend	1,0 - 1,4	1,5 - 2,4	2,5 - 3,4	3,5 - 4,4	4,5 - 5,0					

Table 26: Differentiation of the scores on the sub criteria using the scale from very poor, poor, moderate, good, very good. (own ill)

From this it can be derived that all cases, except for case D&C 1, score mainly good to very good and very good on the collaborative sub-criteria. Cases ECI A and ECI B score

exceptionally high on the collaborative sub criteria, and cases ECI C and D&C 2 score good to very good on the collaborative sub criteria.

The limitation of Table 26 is that the differentiation is only based on the scale from RECAP. In this table the differentiation cannot be used to compare scores of the cases in relation with each other, as the differentiation is done based on the median and not based on the average score of all participants. In the table above, the median is 3,0. Table 26 can only be used to show the scores based on the scale of RECAP. Furthermore, by showing the scores of both the client and contractor of each case, the differences are also not clear.

In order to compare the scores on the collaborative sub-criteria in relation with each other, first the distribution of the scores will be shown. This is done to show that the average is higher than is assumed in Table 26. The distribution of the scores of all participants on only the collaborative sub-criteria is shown in Figure 34. The data distribution clearly shows that the scores on all sub criteria for all cases is distributed unevenly. From the 143 scores 119 are higher than the score of 3,4. The average of all scores is 4,0.

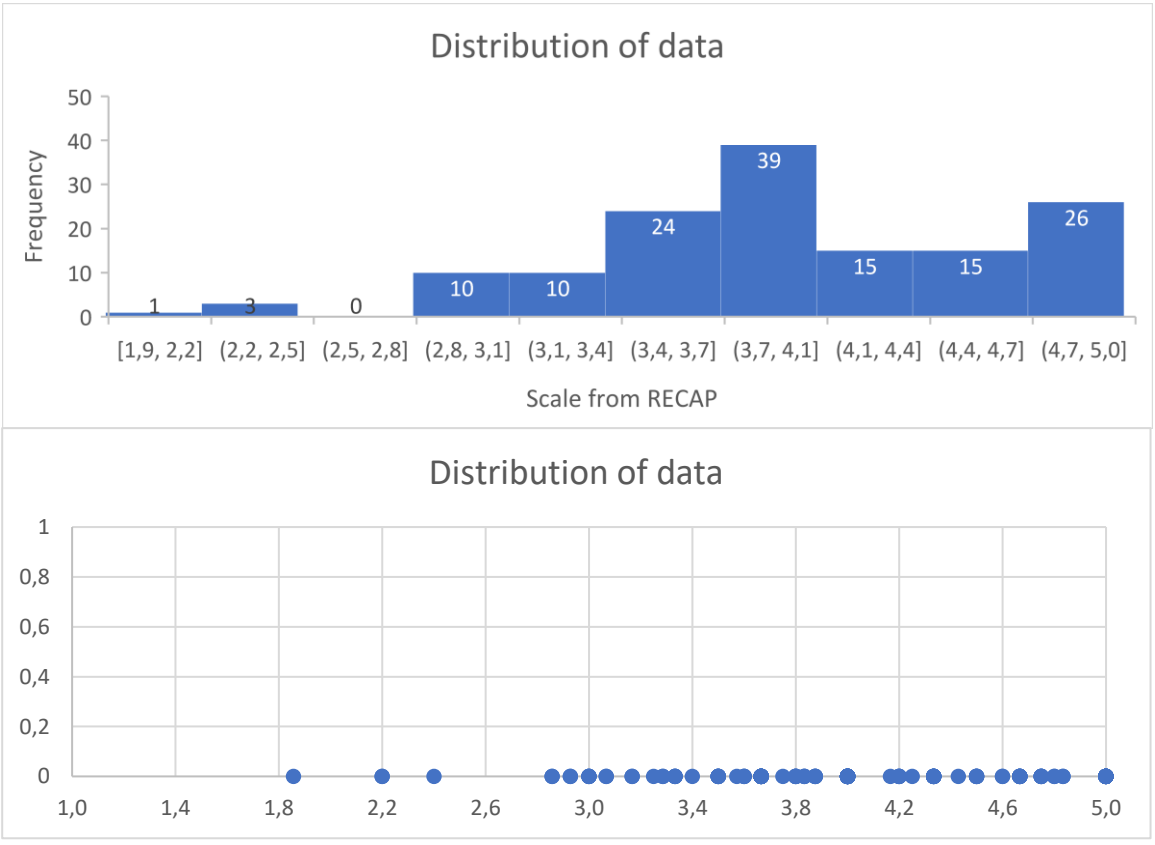

Figure 34: Distribution of the scores of all participants on only the collaborative sub-criteria. (own ill.)

With this data, a new differentiation based on the mentioned data distribution can be made in a new table. In Table 27, the scores for each case is averaged by combining the scores from the client and the contractor of each case. The new scale is as following:

- Very poor scores of lower than 3,25 are marked red
- Poor scores from 3,25 – 3,74 are marked orange
- Moderate/average scores from 3,75 – 4,24 are marked yellow
- Good scores from 4,25 – 4,75 are marked light green

- Very good scores higher than 4,75 are marked dark green.

	ECI A		ECI B		ECI C		D&C 1		D&C 2	
Sub-criteria	**Contractor A**	**Client A**	**Contractor B**	**Client B**	**Contractor C**	**Client C**	**Contractor 1**	**Client 1**	**Contractor 2**	**Client 2**
Front-end definition	4,80	3,60	4,80	4,70	3,50	3,70	3,30	2,20	3,40	3,60
Team integration	4,30	4,20	4,80	3,70	4,20	4,30	2,20	2,40	4,00	3,10
Joint working	4,70	4,00	4,00	3,30	4,20	4,00	2,90	1,90	3,60	2,90
SM commitment	5,00	5,00	4,70	3,00	3,80	3,80	4,20	4,60	3,00	3,80
SM trust	5,00	5,00	4,80	4,70	4,50	4,00	4,00	5,00	4,00	3,90
Relational norms	5,00	4,40	4,80	4,60	4,20	3,30	4,00	2,90	3,80	3,50
Team communication	4,00	3,50	5,00	5,00	4,50	4,30	3,00	3,50	4,00	4,00
Team coordination	5,00	3,00	4,00	4,30	4,30	4,00	4,30	3,70	4,00	3,20
Balanced contribution	5,00	3,70	4,70	4,30	3,30	4,30	3,30	3,70	4,00	3,70
Team mutual support	5,00	3,70	5,00	4,70	4,00	5,00	4,00	3,30	3,70	3,70
Alignment of effort	5,00	4,30	4,00	4,00	3,30	5,00	4,30	3,70	4,00	3,70
Team cohesion	5,00	4,80	4,80	4,50	4,50	4,50	3,50	3,80	4,00	3,90
Team affective trust	5,00	4,70	4,80	4,80	4,00	4,00	3,80	4,00	4,00	3,80

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75

Table 27: Differentiation of the scores on the sub criteria using a new scale from very poor, poor, moderate, good, very good, which is based on the data distribution (own ill.)

Appendix I: Analysis 1

In this appendix the steps of Analysis 1 are shown. For Analysis 1 the RECAP scores in the green area, shown in Table 28, are used.

	ECI A		ECI B		ECI C		D&C 1		D&C 2	
Sub-criteria	Contractor A	Client A	Contractor B	Client B	Contractor C	Client C	Contractor 1	Client 1	Contractor 2	Client 2
Front-end definition	4,80	3,60	4,80	4,70	3,50	3,70	3,30	2,20	3,40	3,60
Team integration	4,30	4,20	4,80	3,70	4,20	4,30	2,20	2,40	4,00	3,10
Joint working	4,70	4,00	4,00	3,30	4,20	4,00	2,90	1,90	3,60	2,90
SM commitment	5,00	5,00	4,70	3,00	3,80	3,80	4,20	4,60	3,00	3,80
SM trust	5,00	5,00	4,80	4,70	4,50	4,00	4,00	5,00	4,00	3,90
Relational norms	5,00	4,40	4,80	4,60	4,20	3,30	4,00	2,90	3,80	3,50
Team communication	4,00	3,50	5,00	5,00	4,50	4,30	3,00	3,50	4,00	4,00
Team coordination	5,00	3,00	4,00	4,30	4,30	4,00	4,30	3,70	4,00	3,20
Balanced contribution	5,00	3,70	4,70	4,30	3,30	4,30	3,30	3,70	4,00	3,70
Team mutual support	5,00	3,70	5,00	4,70	4,00	5,00	4,00	3,30	3,70	3,70
Alignment of effort	5,00	4,30	4,00	4,00	3,30	5,00	4,30	3,70	4,00	3,70
Team cohesion	5,00	4,80	4,80	4,50	4,50	4,50	3,50	3,80	4,00	3,90
Team affective trust	5,00	4,70	4,80	4,80	4,00	4,00	3,80	4,00	4,00	3,80

Table 28: The RECAP scores for all cases of all participants, the scores in the green area are used for conducting Analysis 1. (own ill)

Step A

Step A consists of classifying the used scores to conduct Analysis 1, following the scale developed in Appendix H. This step is shown in Table 29.

	ECI A		ECI B		ECI C		D&C 1		D&C 2	
Sub-criteria	Contractor A	Client A	Contractor B	Client B	Contractor C	Client C	Contractor 1	Client 1	Contractor 2	Client 2
Front-end definition	4,80	3,60	4,80	4,70	3,50	3,70	3,30	2,20	3,40	3,60
Team integration	4,30	4,20	4,80	3,70	4,20	4,30	2,20	2,40	4,00	3,10
Joint working	4,70	4,00	4,00	3,30	4,20	4,00	2,90	1,90	3,60	2,90
SM commitment	5,00	5,00	4,70	3,00	3,80	3,80	4,20	4,60	3,00	3,80
SM trust	5,00	5,00	4,80	4,70	4,50	4,00	4,00	5,00	4,00	3,90
Relational norms	5,00	4,40	4,80	4,60	4,20	3,30	4,00	2,90	3,80	3,50
Team communication	4,00	3,50	5,00	5,00	4,50	4,30	3,00	3,50	4,00	4,00
Team coordination	5,00	3,00	4,00	4,30	4,30	4,00	4,30	3,70	4,00	3,20
Balanced contribution	5,00	3,70	4,70	4,30	3,30	4,30	3,30	3,70	4,00	3,70
Team mutual support	5,00	3,70	5,00	4,70	4,00	5,00	4,00	3,30	3,70	3,70
Alignment of effort	5,00	4,30	4,00	4,00	3,30	5,00	4,30	3,70	4,00	3,70
Team cohesion	5,00	4,80	4,80	4,50	4,50	4,50	3,50	3,80	4,00	3,90
Team affective trust	5,00	4,70	4,80	4,80	4,00	4,00	3,80	4,00	4,00	3,80

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75

Table 29: Classification of the used RECAP scores for Analysis 1. (own ill.)

Step B

Step B consists of averaging the scores of the clients and contractors for each case. This is shown in Table 30. The scores of the client and contractor are added together and divided by the number of scores.

Sub-criteria	ECI A	ECI B	ECI C	D&C 1	D&C 2
Front-end definition	4,20	4,75	3,60	2,75	3,50
Team integration	4,25	4,25	4,25	2,30	3,55
Joint working	4,35	3,65	4,10	2,40	3,25
SM commitment	5,00	3,85	3,80	4,40	3,40
SM trust	5,00	4,75	4,25	4,50	3,95
Relational norms	4,70	4,70	3,75	3,45	3,65
Team communication	3,75	5,00	4,40	3,25	4,00
Team coordination	4,00	4,15	4,15	4,00	3,60
Balanced contribution	4,35	4,50	3,80	3,50	3,85
Team mutual support	4,35	4,85	4,50	3,65	3,70
Alignment of effort	4,65	4,00	4,15	4,00	3,85
Team cohesion	4,90	4,65	4,50	3,65	3,95
Team affective trust	4,85	4,80	4,00	3,90	3,90

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75

Table 30: Scores of the clients and contractors averaged for each case. (own ill.)

Step C

Step C consists of averaging the scores of the ECI cases and that of the D&C cases. This is done by adding the scores of the ECI cases for each sub-criterion together and divide that by the number of scores, and the same is done for the scores of the D&C cases. By doing this the scores for each collaborative sub-criterion, and therefore also for the collaborative main criteria, can be compared in relation to each other. The scores are shown in Table 31, also the gaps for each sub-criterion is given. The gaps are categorized in three different categories:

- Negligible:0,00 - 0,49
- Moderate: 0,50 - 0,99
- Substantial: > 0,99

Sub-criteria	ECI	D&C	Gap	
Front-end definition	4,18	3,13	●	1,06
Team integration	4,25	2,93	●	1,33
Joint working	4,03	2,83	●	1,21
SM commitment	4,22	3,90	○	0,32
SM trust	4,67	4,23	○	0,44
Relational norms	4,38	3,55	◌	0,83
Team communication	4,38	3,63	◌	0,76
Team coordination	4,10	3,80	○	0,30
Balanced contribution	4,22	3,68	◌	0,54
Team mutual support	4,57	3,68	◌	0,89
Alignment of effort	4,27	3,93	○	0,34
Team cohesion	4,68	3,80	◌	0,88
Team affective trust	4,55	3,90	◌	0,65

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	○ negligible	◌ moderate	● substantial		

Table 31: The average scores of the ECI and D&C cases for each sub-criterion, including the gap between the average scores of the ECI and D&C cases. (own ill.)

Step D

Step D consists of converting the average scores of the sub-criteria to their corresponding collaborative main criterion. This is done by adding the scores of the sub-criteria together and divide that by the number of scores. Also, the gaps between the scores for each main criterion are given. This is shown in Table 32.

Main criteria	ECI	D&C	Gap	
Front-end definition	4,18	3,13	●	1,06
Collaborative practices	4,14	2,88	●	1,27
Relational attitudes	4,42	3,89	◌	0,53
Teamworking quality	4,40	3,77	◌	0,62

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	○ negligible	◌ moderate	● substantial		

Table 32: The combined average scores of all the ECI and D&C cases for each main criterion, including the gaps between the scores. (own ill.)

Appendix J: Analysis 2

In this appendix the steps of Analysis 2 are shown. For Analysis 2 the RECAP scores in the green area, shown in Table 33, are used.

	ECI A		ECI B		ECI C		D&C 1		D&C 2	
Sub-criteria	Contractor A	Client A	Contractor B	Client B	Contractor C	Client C	Contractor 1	Client 1	Contractor 2	Client 2
Front-end definition	4,80	3,60	4,80	4,70	3,50	3,70	3,30	2,20	3,40	3,60
Team integration	4,30	4,20	4,80	3,70	4,20	4,30	2,20	2,40	4,00	3,10
Joint working	4,70	4,00	4,00	3,30	4,20	4,00	2,90	1,90	3,60	2,90
SM commitment	5,00	5,00	4,70	3,00	3,80	3,80	4,20	4,60	3,00	3,80
SM trust	5,00	5,00	4,80	4,70	4,50	4,00	4,00	5,00	4,00	3,90
Relational norms	5,00	4,40	4,80	4,60	4,20	3,30	4,00	2,90	3,80	3,50
Team communication	4,00	3,50	5,00	5,00	4,50	4,30	3,00	3,50	4,00	4,00
Team coordination	5,00	3,00	4,00	4,30	4,30	4,00	4,30	3,70	4,00	3,20
Balanced contribution	5,00	3,70	4,70	4,30	3,30	4,30	3,30	3,70	4,00	3,70
Team mutual support	5,00	3,70	5,00	4,70	4,00	5,00	4,00	3,30	3,70	3,70
Alignment of effort	5,00	4,30	4,00	4,00	3,30	5,00	4,30	3,70	4,00	3,70
Team cohesion	5,00	4,80	4,80	4,50	4,50	4,50	3,50	3,80	4,00	3,90
Team affective trust	5,00	4,70	4,80	4,80	4,00	4,00	3,80	4,00	4,00	3,80

Table 33: The RECAP scores for all cases of all participants, the scores in the green area are used for conducting Analysis 2. (own ill)

Step A

Step A consists of classifying the used scores to conduct Analysis 2, following the scale developed in Appendix H. The clients' scores are not used. This step is shown in Table 34.

	ECI A	ECI B	ECI C	D&C 1	D&C 2
Sub-criteria	Contractor A	Contractor B	Contractor C	Contractor 1	Contractor 2
Front-end definition	4,80	4,75	3,50	3,25	3,40
Team integration	4,33	4,75	4,20	2,20	4,00
Joint working	4,67	4,00	4,17	2,86	3,57
SM commitment	5,00	4,67	3,80	4,20	3,00
SM trust	5,00	4,75	4,50	4,00	4,00
Relational norms	5,00	4,80	4,20	4,00	3,80
Team communication	4,00	5,00	4,50	3,00	4,00
Team coordination	5,00	4,00	4,33	4,33	4,00
Balanced contribution	5,00	4,67	3,33	3,33	4,00
Team mutual support	5,00	5,00	4,00	4,00	3,67
Alignment of effort	5,00	4,00	3,33	4,33	4,00
Team cohesion	5,00	4,75	4,50	3,50	4,00
Team affective trust	5,00	4,83	4,00	3,83	4,00

Table 34: Classification of the used RECAP scores for Analysis 2. (own ill.)

Step B

Step B consists of averaging the scores of the contractors for the ECI and D&C cases. This is shown in Table 35. The scores of the contractors in the ECI cases are added together and divided by the number of scores, the same is done for the scores of the contractors in the D&C cases. Furthermore, the gaps between the scores are provided. By doing this the scores for each collaborative sub-criterion, and therefore also for the collaborative main criteria, can be compared in relation to each other.

Contractors			
Sub-criteria	**ECI**	**D&C**	**Gap**
Front-end definition	4,35	3,33	1,03
Team integration	4,43	3,10	1,33
Joint working	4,28	3,21	1,06
SM commitment	4,49	3,60	0,89
SM trust	4,75	4,00	0,75
Relational norms	4,67	3,90	0,77
Team communication	4,50	3,50	1,00
Team coordination	4,44	4,17	0,28
Balanced contribution	4,33	3,67	0,67
Team mutual support	4,67	3,83	0,83
Alignment of effort	4,11	4,17	-0,06
Team cohesion	4,75	3,75	1,00
Team affective trust	4,61	3,92	0,69

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 35: Scores of the contractors averaged for the ECI and D&C cases, including the gaps. (own ill.)

Step C

Step C consists of converting the average scores of the sub-criteria to their corresponding collaborative main criterion. This is done by adding the scores of the sub-criteria together and divide that by the number of scores. Also, the gaps between the scores for each main criterion are given. This is shown in Table 36.

Contractors			
Main criteria	**ECI**	**D&C**	**Gap**
Front-end definition	4,35	3,33	1,03
Collaborative practices	4,35	3,16	1,20
Relational attitudes	4,64	3,83	0,80
Teamworking quality	4,49	3,86	0,63

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 36: The combined average scores of the contractors of all the ECI and D&C cases for each main criterion, including the gaps between the scores. (own ill.)

Appendix K: Analysis 3

In this appendix the steps of Analysis 3 are shown. For Analysis 3 the RECAP scores in the green area shown in Table 37 are used.

	ECI A		ECI B		ECI C		D&C 1		D&C 2	
Sub-criteria	Contractor A	Client A	Contractor B	Client B	Contractor C	Client C	Contractor 1	Client 1	Contractor 2	Client 2
Front-end definition	4,80	3,60	4,80	4,70	3,50	3,70	3,30	2,20	3,40	3,60
Team integration	4,30	4,20	4,80	3,70	4,20	4,30	2,20	2,40	4,00	3,10
Joint working	4,70	4,00	4,00	3,30	4,20	4,00	2,90	1,90	3,60	2,90
SM commitment	5,00	5,00	4,70	3,00	3,80	3,80	4,20	4,60	3,00	3,80
SM trust	5,00	5,00	4,80	4,70	4,50	4,00	4,00	5,00	4,00	3,90
Relational norms	5,00	4,40	4,80	4,60	4,20	3,30	4,00	2,90	3,80	3,50
Team communication	4,00	3,50	5,00	5,00	4,50	4,30	3,00	3,50	4,00	4,00
Team coordination	5,00	3,00	4,00	4,30	4,30	4,00	4,30	3,70	4,00	3,20
Balanced contribution	5,00	3,70	4,70	4,30	3,30	4,30	3,30	3,70	4,00	3,70
Team mutual support	5,00	3,70	5,00	4,70	4,00	5,00	4,00	3,30	3,70	3,70
Alignment of effort	5,00	4,30	4,00	4,00	3,30	5,00	4,30	3,70	4,00	3,70
Team cohesion	5,00	4,80	4,80	4,50	4,50	4,50	3,50	3,80	4,00	3,90
Team affective trust	5,00	4,70	4,80	4,80	4,00	4,00	3,80	4,00	4,00	3,80

Table 37: The RECAP scores for all cases of all participants, the scores in the green area are used for conducting Analysis 3. (own ill)

Step A

Step A consists of classifying the used scores to conduct Analysis 3, following the scale developed in Appendix H. The contractors' scores are not used. This step is shown in Table 38.

	ECI A	ECI B	ECI C	D&C 1	D&C 2
Sub-criteria	Client A	Client B	Client C	Client 1	Client 2
Front-end definition	3,60	4,67	3,67	2,20	3,60
Team integration	4,20	3,67	4,33	2,40	3,07
Joint working	4,00	3,29	4,00	1,86	2,93
SM commitment	5,00	3,00	3,80	4,60	3,80
SM trust	5,00	4,67	4,00	5,00	3,88
Relational norms	4,43	4,60	3,29	2,86	3,50
Team communication	3,50	5,00	4,25	3,50	4,00
Team coordination	3,00	4,33	4,00	3,67	3,17
Balanced contribution	3,67	4,33	4,33	3,67	3,67
Team mutual support	3,67	4,67	5,00	3,33	3,67
Alignment of effort	4,33	4,00	5,00	3,67	3,67
Team cohesion	4,75	4,50	4,50	3,75	3,88
Team affective trust	4,67	4,83	4,00	4,00	3,83

Table 38: Classification of the used RECAP scores for Analysis 3. (own ill.)

Step B

Step B consists of averaging the scores of the clients for the ECI and D&C cases. This is shown in Table 39. The scores of the clients in the ECI cases are added together and divided by the number of scores, the same is done for the scores of the clients in the D&C cases. Furthermore, the gaps between the scores are provided. By doing this the scores for each collaborative sub-criterion, and therefore also for the collaborative main criteria, can be compared in relation to each other.

Clients			
Sub-criteria	**ECI**	**D&C**	**Gap**
Front-end definition	3,98	2,90	1,08
Team integration	4,07	2,73	1,33
Joint working	3,76	2,39	1,37
SM commitment	3,93	4,20	-0,27
SM trust	4,56	4,44	0,12
Relational norms	4,10	3,18	0,93
Team communication	4,25	3,75	0,50
Team coordination	3,78	3,42	0,36
Balanced contribution	4,11	3,67	0,44
Team mutual support	4,44	3,50	0,94
Alignment of effort	4,44	3,67	0,78
Team cohesion	4,58	3,81	0,77
Team affective trust	4,50	3,92	0,58

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 39: Scores of the clients averaged for the ECI and D&C cases, including the gaps. (own ill.)

Step C

Step C consists of converting the average scores of the sub-criteria to their corresponding collaborative main criterion. This is done by adding the scores of the sub-criteria together and divide that by the number of scores. Also, the gaps between the scores for each main criterion are given. This is shown in Table 40.

Clients			
Main criteria	**ECI**	**D&C**	**Gap**
Front-end definition	3,98	2,90	1,08
Collaborative practices	3,91	2,56	1,35
Relational attitudes	4,20	3,94	0,26
Teamworking quality	4,30	3,68	0,63

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 40: The combined average scores of the clients of all the ECI and D&C cases for each main criterion, including the gaps between the scores. (own ill.)

Appendix L: Analysis 4

In this appendix the steps of Analysis 4 are shown. For Analysis 4 the RECAP scores in the green area shown in Table 41 are used. Analysis 4 is the comparison between the client's and contractor's perception on the collaboration within ECI projects.

	ECI A		ECI B		ECI C		D&C 1		D&C 2	
Sub-criteria	Contractor A	Client A	Contractor B	Client B	Contractor C	Client C	Contractor 1	Client 1	Contractor 2	Client 2
Front-end definition	4,80	3,60	4,80	4,70	3,50	3,70	3,30	2,20	3,40	3,60
Team integration	4,30	4,20	4,80	3,70	4,20	4,30	2,20	2,40	4,00	3,10
Joint working	4,70	4,00	4,00	3,30	4,20	4,00	2,90	1,90	3,60	2,90
SM commitment	5,00	5,00	4,70	3,00	3,80	3,80	4,20	4,60	3,00	3,80
SM trust	5,00	5,00	4,80	4,70	4,50	4,00	4,00	5,00	4,00	3,90
Relational norms	5,00	4,40	4,80	4,60	4,20	3,30	4,00	2,90	3,80	3,50
Team communication	4,00	3,50	5,00	5,00	4,50	4,30	3,00	3,50	4,00	4,00
Team coordination	5,00	3,00	4,00	4,30	4,30	4,00	4,30	3,70	4,00	3,20
Balanced contribution	5,00	3,70	4,70	4,30	3,30	4,30	3,30	3,70	4,00	3,70
Team mutual support	5,00	3,70	5,00	4,70	4,00	5,00	4,00	3,30	3,70	3,70
Alignment of effort	5,00	4,30	4,00	4,00	3,30	5,00	4,30	3,70	4,00	3,70
Team cohesion	5,00	4,80	4,80	4,50	4,50	4,50	3,50	3,80	4,00	3,90
Team affective trust	5,00	4,70	4,80	4,80	4,00	4,00	3,80	4,00	4,00	3,80

Table 41: The RECAP scores for all cases of all participants, the scores in the green area are used for conducting Analysis 4. (own ill)

Step A

Step A consists of classifying the used scores to conduct Analysis 4, following the scale developed in Appendix H. The clients' and contractors' scores for the D&C cases are not used. This step is shown in Table 42.

	ECI A		ECI B		ECI C	
Sub-criteria	Contractor A	Client A	Contractor B	Client B	Contractor C	Client C
Front-end definition	4,80	3,60	4,80	4,70	3,50	3,70
Team integration	4,30	4,20	4,80	3,70	4,20	4,30
Joint working	4,70	4,00	4,00	3,30	4,20	4,00
SM commitment	5,00	5,00	4,70	3,00	3,80	3,80
SM trust	5,00	5,00	4,80	4,70	4,50	4,00
Relational norms	5,00	4,40	4,80	4,60	4,20	3,30
Team communication	4,00	3,50	5,00	5,00	4,50	4,30
Team coordination	5,00	3,00	4,00	4,30	4,30	4,00
Balanced contribution	5,00	3,70	4,70	4,30	3,30	4,30
Team mutual support	5,00	3,70	5,00	4,70	4,00	5,00
Alignment of effort	5,00	4,30	4,00	4,00	3,30	5,00
Team cohesion	5,00	4,80	4,80	4,50	4,50	4,50
Team affective trust	5,00	4,70	4,80	4,80	4,00	4,00

Table 42: Classification of the used RECAP scores for Analysis 4. (own ill.)

Step B

Step B consists of combining and averaging the scores of the contractors for all the ECI cases, combining and averaging the scores of the clients for all the ECI cases. This is shown in Table 43. The scores of the contractors in the ECI cases are added together and divided by the number of scores, the same is done for the scores of the clients in the ECI cases. Furthermore, the gaps between the scores are provided. By doing this the scores for each collaborative sub-criterion, and therefore also for the collaborative main criteria, can be compared in relation to each other.

ECI cases			
Sub-criteria	**Contractors**	**Clients**	**Gap**
Front-end definition	4,35	3,98	0,37
Team integration	4,43	4,07	0,36
Joint working	4,28	3,76	0,52
SM commitment	4,49	3,93	0,56
SM trust	4,75	4,56	0,19
Relational norms	4,67	4,10	0,56
Team communication	4,50	4,25	0,25
Team coordination	4,44	3,78	0,67
Balanced contribution	4,33	4,11	0,22
Team mutual support	4,67	4,44	0,22
Alignment of effort	4,11	4,44	-0,33
Team cohesion	4,75	4,58	0,17
Team affective trust	4,61	4,50	0,11

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 43: Scores of the contractors and clients averaged, separately for the ECI cases, including the gaps. (own ill.)

Step C

Step C consists of converting the average scores of the sub-criteria to their corresponding collaborative main criterion. This is done by adding the scores of the sub-criteria together and divide that by the number of scores. Also, the gaps between the scores for each main criterion are given. This is shown in Table 44.

ECI			
Main criteria	**Contractors**	**Clients**	**Gap**
Front-end definition	4,35	3,98	0,37
Collaborative practices	4,35	3,91	0,44
Relational attitudes	4,64	4,20	0,44
Teamworking quality	4,49	4,30	0,19

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 44: The combined average scores for each main criterion, including the gaps between the scores. (own ill.)

Appendix M: Analysis 5

In this appendix the steps of Analysis 5 are shown. For Analysis 5 the RECAP scores in the green area shown in Table 45 are used. Analysis 5 is the comparison between the client's and contractor's perception on the collaboration within D&C projects.

	ECI A		ECI B		ECI C		D&C 1		D&C 2	
Sub-criteria	Contractor A	Client A	Contractor B	Client B	Contractor C	Client C	Contractor 1	Client 1	Contractor 2	Client 2
Front-end definition	4,80	3,60	4,80	4,70	3,50	3,70	3,30	2,20	3,40	3,60
Team integration	4,30	4,20	4,80	3,70	4,20	4,30	2,20	2,40	4,00	3,10
Joint working	4,70	4,00	4,00	3,30	4,20	4,00	2,90	1,90	3,60	2,90
SM commitment	5,00	5,00	4,70	3,00	3,80	3,80	4,20	4,60	3,00	3,80
SM trust	5,00	5,00	4,80	4,70	4,50	4,00	4,00	5,00	4,00	3,90
Relational norms	5,00	4,40	4,80	4,60	4,20	3,30	4,00	2,90	3,80	3,50
Team communication	4,00	3,50	5,00	5,00	4,50	4,30	3,00	3,50	4,00	4,00
Team coordination	5,00	3,00	4,00	4,30	4,30	4,00	4,30	3,70	4,00	3,20
Balanced contribution	5,00	3,70	4,70	4,30	3,30	4,30	3,30	3,70	4,00	3,70
Team mutual support	5,00	3,70	5,00	4,70	4,00	5,00	4,00	3,30	3,70	3,70
Alignment of effort	5,00	4,30	4,00	4,00	3,30	5,00	4,30	3,70	4,00	3,70
Team cohesion	5,00	4,80	4,80	4,50	4,50	4,50	3,50	3,80	4,00	3,90
Team affective trust	5,00	4,70	4,80	4,80	4,00	4,00	3,80	4,00	4,00	3,80

Table 45: The RECAP scores for all cases of all participants, the scores in the green area are used for conducting Analysis 5. (own ill)

Step A

Step A consists of classifying the used scores to conduct Analysis 5, following the scale developed in Appendix H. The clients' and contractors' scores for the ECI cases are not used. This step is shown in Table 46.

	D&C 1		D&C 2	
Sub-criteria	Contractor 1	Client 1	Contractor 2	Client 2
Front-end definition	3,30	2,20	3,40	3,60
Team integration	2,20	2,40	4,00	3,10
Joint working	2,90	1,90	3,60	2,90
SM commitment	4,20	4,60	3,00	3,80
SM trust	4,00	5,00	4,00	3,90
Relational norms	4,00	2,90	3,80	3,50
Team communication	3,00	3,50	4,00	4,00
Team coordination	4,30	3,70	4,00	3,20
Balanced contribution	3,30	3,70	4,00	3,70
Team mutual support	4,00	3,30	3,70	3,70
Alignment of effort	4,30	3,70	4,00	3,70
Team cohesion	3,50	3,80	4,00	3,90
Team affective trust	3,80	4,00	4,00	3,80

Table 46: Classification of the used RECAP scores for Analysis 5. (own ill.)

Step B

Step B consists of combining and averaging the scores of the contractors for all the D&C cases, combining and averaging the scores of the clients for all the D&C cases. This is shown in Table 47: Scores of the contractors and clients averaged, separately for the D&C cases, including the gaps. (own ill.). The scores of the contractors in the D&C cases are added together and divided by the number of scores, the same is done for the scores of the clients in the D&C cases. Furthermore, the gaps between the scores are provided. By doing this the scores for each collaborative sub-criterion, and therefore also for the collaborative main criteria, can be compared in relation to each other.

D&C			
Sub-criteria	Contractors	Clients	Gap
Front-end definition	3,33	2,90	0,43
Team integration	3,10	2,73	0,37
Joint working	3,21	2,39	0,82
SM commitment	3,60	4,20	-0,60
SM trust	4,00	4,44	-0,44
Relational norms	3,90	3,18	0,72
Team communication	3,50	3,75	-0,25
Team coordination	4,17	3,42	0,75
Balanced contribution	3,67	3,67	0,00
Team mutual support	3,83	3,50	0,33
Alignment of effort	4,17	3,67	0,50
Team cohesion	3,75	3,81	-0,06
Team affective trust	3,92	3,92	0,00

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 47: Scores of the contractors and clients averaged, separately for the D&C cases, including the gaps. (own ill.)

Step C

Step C consists of converting the average scores of the sub-criteria to their corresponding collaborative main criterion. This is done by adding the scores of the sub-criteria together and divide that by the number of scores. Also, the gaps between the scores for each main criterion are given. This is shown in Table 48.

D&C			
Main criteria	Contractors	Clients	Gap
Front-end definition	3,33	2,90	0,43
Collaborative practices	3,16	2,56	0,59
Relational attitudes	3,83	3,94	-0,11
Teamworking quality	3,86	3,68	0,18

Legend	<3,25	3,25 - 3,74	3,75- 4,24	4,25 - 4,75	>4,75
Gaps	negligible	moderate	substantial		

Table 48: The combined average scores for each main criterion, including the gaps between the scores. (own ill.)

Appendix N: Expert validation statements

In Table 49 the statements presented to the expert panel to validate are presented.

#	Topics	Statement	1	2	3	4	5	Explanation of score
1	Collaboration in general	Without trust, there is no collaboration.						
2	Collaboration in general	Good collaboration is mainly the result of the chemistry between project teams from the client and the contractor.						
3	Collaboration in general	Good collaboration cannot be created artificially when there is a lack of chemistry between the project teams of the client and the contractor						
4	Collaboration in general	Poor collaboration could result in good project performance (time, budget, scope).						
5	Collaboration in general, attitude	An open and transparent attitude always has positive effects on the collaboration						
6	Collaborating remotely	Collaborating remotely is possible by clearly agreeing in advance how this will be implemented.						
7	Collaborating remotely, Trust	In order for remote collaboration to succeed, the client must trust the contractor.						
8	Collaborating remotely, Team spirit	Collaborating remotely has a negative effect on the relationship between the client and contractor because no team spirit can be formed.						
9	Collaborating remotely, Problem solving	Collaborating remotely means that it takes longer to solve problems quickly and effectively.						
10	One project team, No blame culture	Forming a single project team ensures a "no-blame" culture. The client and contractor have insight into each other's shortcomings and strengths.						
11	Contract	The contact is more important than the contract.						
12	Collaboration in general, Contract	The used contract / form of collaboration determines the collaboration.						
13	ECI	ECI is favourable because the contractor sits at the table during the design phase. The construction phase will therefore be smoother						

14	ECI	ECI is beneficial for the client if he does not have the required knowledge / expertise.						
15	ECI	ECI is disadvantageous for the client because the contractor is the first and only allowed to make a bid after the design team phase (lack of competition).						
16	ECI, Capacity	The advantage for the contractor to be the first and only one to be allowed to bid after the design team phase outweighs the disadvantage of the extra capacity required during the design team phase.						
17	One project team, D&C	For good collaboration, it is not necessary in D&C projects to jointly set up the project goals, scope and objectives together.						
18	D&C, Risks	The D&C contract is favourable for the client because the client has less responsibilities and liabilities.						
19	Attitude, ECI	In order for ECI to succeed extra attention is needed for the soft aspects of collaboration, for example by holding a number of workshops during the design team phase.						
20	Attitude, D&C, Mandate	During the design team phase, the representatives of the client must have more mandate than with in a D&C project, because critical design choices have to be taken during the design team phase.						

Table 49: The statements of the expert validation. (own ill.)